OmniMap® RS55/tc

Sheet Resistance Mapping Systems with StatTrax® Software version 6.3

User's Guide

Volume 1 of 2

June 1996
04-0263 A

This manual supports:

- *Auto* RS55/tc Resistivity Mapping Systems
- RS55/tc Resistivity Mapping Systems

PRINTED ON CLEANROOM PAPER

This manual contains chapters 1 through 6.

Tencor®
Film Measurement Division

A Quick Guide to This Manual

Do you want to know about...

- Learning to use your system
  See Chapter 2.
- Overview of system hardware and software
  See Chapter 1.
- Setting general system parameters
  See page 3-14.
- Precautions for handling cartridges
  See page 1-5.
- File naming conventions used in StatTrax software
  See page 1-18.
- Test measurement patterns
  See Appendix B.
- About Temperature Coefficient of Resistance (TCR) curves
  See page 5-10.
- Loading wafers automatically
  See page 6-9.
- About P/N Typing
  See page 4-34.
- Basic maintenance procedures for your system
  See Appendix C.

Note *If the subject you want to look up is not listed above, please refer to the Table of Contents or the Index.*

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The OmniMap RS55/tc Resistivity Mapping System

The OmniMap RS55/tc Resistivity Mapping System is a highly advanced sheet resistance measurement system designed for process control in semiconductor fabs. The RS55/tc is similar to our earlier RS55 model; however, the RS55/tc provides an additional feature called ***temperature compensation.*** The Temperature Compensation feature

- Generates a temperature coefficient of resistance (TCR) curve by heating the wafer from ambient temperature up to 35 °C while measuring Rs versus temperature
- Enables the system to automatically correct all subsequent sheet resistance measurements using the measured temperature and the TCR of the material

As four-point probe measurements have continued to improve, temperature has emerged as a significant variable affecting the measured sheet resistance of metals and semiconducting materials. This is because many materials used in semiconductor fabrication have reasonably high temperature coefficients of resistance (TCRs). Compensating for the differences in temperature changes improves the accuracy and repeatability of sheet resistance measurements.

The RS55/tc collects, analyzes, and displays sheet resistance data on various conductive layers such as implants, diffusions, epi, CVD, metals, and bulk substrates. The system provides accurate and repeatable sheet resistance measurements from 5 mΩ/sq to 5 MΩ/sq on 2-inch (50-mm) to 8-inch (200-mm) wafers by uniting sophisticated modeling algorithms, advanced analysis techniques, and precision electronics.

With StatTrax software, the system can measure up to 1,264 sites per wafer (using standard or user-defined patterns) and display test results in the form of Contour Maps, 3D Maps, Diameter Scans, and Die Maps. In addition, you can retrieve and analyze data from the StatTrax database and use it to generate trend charts for short- or long-term process monitoring.

The system's computer houses a fixed hard disk drive for loading and running the system software, and uses removable-cartridge drives to store and retrieve test configurations and collected data. The system's hard disk and cartridges are partitioned into ***user accounts*** to further enhance your data storage capabilities.

An optional wafer handler automatically transfers wafers, and can be set to perform flat- or notch- alignment as well as centering. The wafer handler offers dual-cassette loading and unloading of 3-inch to 8-inch wafers under local or remote control.

Measurement Specifications

The following are measurement specifications for the system.

- Measurement range: <5 mΩ/sq to >5 MΩ/sq
- Typical measurement time: 3.5–4.5 seconds per test site
- Absolute accuracy, based on NIST (NBS) standard wafers corrected to 23 °C: ±1% of NIST certified range
- Measurement repeatability < 0.2% (1 sigma)
- Edge exclusion, Auto systems:
  - 6 mm from edge of conductive film with 62.5-mil probe head
  - 5 mm from edge of conductive film with 40-mil probe head
  - 3 mm from edge of conductive film with 25-mil probe head
- Edge exclusion, Manual systems:
  - 7 mm from edge of conductive film with 62.5-mil probe head
  - 6 mm from edge of conductive film with 40-mil probe head
  - 5 mm from edge of conductive film with 25-mil probe head
- Temperature measurement accuracy: ±0.5 °C
- Temperature measurement repeatability: ±0.2 °C

Hardware Configuration

The following are hardware specifications for the system.

- Accommodates all standard wafer sizes: 2-, 3-, 3.25-inch, and 100-, 125-, 150- and 200-mm
- Thick substrate option, allowing measurement of 6-mm thick materials
- Tencor-enhanced computer:
  - Fixed hard disk drive
  - Removable-cartridge drive
  - 3.5-inch diskette drive, 1.44-MB capacity
- High-resolution color monitor
- Optional dot matrix or color graphics printer
- Optional dual-cassette wafer handler with flat aligner for 100- through 200-mm wafers
- Optional signal tower (available with handler option only)
- Dimensions: D x W x H = 38.26 x 41 x 64 inches
- Weight: 650 lbs.
- Power requirements: 115/230V, <8 A, 50/60 Hz
- Vacuum: 500-mm Hg
- Pressure: 40–60 PSI

Probe Head Specifications

The following are specifications for the system's probe head.

- Precision four-point probe head with integrated connector
- .040-inch probe spacing; 100-gm loading; 0.0016-, 0.004-, 0.008-, or 0.020-inch tip radius
- .025-inch probe spacing for enhanced spatial resolution; 100-gm loading; 0.0016-, 0.004-, or 0.008-inch tip radius
- .0625-inch probe spacing; 200-gm loading; 0.0016-inch tip radius

Measurement Capabilities

The system's measurement capabilities include

- Routine check: 1–30 sites programmable (ASTM standard tests included)
- XY map: Up to 1264 sites programmable
- P/N Typing
- Single- or dual-configuration

Analysis Capabilities

The system's analysis capabilities include

- Contour/3D Map and Diameter Scan: 49, 81, 121, 225, 361, 441, 625 sites
- Probe qualification test: 20 sites
- Trend and SQC Charts
- Histograms
- File editing and data extraction
- Calibration curves for low-dose monitoring
- Average, difference, and ratio maps
- Temperature coefficient of resistance curves

Data Transfer Capabilities

The system's data transfer capabilities include

- SECS-II or RS232 communication (for uploading data)
- Enhanced SECS-II for fully automated operation (optional)
- Limited generic equipment model (GEM) compliance (optional capability only available with wafer handler)

Summary of Chapter Contents

The following summarizes the contents of this guide.

Chapter 1 "System Overview," contains information to familiarize you with the RS55/tc system and StatTrax software. The chapter starts with a brief hardware overview and provides directions on using the cartridge drive. It also provides an overview of StatTrax software, which summarizes what you need to know to use the software productively. Finally, the chapter contains diagrams that describe some important functions of the software (for example, collecting and retrieving data).

Chapter 2 "Tutorial," written for the operator, describes collecting data, performing a contour map test, and generating a trend chart of the collected data.

Note *The system must be in demonstration mode (DEMO MODE) to perform the Tutorial, and the Tutorial cartridge must be inserted in the cartridge drive. (The Tutorial cartridge is identified as such on the cartridge's front label.)*

Chapter 3 "Setting Up the System" explains how to prepare your system's software for operation. This chapter includes procedures for setting up your system's accounts, establishing parameters for transferring or uploading data, performing a probe qualification test, and conditioning the probe head. (Probe conditioning is only required as determined by the success or failure of a periodic probe qualification test.)

Chapter 4 "Setting Up Standard Tests" describes how to set up your wafer test parameters in the StatTrax Index Cards for each test folder. This chapter also describes how to copy tests setups from one test folder to another.

Chapter 5 "Setting Up Advanced Tests" describes how to set up advanced tests such as Custom Polar-coordinate and Cartesian-coordinate Quick Tests, Custom Contour Map tests, and tests that reference a TCR value. This chapter also includes procedures for using Correlation Curves to convert ohms/sq to other measurement units, for deleting Quick Test setups, and for setting up Batch Recipes.

Chapter 6 "Collecting Data," describes how to collect data. Sections include selecting a test folder, editing color-coded text fields before running a test, and testing wafers manually and automatically.

Chapter 7 "Viewing and Analyzing Data," gives information about various ways to view and analyze data after testing.

Chapter 8 "Managing Data Files," describes all aspects of managing your data files, from sorting data within the system to transferring data using Enhanced SECS-II, basic SECS-II, or a floppy diskette.

Chapter 9 "Reference" is a glossary of terms, functions, fields, and index cards. This chapter is a concise source of information about StatTrax software and the many functions supported by the RS55/tc system.

Appendix A "Sheet Resistance Measurement Theory" describes the value of sheet resistance measurements and the techniques used to make the measurements.

Appendix B "Test Measurement Patterns" describes the pre-established test patterns available in StatTrax.

Appendix C "Basic System Troubleshooting" provides elementary troubleshooting procedures. For more detailed procedures, refer to the system's maintenance manual.

Appendix D "Selecting and Testing Probe Heads" provides guidelines for selecting the proper probe head as well as procedures for checking the repeatability of the probe head, and determining the probe-conditioning count.

Appendix E "Default Test Configurations" describes the default setups for Contour Map, Diameter Scan, Probe Qual, Pattern, and Quick Tests.

Appendix F "The Signal Tower Option" describes the use and function of the optional Signal Tower.

Learning System Basics

We recommend that you follow the steps outlined below to learn the basics of your OmniMap system. Be sure to read the "Read This First" section of each chapter.

Sit down at the system with this manual, and

1. Read through Chapter 1 to become familiar with the system and the basics of its operation.
2. Using the Tutorial Cartridge provided with your system, follow the procedures in Chapter 2. The Tutorial is a short exercise designed to help you learn the basic functions of your system—collecting and displaying sheet resistance data.

Process engineers might continue with the following steps:

3. Go to Chapter 3, and, beginning with "Selecting and Logging On to a User Account," follow the procedures for setting up the system for testing.
4. Go to Chapter 4, and practice setting up a standard test.
5. Go to Chapter 6, and run the tests you set up.
6. Go to Chapter 7, and follow the procedures for viewing and analyzing test data.

Conventions

The following conventions are used in this manual.

- The word ***system*** refers to the resistivity mapping system (including the wafer handler, tester, computer, and all peripheral devices).
- The word ***tester*** refers to the system's tester.
- The term ***process operator*** is used to describe a person in the wafer fabrication area who runs tests on the system.
- The term ***process engineer*** is used to describe a person who sets up tests on the system.
- TEXT IN ALL CAPS denotes the capitalized text that appears in the screens (most notably in the command boxes located across the bottom of the StatTrax screens and in the text fields on index cards).
- Keyboard keys are shown with an initial capital letter. For example:

  After keying in your response, press Enter.
- Key combinations and sequences are described as follows:
  - "Press Shift + ~" means hold down Shift, and press ~.
  - "Press Alt, F" means press and release Alt, then press and release F.
- *Text in italics* is used for titles of manuals and diskettes. Italics is also used for emphasis.
- Text in ***bold italics*** denotes words or phrases with special meaning and is sometimes used for emphasis.
- `Text in Courier` represents system messages.
- `Text in` **`Bold Courier`** represents text you must key in. For example:

  At the prompt, type **`12`**, and press Enter.
- Quotation marks ("_") identify sections and chapters within the manual.
- The words *choose*, *select*, and *highlight* are used interchangeably throughout the manual.
- Use the keyboard's directional keys to select text fields on the screen.
- Procedures for executing a command are written as follows:

  Press F4 (TREND CHART)

  where F4 represents the function key, and (TREND CHART) represents the words in the command box.
- To execute a command, press the associated function key or use the trackball to select the command box.
  - The keyboard's function keys F1 through F8 correspond, from left to right, to the command boxes that appear along the bottom of the screen display.
  - To execute commands with the trackball, use the palm of your hand to move the ball and position the cursor over a command box or text field. Then click the left trackball button, or press Enter.

Technical Support and Service Procedures

A Note to Our Customers . . .

In February 1994, Tencor Instruments and the Prometrix Corporation merged business operations. Service is now provided through the Tencor Field Service Operation.

We strongly encourage you to report any mechanical problems or operational difficulty you have with the system, whether major or minor. This helps us keep track of failures more accurately and helps us provide you with

- Faster, more effective service
- Our latest software updates
- Informative technical bulletins

In addition, for assistance with software or challenging applications, Tencor provides factory-based (in many areas, local) applications engineering support. This support is provided as part of a new system startup and on an as-needed basis to ensure long-term customer satisfaction.

Gathering System Information

If you cannot correct a hardware or software problem using the information in this manual, write down the following information and have it ready *before* you request service:

- All symptoms of the problem
- The current software revision level (appears on the Introduction Screen)
- The serial number of your system—look for the system label on the computer's rear panel. (Also note the computer revision level if the problem is computer-related.)

Arranging for Service

Field Service personnel will attempt to determine the nature of the problem using the information you provide. Generally, the cause can be quickly isolated. A replacement module, if required, can often be pulled from your Recommended Spares Kit or shipped to you via overnight courier.

Customers in the U.S. and Canada

After you have gathered information about your system's hardware or software problem, please contact your nearest Tencor service office. Customers in the United States can use our toll-free service line, 1-800-722-6775. This number is available from 6:00 a.m. to 6:00 p.m. Pacific Time.

International Customers

Please contact your local Tencor representative for the quickest and most direct response to your service need.

Maintenance Charges

The following describes parts and labor charges for repairing or maintaining your system.

If You Have a Warranty

Parts and labor are covered as stated in the product warranty. Replacement parts are shipped as soon as possible. All defective parts should be returned to Tencor within the specified time period.

If You Do Not Have a Warranty

If your system is no longer under warranty, a purchase order (PO) must be generated before any parts can be shipped. In general, Tencor will ship the parts after a PO number is phoned in; however, a hard copy of the PO still must follow. Tencor publishes a price list of the most common replaceable parts.

Returning Parts

Please contact Tencor's Order Processing Department for shipping information *before* returning defective or unused parts for repair. You will be provided with a Return Materials Authorization (RMA) number which *must be visible on the shipping carton*. Also included will be directions on methods of packaging and transportation to ensure the safe and economical delivery of your returned items.

Chapter 1
System Overview

Read This First

Read through this chapter before you use the OmniMap system for the first time. This chapter provides an overview of the system's hardware and StatTrax software. Pay special attention to the section "Precautions for Handling Cartridges and Using the System." It lists the precautions you should take to help ensure the integrity of the system and your test data.

Hardware Overview

The system hardware consists of the following components:

- Computer
- Hard drive
- Cartridge drive
- Floppy drive
- Color monitor
- Trackball
- Keyboard
- Tester
- GEM compliance kit (optional)
- Line conditioner
- Wafer handler (optional)

Figure 1-1 shows the system's tester, computer monitor, keyboard, wafer handler, and computer. For information on hardware specifications, refer to the section "Hardware Specifications" in the Introduction.

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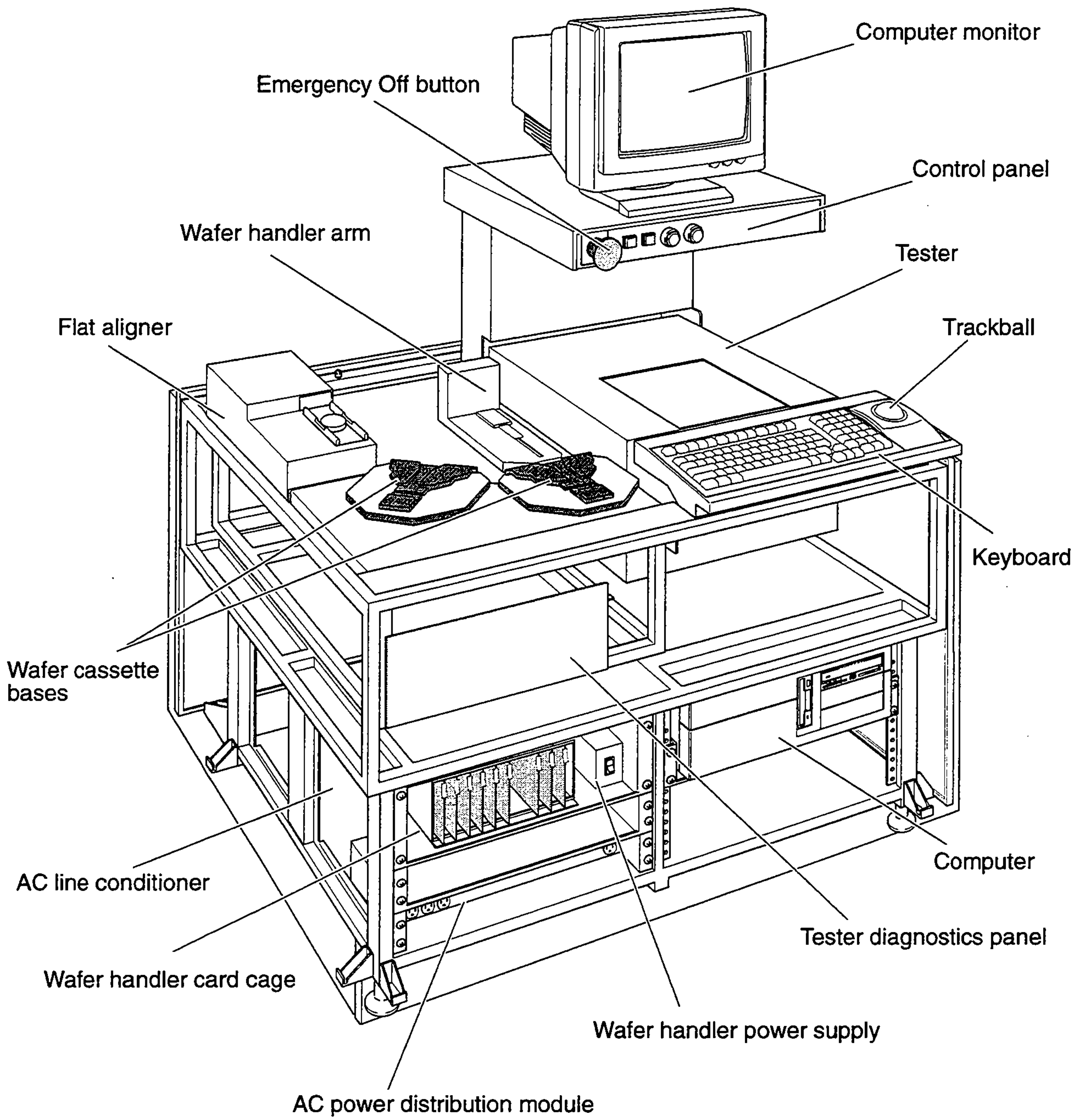


Figure 1-1: *OmniMap Auto RS55/tc System*

The Computer

The resistivity system's computer includes

- A fixed hard disk for loading and running the system software and for storing test configurations and collected data
- A cartridge drive for backing up/storing test configurations and collected data (on */tc* systems)
- A 3.5-inch floppy-diskette drive for loading software updates

Before you ship or move the computer, do the following:

- Insert the plastic shipping insert that came with the system into the 3.5-inch diskette drive to prevent head misalignment.
- Remove any cartridge from the system's cartridge drive.

The internal fixed drive should not be subjected to shock during movement or transport.

The Cartridge Drive

The OmniMap RS55/tc computer includes a removable-cartridge drive. The drive is located in the front of the computer's main unit. The components of the cartridge drive front panel are identified in Figure 1-2. The front panel LEDs indicate both normal and abnormal states of the drive. Table 1-1 shows the front panel LED status during the normal operation cycle of the drive, while Table 1-2 lists the LED status indicators for other drive states.

Table 1-1: *Indication of Cartridge Front Panel LEDs, Normal Operation Cycle*

Cycle	LED Status	Drive State
Power Up Cycle	Amber flashing, Green off for about 5 seconds	Cartridge installed and drive powering up
	Amber steady, Green off for about 15 seconds	Diagnostic self-test running
Operation	Amber off, Green steady	Ready
	Amber flashing, Green steady	Ready, data being stored or retrieved
Power Down Cycle	Amber flashing, Green off	Stop/Start button pressed, drive powering down

Table 1-2: *Indication of Cartridge Front Panel LEDs, Other Drive States*

LED Status	Drive State	Suggested Action
Off	No cartridge loaded	Load cartridge.
	Stop-button pushed	Push load lever to the left to begin the startup sequence. (Push the lever to the right to eject the cartridge.)
	Power not on or power-failure	Check system power.

Table 1-2: Indication of Cartridge Front Panel LEDs, Other Drive States (Continued)

LED Status	Drive State	Suggested Action
Amber flashing, Green flashing	Drive failed	Reboot computer. If problem persists, replace the drive.
Amber flashing, Green off for more than 30 seconds	Drive failed part of power-up cycle	Try again or correct fault condition.

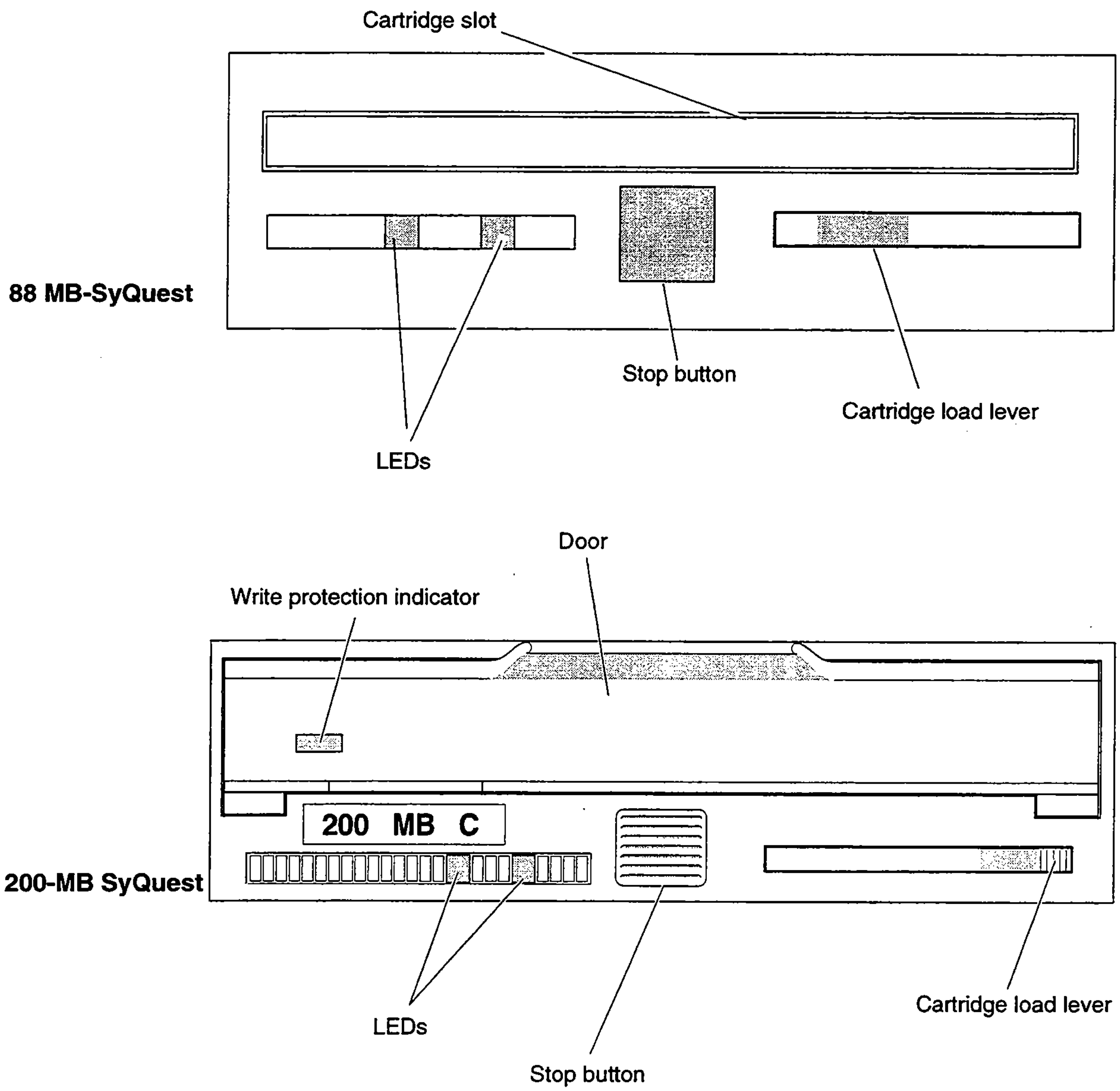


Figure 1-2: Cartridge Drive Front Panel Components

Removable Cartridges

Use the cartridges supplied with your OmniMap RS55/tc system to store test setups and process data. This portable storage system enables you to create a virtually unlimited number of independent databases. It also provides a convenient means for data backup. Systems equipped with a cartridge drive also include a static dissipative cartridge rack (***ESD station***) to store cartridges when not in use. Regular use of this rack will reduce damage due to static discharge. The ESD station must be properly grounded in order to be effective.

You must use cartridges that have been specifically formatted for use in the system. Improperly formatted cartridges will not function in the OmniMap system's cartridge drive.

When a cartridge is in the drive and is not spinning at full speed, both LEDs on the cartridge drive are off. As you move the cartridge load lever to the left, the disk attains its full rotational speed. If the green LED is lit, the cartridge has reached full rotational speed.

Precautions for Handling Cartridges and Using the System

Always observe the following precautions:

- To avoid particulate contamination, never open the cartridge's head-access door (the semicircular door).
- Place the cartridge in the ***ESD station*** before inserting it in the system's drive.
- Only use cartridges that are initialized for the system.
- Check the cartridge's orientation before inserting the cartridge in the drive. The arrow imprinted on the cartridge must be on the upper surface of the cartridge, pointing towards the system.
- Never force the drive lever on the cartridge drive while the cartridge drive LED is on or blinking. Forcing this lever can damage the disk drive.
- Decelerate a cartridge and remove it from the drive only when the monitor displays the Introduction, Account Select, or Backup/Delete Files Screens.
- To change cartridges during data manipulation or printing, you must return to the Introduction or Account Select Screens. After changing cartridges, you must LOG ON to an account before proceeding to the desired operation.
- Use a new cartridge if the current one is at 75% or more of its capacity.
- Always power off the computer after removing a suspect cartridge. This clears the system's internal memory.
- Always transport cartridges in their protective case when they are not being used. This protects them from contamination or damage.
- Do not turn the system on if the wafer handler finger is near the tester stage. Doing so can cause the finger to crash into the cassette or stage.
- Use the software command (Ctrl+Alt+Delete) when you need to reboot the system.
- Do not place anything on top of the system or wafer handler.

Inserting and Removing a Cartridge

CAUTION

- Place the cartridge in the ***ESD station*** before inserting it into the drive
- Check the cartridge's orientation before inserting the cartridge in the drive. The arrow imprinted on the cartridge must be on the upper surface of the cartridge, pointing towards the system.
- Never force the lever on the cartridge drive while the cartridge drive LED is on or blinking. Forcing this lever can damage the drive.
- Decelerate a cartridge, and remove it from the drive only when the monitor displays the Introduction, Account Select Screen, or Backup/Delete File Screens. These are the only StatTrax Screens displaying the SELECT ACCOUNT or LOG ON ACCOUNT commands.

To insert a cartridge into the drive

1. Make sure that the SELECT ACCOUNT or LOG ON ACCOUNT command box is displayed (as in the Introduction and Account Select Screens).
2. Insert the cartridge into the disk drive with the top label facing up and the front label and write protect indicator facing you (refer to Figure 1-3). On the 200-MB model, you will first need to open the cartridge door.
3. Push the cartridge into the drive until it is completely inside the front panel and comes to a stop. The cartridge load-lever will pop out from the front panel.
4. Move the cartridge load-lever to the left until it is flush with the front panel. The Stop button will pop out slightly from the front panel, and the amber LED will start to flash.
5. Wait for the green LED to turn on and the amber LED to go off. You are now ready to log on to the cartridge or a fixed-drive account.
6. From the Introduction Screen, press F3 (ACCOUNT SELECT).
7. Select the cartridge drive account you want to access, and press F1 (LOG ON ACCOUNT).

   The system displays disk information and asks you to press any key.
8. Press any key.

   The system displays the Introduction Screen.

CAUTION *Tencor recommends that the system be powered on before you remove a cartridge. If there is no power going to the drive or computer, turn on the system, and wait one minute before proceeding to ensure that the disk has stopped spinning.*

To remove a cartridge from the drive

1. Make sure that the SELECT ACCOUNT or LOG ON ACCOUNT command box is displayed (as in the Introduction and Account Select Screens).
2. Press the Stop button. The green LED will go off, and the amber LED will start to flash. The cartridge load lever will pop out from the front panel. *Do not move the cartridge load lever yet!*
3. Wait for the amber LED to stop flashing.

CAUTION *Wait until the Amber LED stops flashing before removing the cartridge! (This takes about 10 seconds.)*

4. Move the cartridge load lever to the right until it is flush with the front panel. The cartridge will eject immediately.
5. Remove the cartridge from the drive and place it in its protective case.

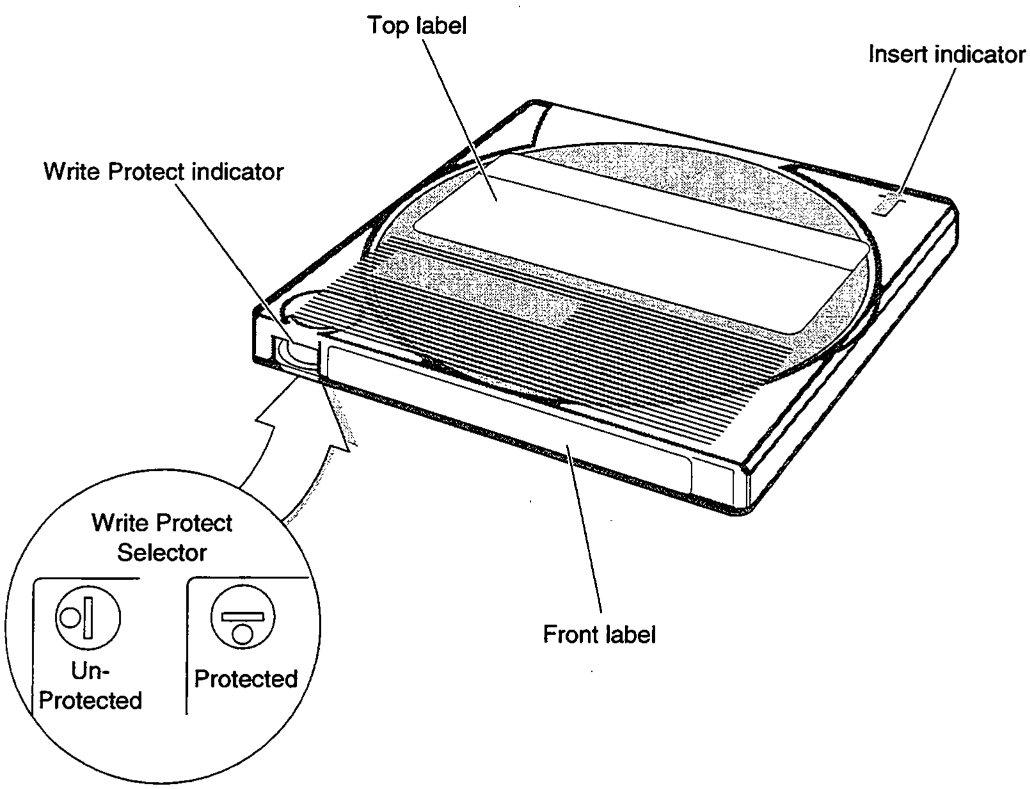


Figure 1-3: *Cartridge Components*

The Floppy Drive

The system computer incorporates a 3.5-inch floppy drive (Figure 1-4) for installing software upgrades. Figure 1-5 identifies the components of a 1.44-MB diskette.

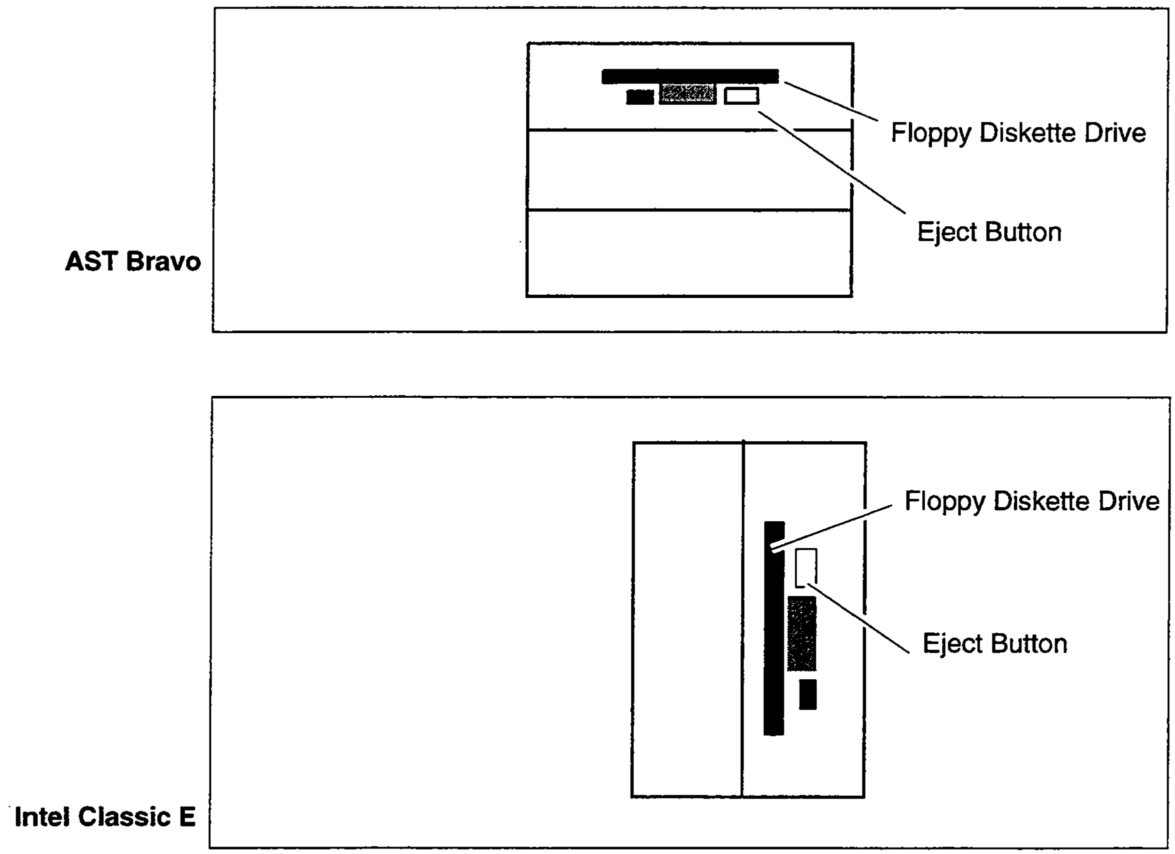


Figure 1-4: Floppy Diskette Drive Location

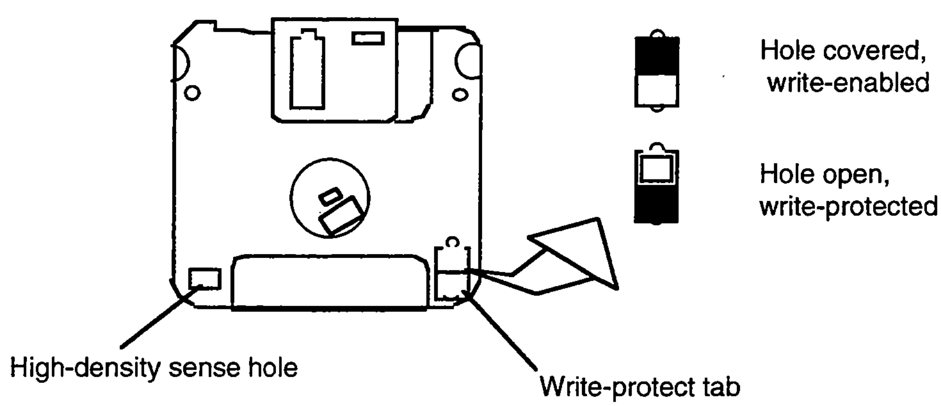


Figure 1-5: Floppy Diskette Components

The Tester

The tester is a self-contained measurement unit capable of mapping resistivity variations in wafers up to 200 mm (7.87 inches) in diameter. The tester controls the stage movement and performs measurements as directed by the system's computer.

The Color Monitor

All systems include a high-resolution, VGA color monitor. The monitor displays output from both the system and the optional SECS-II or GEM computers. Observe the following precautions:

- Wipe the screen periodically with a soft, static-free cloth to maintain the clarity of the display. (The monitor generates static electricity that attracts dust particles to the screen.)
- Do not open the monitor.
- Do not drop, bump, or jar the monitor.
- Do not use the monitor if the monitor case or screen is cracked.
- Do not block the ventilation slots on top of the monitor.

WARNING *For the user's safety, power cords supplied with the computer monitor have grounded plugs. The power cords should be used with properly grounded 3-hole wall outlets to avoid electrical shock and reduce* ***noise.*** *(You may also use multiple outlet strips that have their own circuit breakers.)*

The Trackball

Your system comes with a trackball. The trackball gives you a visually intuitive method of implementing software commands, selecting text fields, or scrolling through a directory. To implement a function, drag the trackball so that the cursor is positioned over the function and click the left trackball button.

The Keyboard

The computer keyboard consists of a standard typewriter keyboard, cursor-control keys, status-indicator LEDs, a dual-function numerical keypad, and function keys.

StatTrax software displays eight context-sensitive command boxes at the bottom of its screens. Each of these command boxes corresponds (from left to right) to one of the function keys (F1-F8) at the top of your computer keyboard. You execute a command by pressing the corresponding function key.

The function keys displayed on the Introduction Screen execute the following commands (refer to Figure 1-6):

- F1 FOLDER SELECT—accesses Operations Mode and its Folder Select Screen
- F2 WAFER HANDLER MENU—accesses the Wafer Handler Menu
- F3 ACCOUNT SELECT—accesses the Account Select Screen
- F4 TURN ON SYSTEM/DEMO—switches between Test and Demonstration Modes
- F8 SET UP—accesses Engineering Mode and the Main Engineering Menu.

The F9–F12 keys are not employed by StatTrax and should not be pressed.

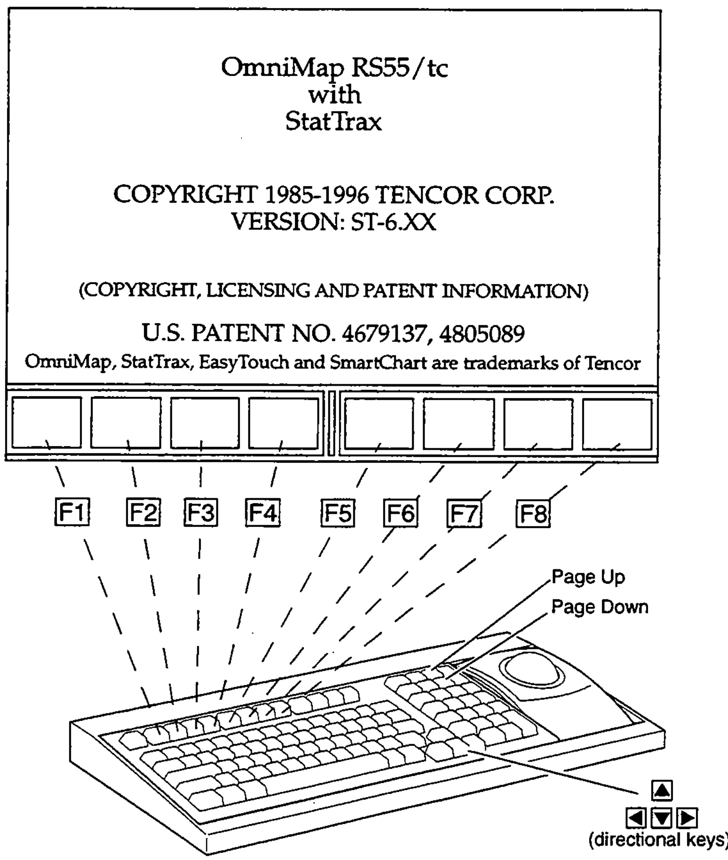


Figure 1-6: Command Boxes and Corresponding Keyboard Keys, Introduction Screen

The GEM Compliance Option

GEM is a communications standard/protocol, a superset of the SECS-II communications standard that is supported by StatTrax. In order to simplify installation, Tencor implements the GEM communications standard by placing an adapter box between the SECS-II port and the GEM host. The adapter box contains a PC running a windows-based application that converts incoming GEM messages (from the Host) to SECS-II messages, which can be read by StatTrax, and vice versa. To view the status of GEM communications, set the rotary switch mounted next to the trackball to the GEM position.

The Line Conditioner

The line conditioner protects the system from power transients and electrical noise which might occur on the facility's AC line voltage. All system components must be connected to the facility's line voltage through the line conditioner. The line conditioner protects the system electrically and is required under the terms of the system warranty.

Important *The system warranty requires that the line conditioner be used to protect all system components. The line conditioner must be dedicated exclusively to the resistivity system and should not be used with any other products.*

The Wafer Handler

The wafer handler (Figure 1-7) automatically transfers wafers between the tester's wafer platen and the wafer cassettes (boats). The wafer handler holds two wafer cassettes. Cassettes sit upright on the black cassette bases near the front of the wafer handler unit. You can program the wafer handler to pre-align the major flat or notch of each wafer before placing the wafer on the platen.

The wafer handler's shuttle-arm assembly can

- Return tested wafers to their original cassette and slot
- Return tested wafers to the corresponding slot in a second cassette
- Return tested wafers to a second cassette in inverse order
- Sort wafers according to test results

Important *Use only SEMI standard H-bar wafer cassettes that sit flat against the cassette base and shoeplate. Do not use virgin Teflon® cassettes (semi-transparent). Virgin Teflon passes the infrared signal that the wafer handler uses to detect the presence of a cassette; therefore, the wafer handler cannot detect a virgin Teflon cassette when it is in place.*

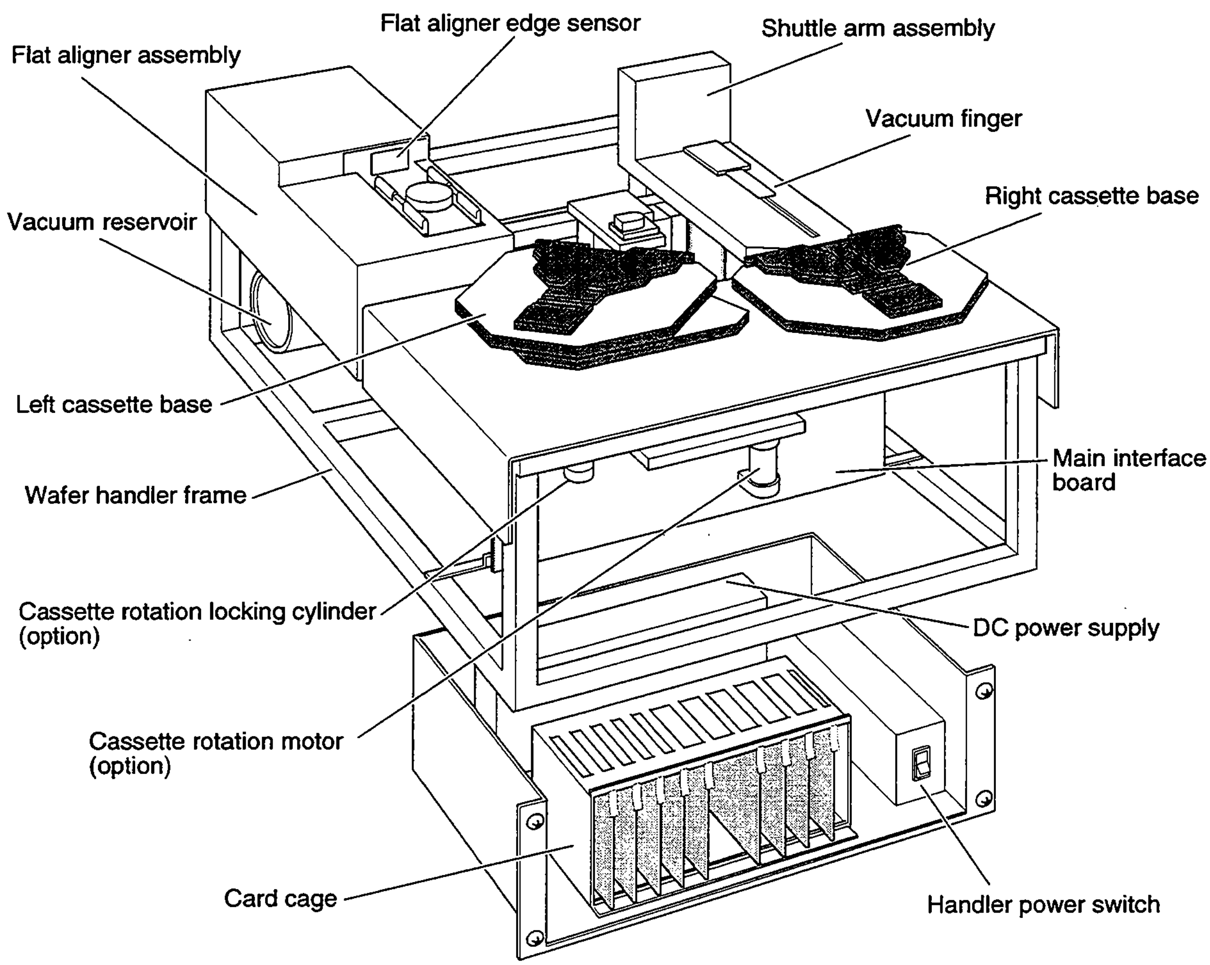


Figure 1-7: Wafer Handler

The Wafer Platen

The *Auto* OmniMap system can operate in a fully automatic mode using the wafer handler to transfer wafers to and from the platen. However, the stage is equipped with a series of precision alignment holes to ensure that wafers are centered correctly when the operator must load them manually. When positioning wafers manually, install the two Teflon *alignment screws* in the paired holes as indicated in Figure 1-8. (For information on automatic and manual wafer loading, refer to the section "Loading Wafers Manually" in Chapter 6.)

WARNING

- ❑ *Do not attempt to measure any wafer thicker than 3 mm without the thin stage option; doing so can damage the system.*
- ❑ *Never place anything on the sliding door at the top of the tester. If the door opens, the item will fall inside the tester.*

CAUTION *Use only the Teflon alignment screws provided with the system. Metal pins can cause a short between the probe head and the stage, affecting measured resistivity values.*

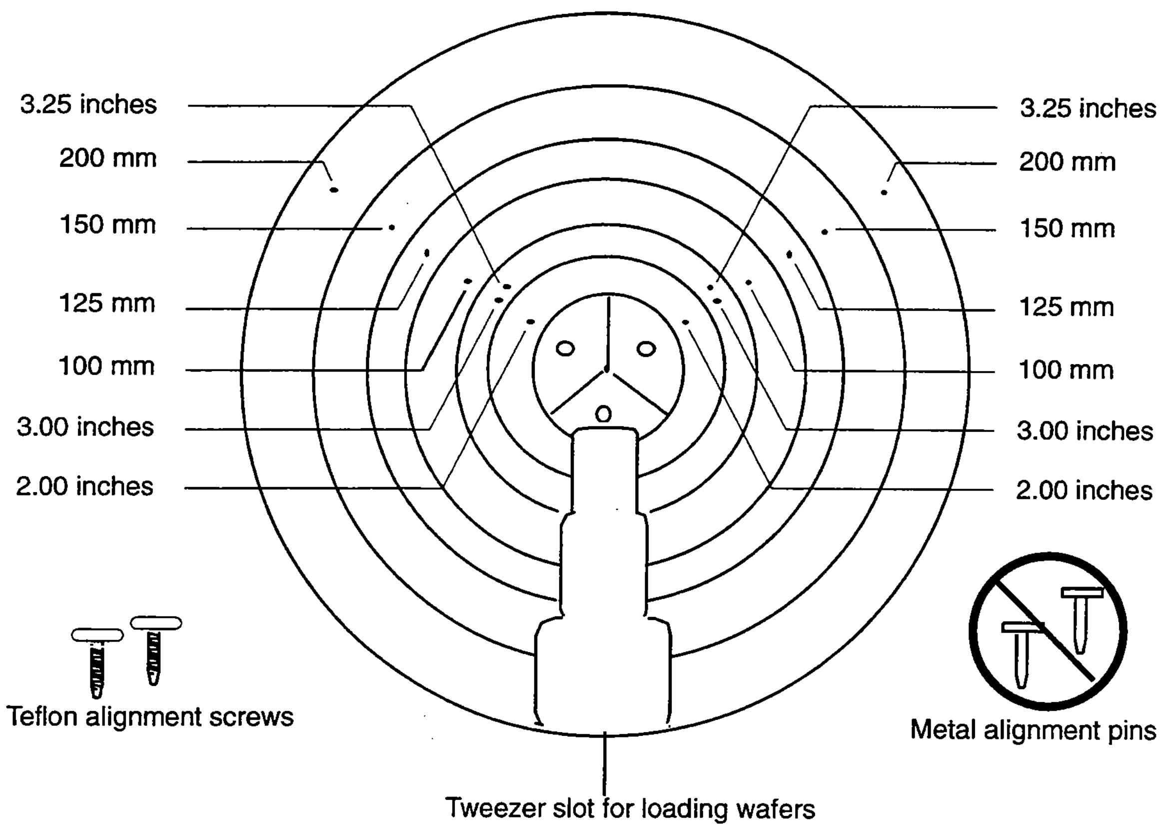


Figure 1-8: *Alignment Holes in the Wafer Platen*

StatTrax Software Overview

StatTrax is Tencor's interactive statistical tracking software. It controls the tester and peripheral hardware through a series of test setup instructions that you enter in the software. StatTrax also stores the test data, analyzes the test results, and displays the test data in a variety of graphic forms. StatTrax software enables you to monitor an unlimited number of process parameters and operating conditions. Die Maps, Contour Maps, 3D Maps, and Diameter Scans help you visualize non-uniformities on tested wafers. Trend Charts and Statistical Quality Control (SQC) Charts, updated in real time, enable you to detect and correct process drifts.

StatTrax divides your internal fixed hard drive into independent *user accounts*. You organize data within each account using the StatTrax *electronic filing system*. You access the data through a series of ***menus*** or ***screens***. StatTrax automatically customizes these screens for test ***Engineering*** (test setup) or ***Operations*** (data collection) ***Modes***. Test data is stored within individual ***test folders***. Each folder contains a set of *index cards* which record the specific test's parameters and results. The process engineer regulates access to this data through ***password protection*** and ***StatTrax color coding***. The following sections briefly describe

- User Accounts
- Electronic filing system
- Engineering Mode
- Operations Mode
- Main Engineering Menu
- Test Folders
- Index Cards
- Password protection
- Color coding

The sections are followed by diagrams describing some of the major system functions and operations.

User Accounts

The User Account feature creates distinct ***user accounts*** on both the internal fixed drive and the removable cartridges. These accounts can be individually password-protected, allowing several users to work on the same system without risk to their data. (See "Account-Level Password Protection" later in this chapter.)

Electronic Filing System

StatTrax organizes data from your film processes in a three-level electronic filing system of linked ***cabinets, drawers,*** and ***folders***. Cabinets, drawers, and folders, like directories with subdirectories in DOS, provide a logical pathway to the desired test routine. Each user account houses nine cabinets, each containing nine drawers capable of holding up to nine folders: a total of 729 test folders per user account (Figure 1-9) The number of files stored in each folder is limited by the amount of data in the files. Each account can store up to 20 megabytes of data.

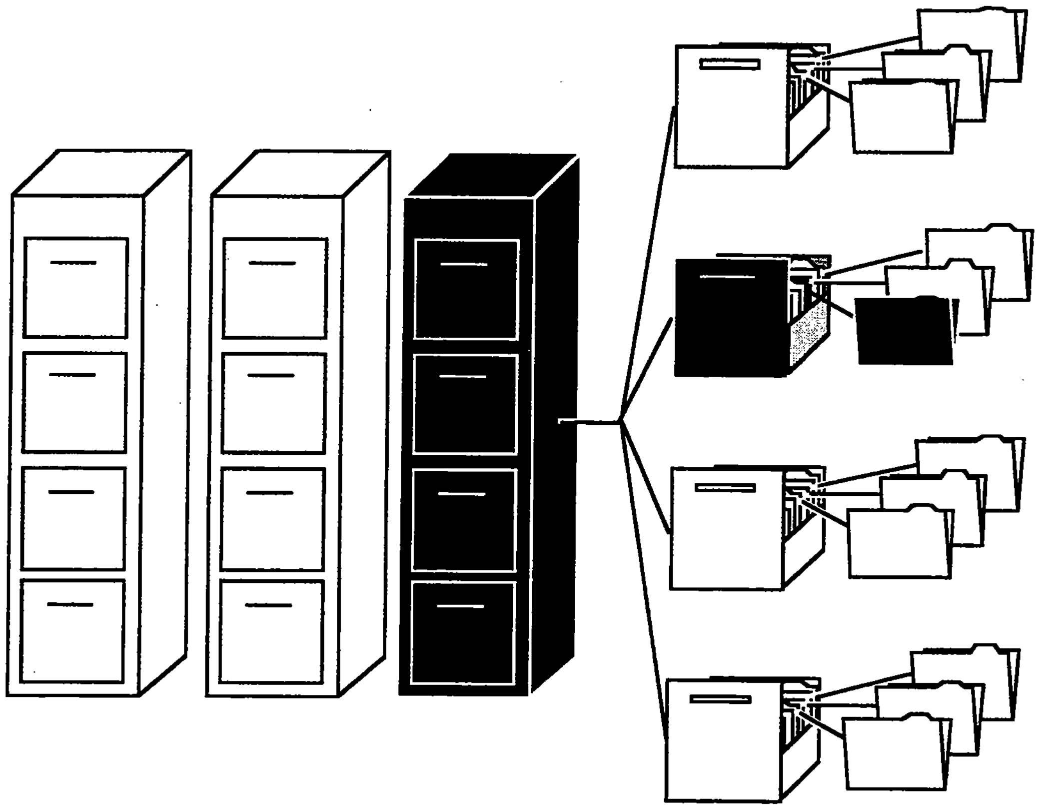


Figure 1-9: *StatTrax Data Filing System*

Engineering Mode (Orange Screen Border)

The process engineer controls data collection by setting up test procedures in Engineering Mode. These test procedures define data collection and mapping parameters. The process engineer can also use Engineering Mode to generate additional maps or plots of the data, edit the data, and print lists of test results.

By password-protecting an account, the engineer can require that the correct password be entered after pressing F8 (Setup) to access Engineering Mode. In this way, the engineer can regulate the operators' access to the test parameters and thus their ability to edit the test setup. (Refer to the later section "Account-Level Password Protection.")

When the system software is in Engineering Mode, the screen border is orange.

Operations Mode (Green Screen Border)

The process operator uses Operations Mode to edit test parameters (as prescribed by the process engineer), collect and analyze test data, and print wafer maps or plots. You enter Operations Mode by pressing F1 (FOLDER SELECT) from the Introduction Screen. When the system software is in Operations Mode, the screen border is green.

The Main Engineering Menu

You control system operations through the Main Engineering Menu (Figure 1-10). Each MENU selection offers a specific set of ITEM selections enabling you to direct system-level functions, set up testing parameters, view and analyze test results, or manage data files.

For example, to create a new test, you press F1 (SELECT) with TEST DEVELOPMENT and TEST SETUP highlighted as shown in Figure 1-10. The system responds by displaying the Folder Select Screen. In the Folder Select Screen you select and name a folder to contain your test setup. This test folder contains the index cards in which you will enter the test's parameters.

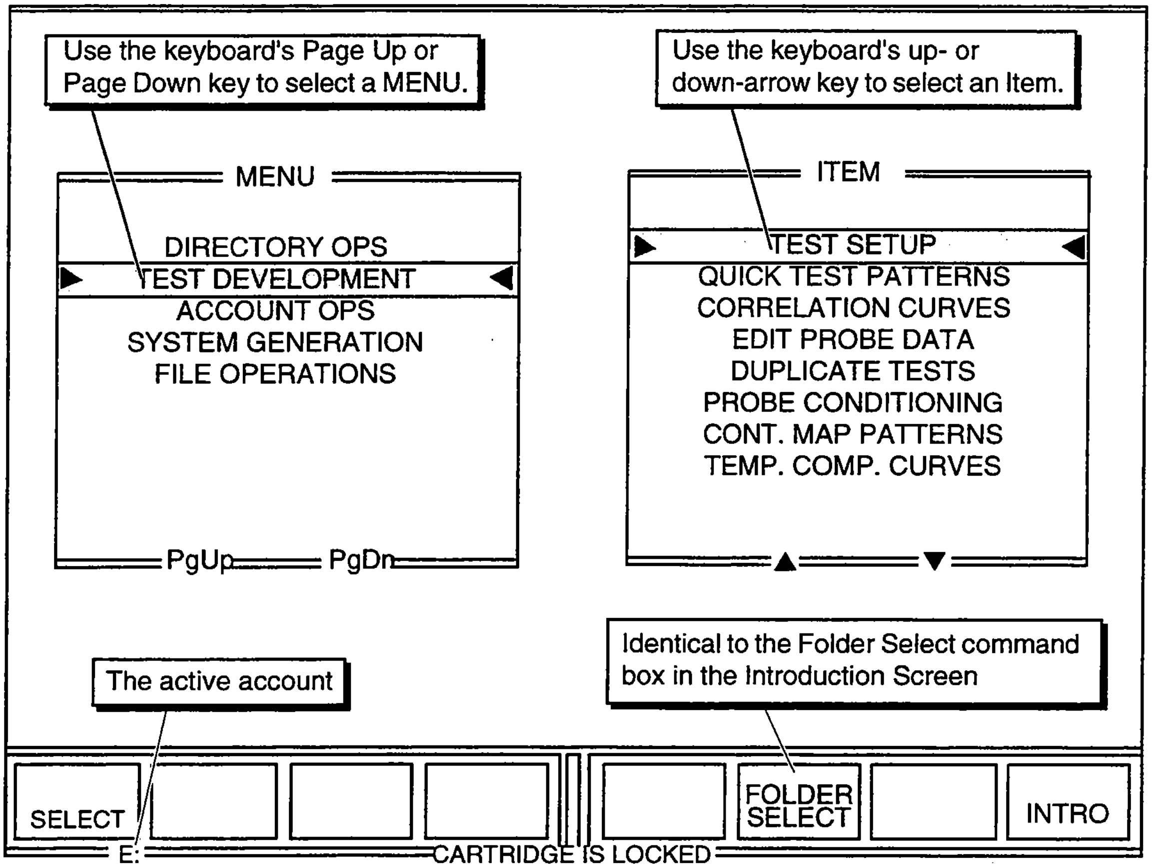


Figure 1-10: Main Engineering Menu, Test Development

Selecting a Test Folder in Operations and Engineering Modes

StatTrax stores each test setup, and any corresponding collected data, within its own folder. You access individual folders through the Folder Select Screens. The Engineering Mode's Folder Select Screen (Figure 1-11) and the Operations Mode's Folder Select Screen (Figure 1-12) are customized according to their respective mode. You access the Engineering Folder Select Screen by choosing F1 (SELECT) from the Main Engineering Menu (with TEST DEVELOPMENT and TEST SETUP selected). You access the Operations Folder Select Screen from the Introduction Screen by pressing F1 or from the Main Engineering Menu by pressing F6.

You use the left- and right-arrow keys to move between the Cabinet, Drawer, and Folder lists; you use the up- and down-arrow keys to highlight the desired field in these lists. As you scroll through the list of cabinets in the Folder Select Screen, the corresponding drawer and folder entries instantly appear. This feature enables you to browse through all the file drawers in a matter of seconds.

- When you select a cabinet in the CABINET listing, the DRAWER listing automatically displays the drawers in the cabinet.
- When you select the desired drawer in the DRAWER listing, the FOLDER listing automatically displays the folders in the selected drawer.

Naming a Test Folder in Engineering Mode

To name a new test folder, you select the cabinet, drawer, and folder in Engineering Mode. You then type the name (up to 20 characters) in the blank field in the folder list. (Similarly, you name cabinets and drawers by typing names into blank fields in their lists.)

Conventions for Naming Test Folders

StatTrax folder IDs follow the form [n1 n2 n3 - z t] where

- ***n1 n2 n3*** is a three-digit number that identifies the cabinet (n1), drawer (n2), and folder (n3).
- *z* represents a test type
  - XY — Cartesian Coordinate (XY die Map)
  - M — Polar Coordinate (Contour or 3D Map)
  - S — Diameter Scan
  - Q — Quick Test
  - P — Qualification/Precision Test
- *t* is the number of test files in the folder. If the folder contains no files, the *t* field displays EMPTY when viewed in Operations Mode.

For example, the ID [321-M 14] indicates that the third cabinet, second drawer, first folder is set up for Polar-coordinate Contour Map Tests (M), and contains the collected data for 14 tests.

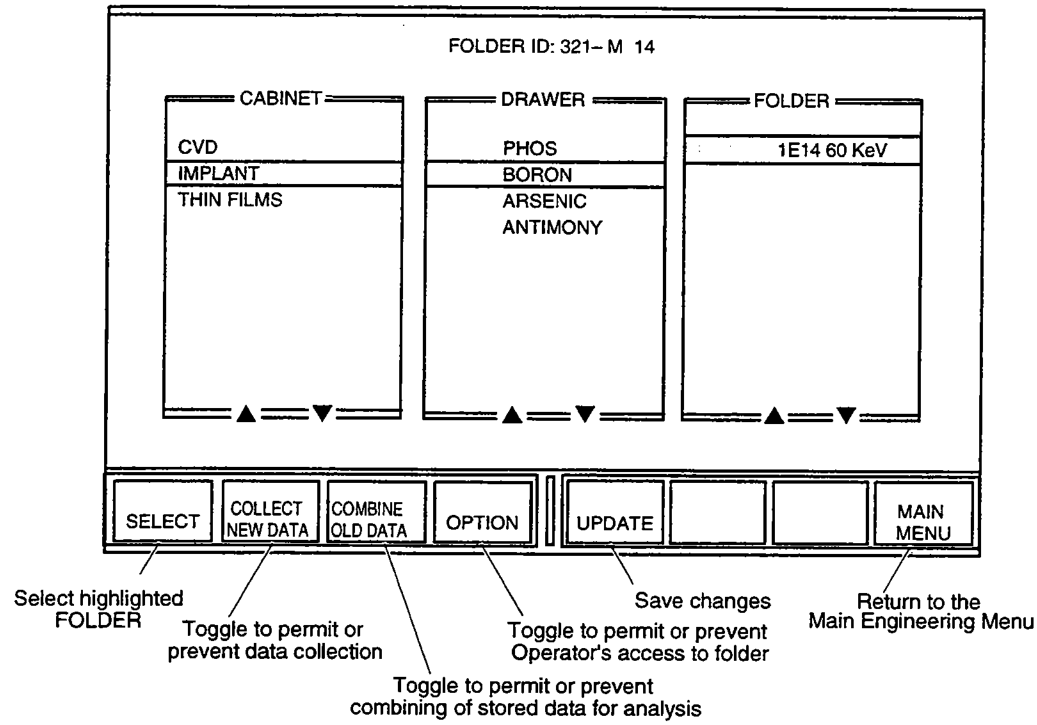


Figure 1-11: *Folder Select Screen, Engineering Mode*

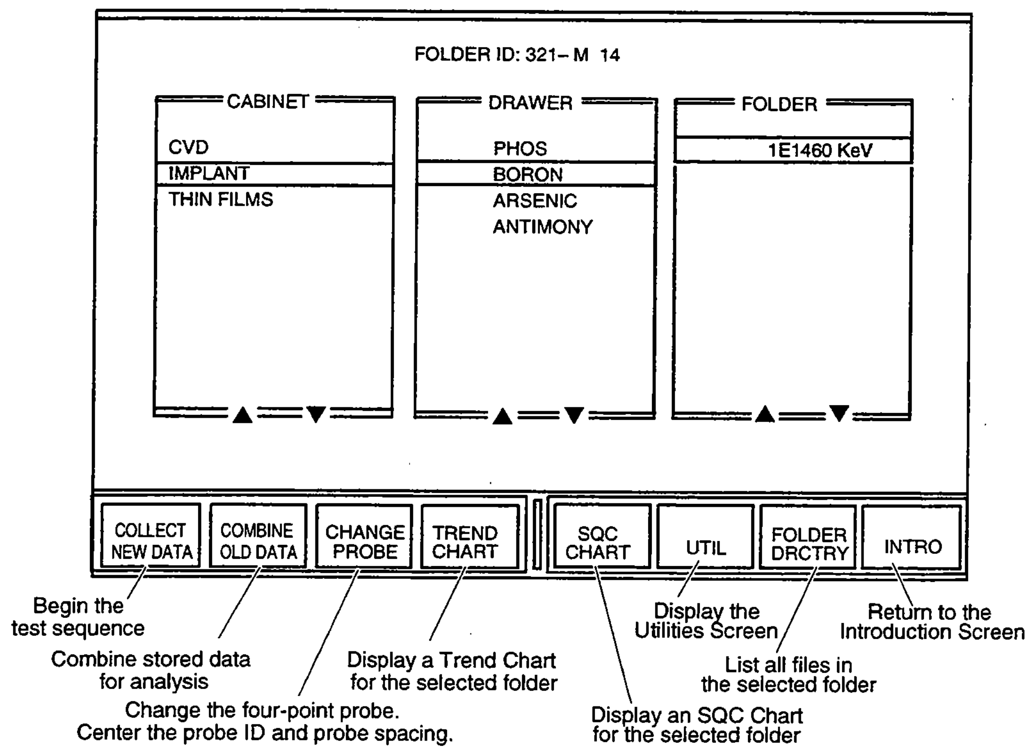


Figure 1-12: *Folder Select Screen, Operations Mode*

Using Index Cards

Each StatTrax test folder contains a series of ***index cards*** in which you set up the wafer test, view test results, and generate statistical charts. Working in Engineering Mode, you establish specific test parameters in each index card. For example, in the Measure Type Index Card, you choose the appropriate measurement settings for your test.

You access individual index cards through a set of card ***indexes***. StatTrax groups related index cards within the same card index. You move from one card index to another by pressing the Page Up or Page Down key. You select a specific index card by pressing the left- or right-arrow key. You move between text fields within the index card by pressing the up- or down-arrow key. Figure 1-13 depicts the card indexes and their associated index cards. Figure 1-14 shows the Wafer Facts Index Card in Engineering Mode.

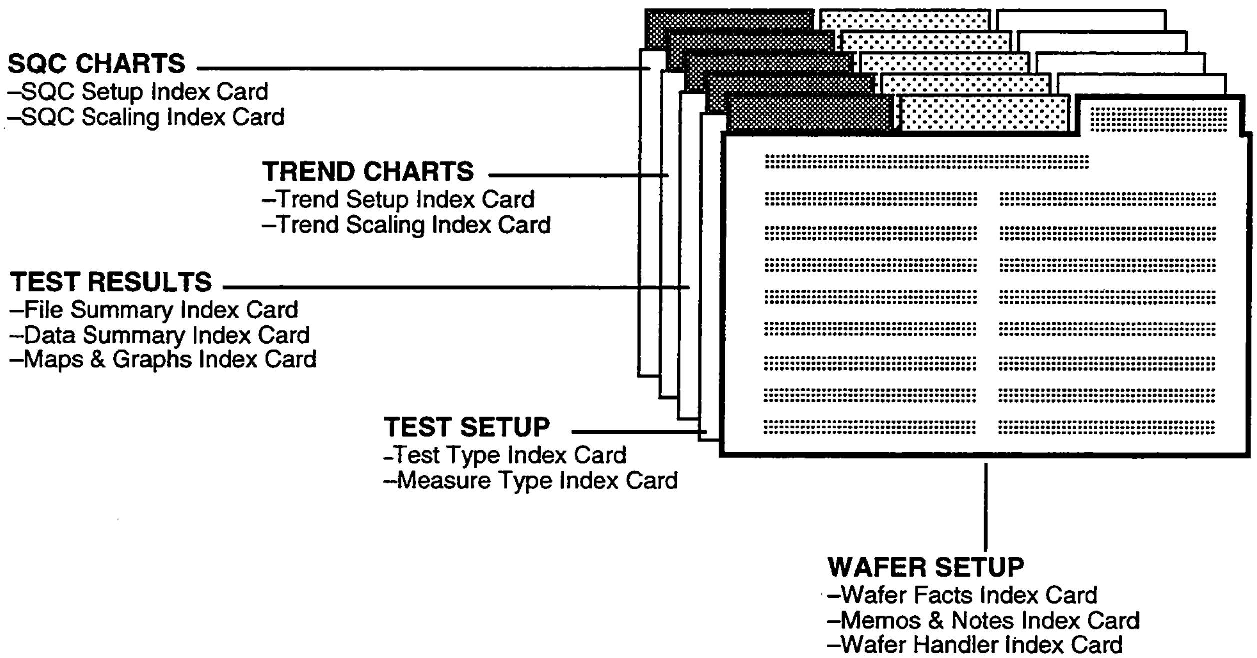


Figure 1-13: StatTrax Index Cards

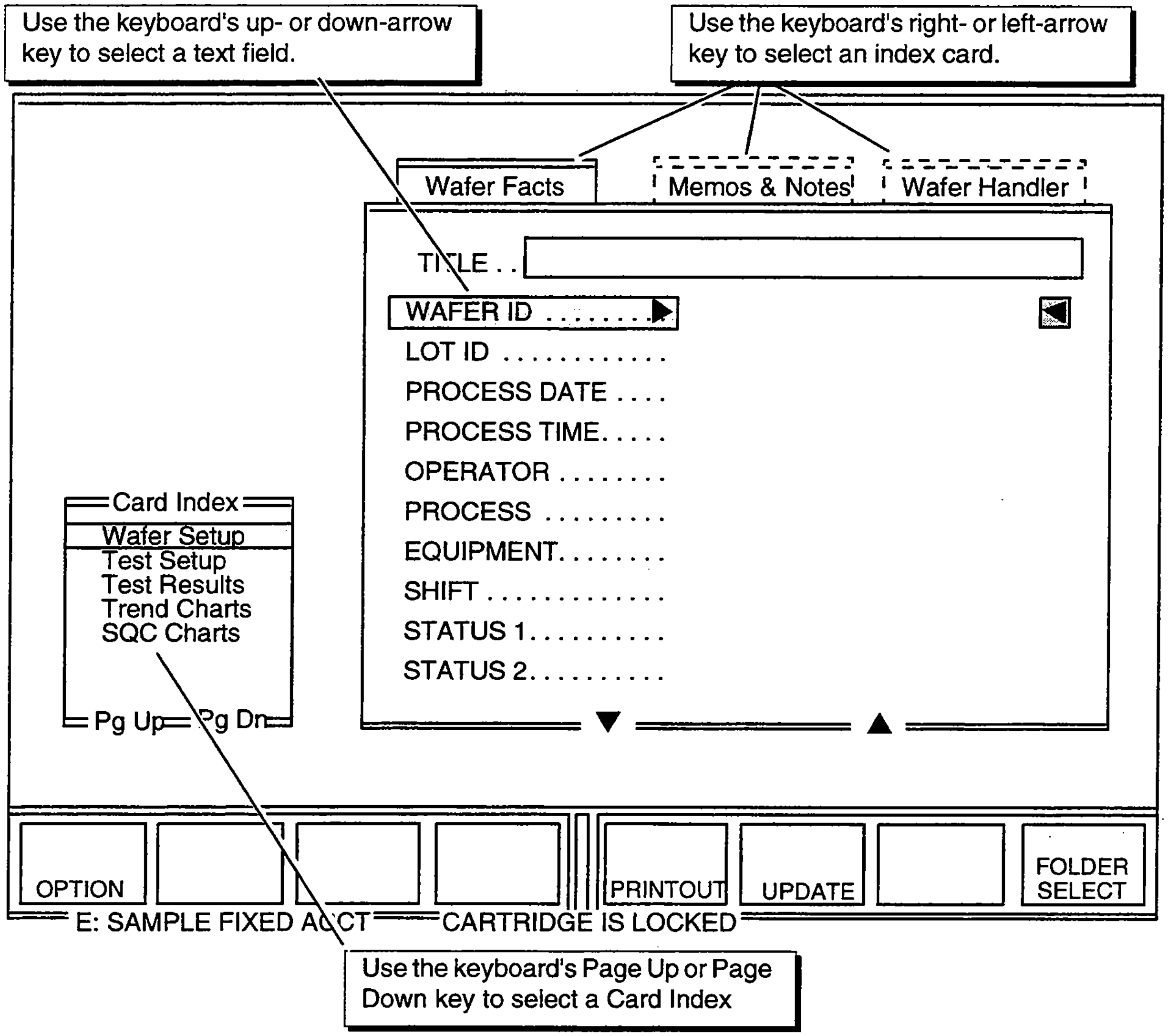


Figure 1-14: Wafer Facts Index Card, Engineering Mode

Account-Level Password Protection

StatTrax lets you establish an account-level password to restrict access to an account's Engineering Mode. The account password prevents unauthorized changes to the wafer test parameters within the account. After entering the correct password for the account, you can move between the account's Engineering and Operations Modes from the Main Engineering Menu without having to re-enter the password. Refer to "Password-Protecting an Account" in Chapter 3 for instructions on establishing passwords.

Using Color-Coding to Restrict Access to Cabinets, Drawers, and Folders

By changing a field for a cabinet, drawer, or folder from blue to black (in Engineering Mode), you can restrict access to cabinets, drawers, and folders. This prevents a user from viewing (and thus accessing) the cabinet, drawer, or folder in Operations Mode.

The OPTION Command Box displayed at the bottom of the Engineering Folder Select Screen (Figure 1-11) allows you to restrict viewing access to a cabinet, drawer, or folder. Cabinet, drawer, and folder names originally appear on blue fields. Blue fields permit viewing in Engineering or Operations Mode. Using the OPTION command box to change the selected field from blue to black restricts viewing to Engineering Mode only.

If a cabinet, drawer, or folder has restricted access (or is empty), the Folder Select Screen for the FOLDER DIRECTORY and FILE TRANSFER & COPY selections (described in Chapter 8) displays the Folder ID number on a red field.

Using Color-Coding to Set Text-Entry Requirements for the Operator

Within the individual index cards in Engineering Mode, StatTrax software lets you set text-entry requirements for the process operator. By using the OPTION command box (shown in Figure 1-14) to color-code a text field, the engineer specifies when operators may, or when they must, enter information into the text field. Table 1-3 defines these color codes.

Table 1-3: *Color Codes in Text Fields*

Field Color	Meaning
Black	Operators cannot make entries.
Light Blue	Entries are optional.
Orange	Operators must make an entry each time they open the test folder. (Operators must enter the information only once for each series of wafers from a test folder, as long as they do not exit that folder.)
Red	Operators must make an entry before testing each wafer.

After an operator makes an entry in an orange or red text field, the display changes to dark blue lettering on a light blue field. The system will not allow the operator to begin the test if any fields remain red or orange.

System Software Diagrams

This section contains diagrams of some major system functions and operations. Figure 1-15 gives an overview of the major system functions, while Figure 1-16 through Figure 1-20 outline specific operations (see Table 1-4).

Table 1-4: *Major StatTrax Functions*

Function	Figure	For More Information
Collecting Data	Figure 1-16	Refer to Chapter 6
Retrieving Data	Figure 1-17	Refer to Chapter 7
Combining Data	Figure 1-18	Refer to Chapter 7
Setting Up a Test Folder	Figure 1-19	Refer to Chapters 4 and 5
Directory Sorting	Figure 1-20	Refer to Chapter 8

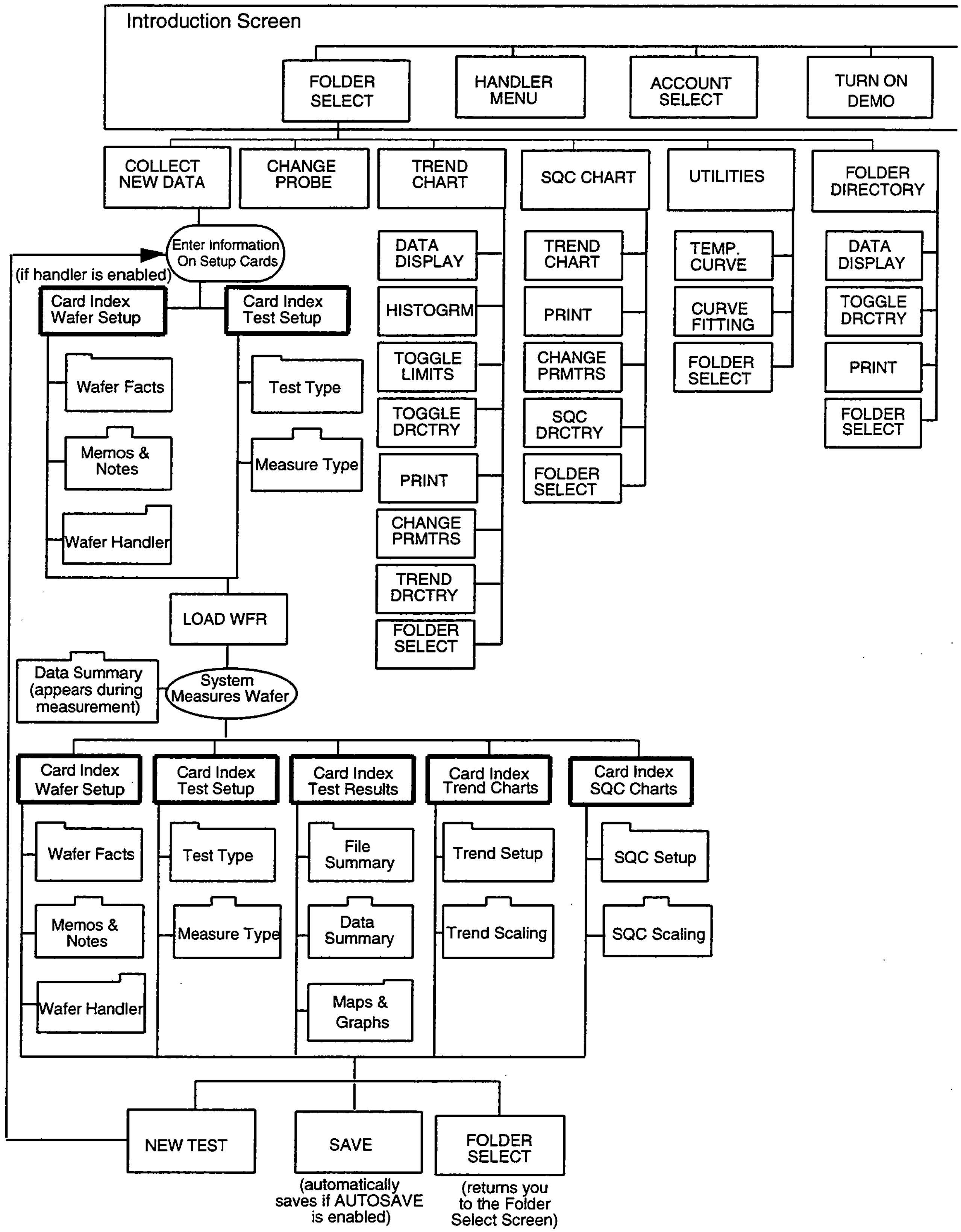
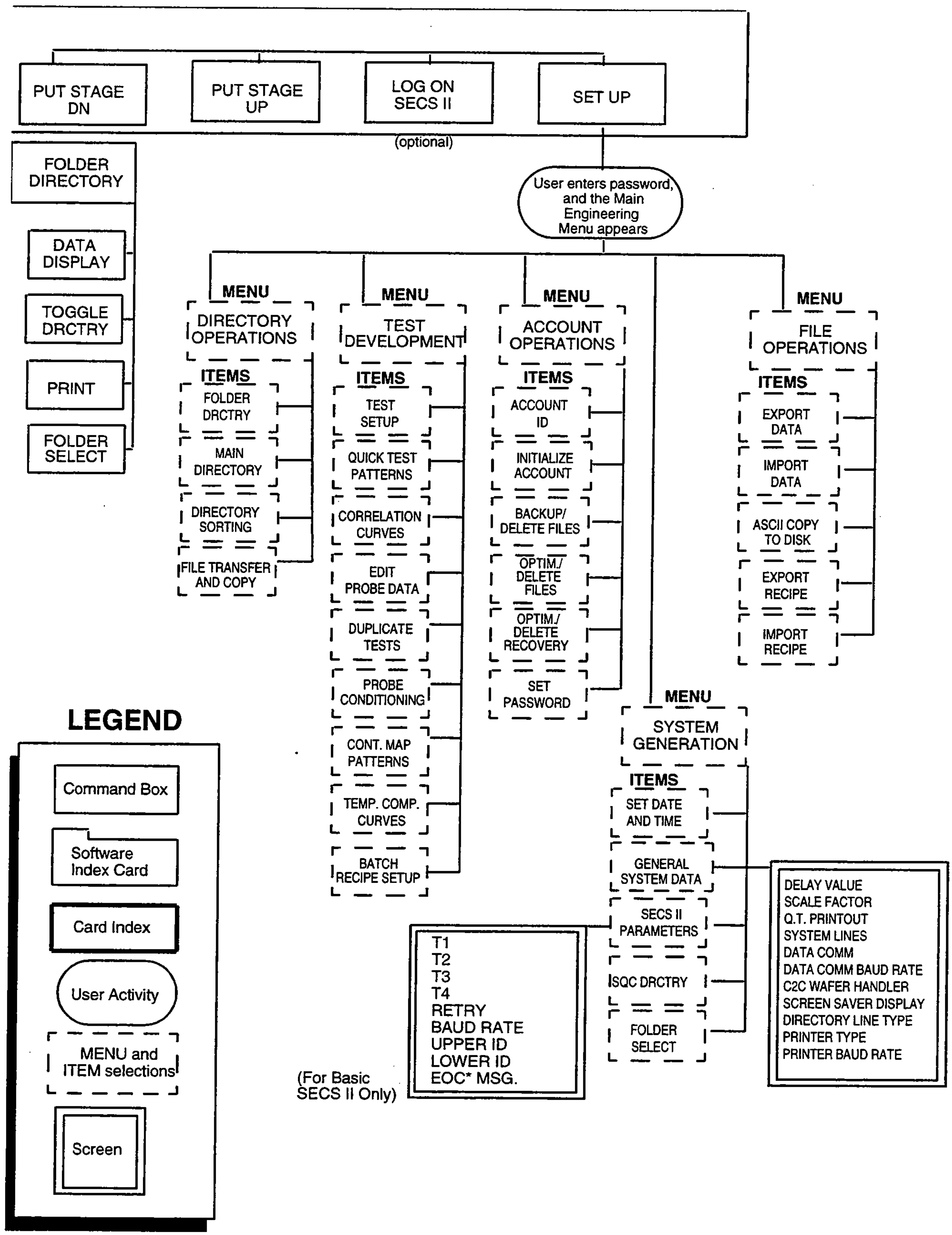


Figure 1-15: StatTrax System Functions


PUT STAGE DN
PUT STAGE UP
LOG ON SECS II
(optional)
SET UP
FOLDER DIRECTORY
DATA DISPLAY
TOGGLE DRCTRY
PRINT
FOLDER SELECT
User enters password, and the Main Engineering Menu appears
MENU
DIRECTORY OPERATIONS
ITEMS
FOLDER DRCTRY
MAIN DIRECTORY
DIRECTORY SORTING
FILE TRANSFER AND COPY
MENU
TEST DEVELOPMENT
ITEMS
TEST SETUP
QUICK TEST PATTERNS
CORRELATION CURVES
EDIT PROBE DATA
DUPLICATE TESTS
PROBE CONDITIONING
CONT. MAP PATTERNS
TEMP. COMP. CURVES
BATCH RECIPE SETUP
MENU
ACCOUNT OPERATIONS
ITEMS
ACCOUNT ID
INITIALIZE ACCOUNT
BACKUP/ DELETE FILES
OPTIM./ DELETE FILES
OPTIM./ DELETE RECOVERY
SET PASSWORD
MENU
FILE OPERATIONS
ITEMS
EXPORT DATA
IMPORT DATA
ASCII COPY TO DISK
EXPORT RECIPE
IMPORT RECIPE
MENU
SYSTEM GENERATION
ITEMS
SET DATE AND TIME
GENERAL SYSTEM DATA
SECS II PARAMETERS
SQC DRCTRY
FOLDER SELECT
DELAY VALUE
SCALE FACTOR
Q.T. PRINTOUT
SYSTEM LINES
DATA COMM
DATA COMM BAUD RATE
C2C WAFER HANDLER
SCREEN SAVER DISPLAY
DIRECTORY LINE TYPE
PRINTER TYPE
PRINTER BAUD RATE
T1
T2
T3
T4
RETRY
BAUD RATE
UPPER ID
LOWER ID
EOC* MSG.
(For Basic SECS II Only)
LEGEND
Command Box
Software Index Card
Card Index
User Activity
MENU and ITEM selections
Screen

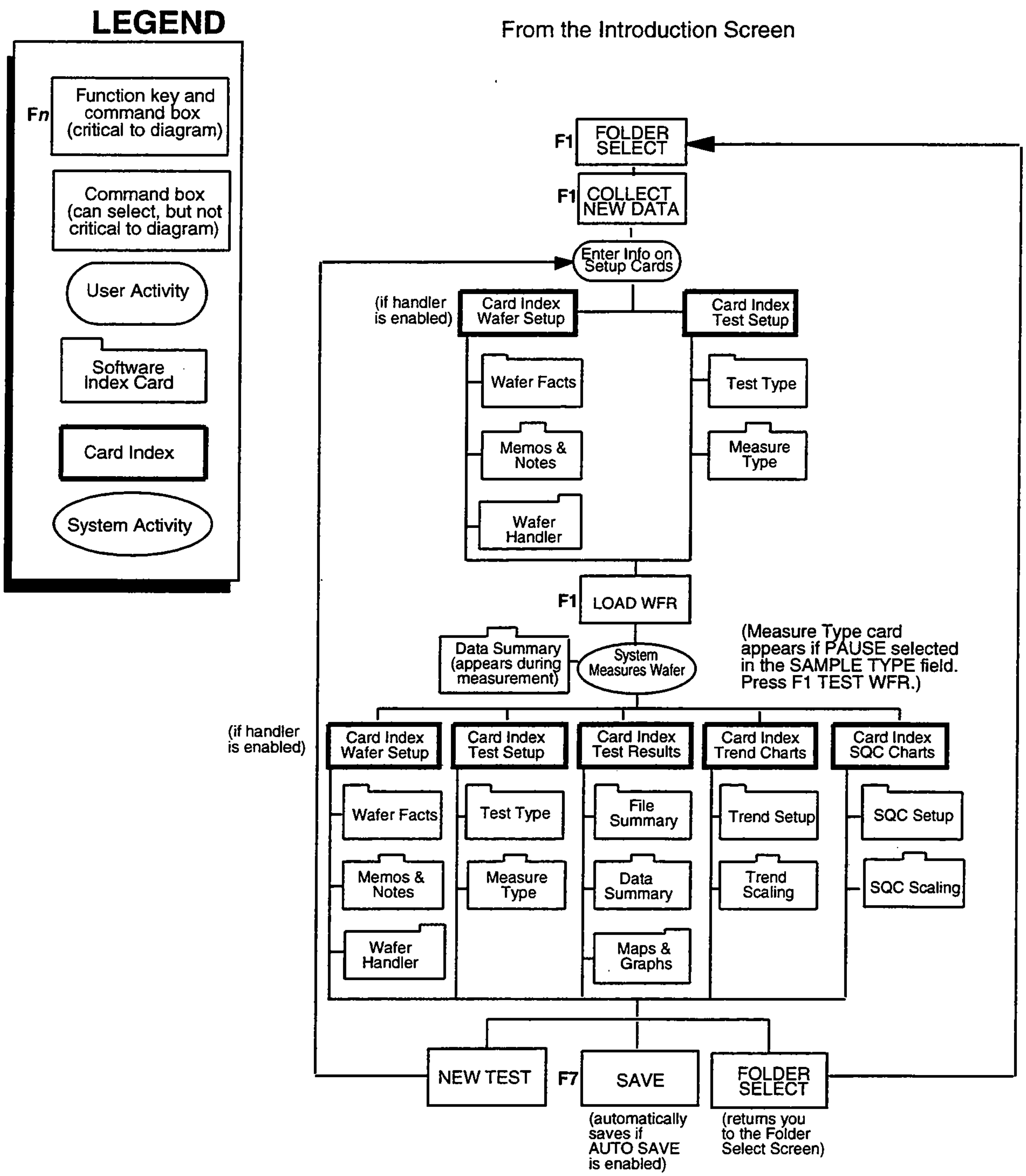


Figure 1-16: Collecting Data, Operations Mode

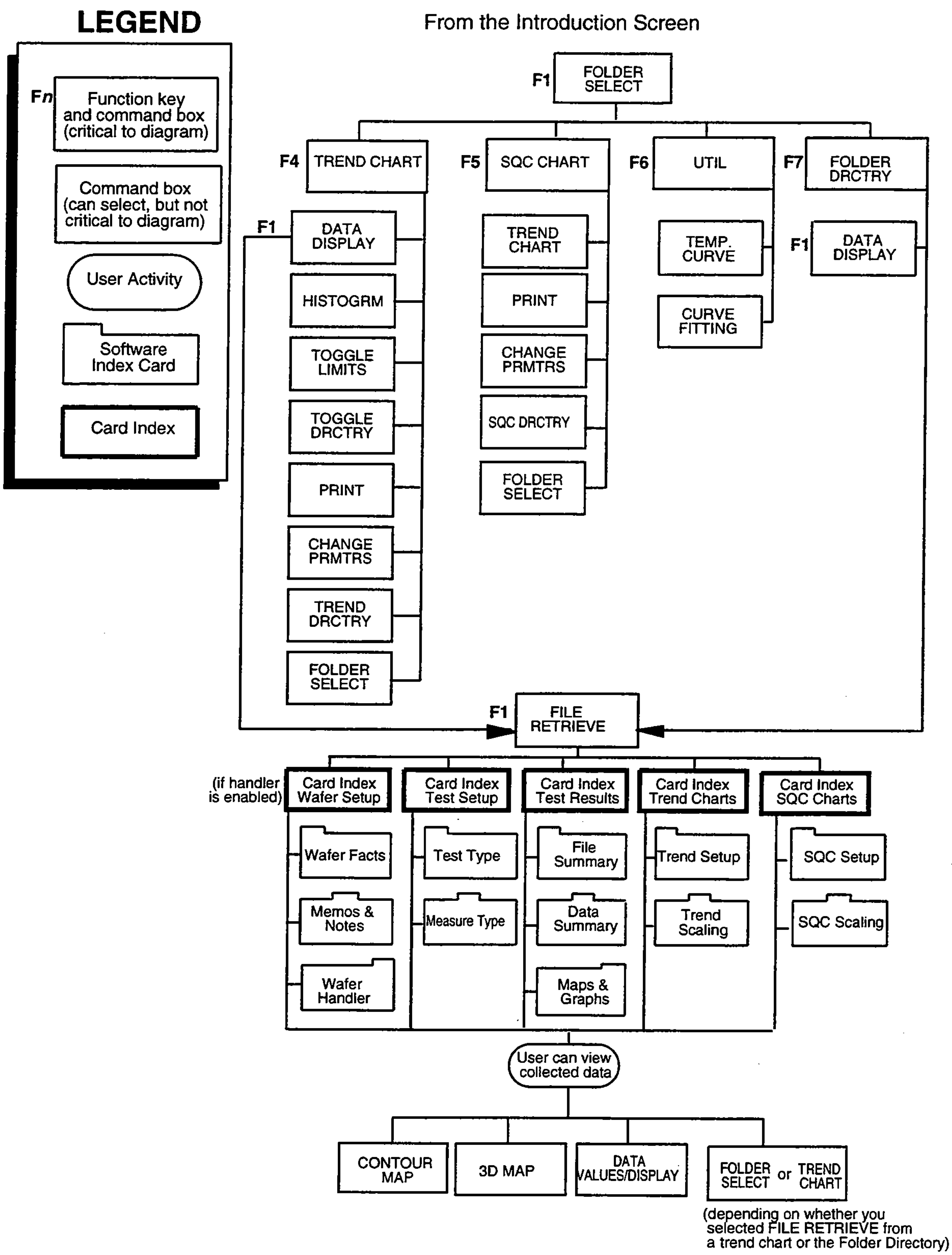


Figure 1-17: Retrieving Data, Operations Mode

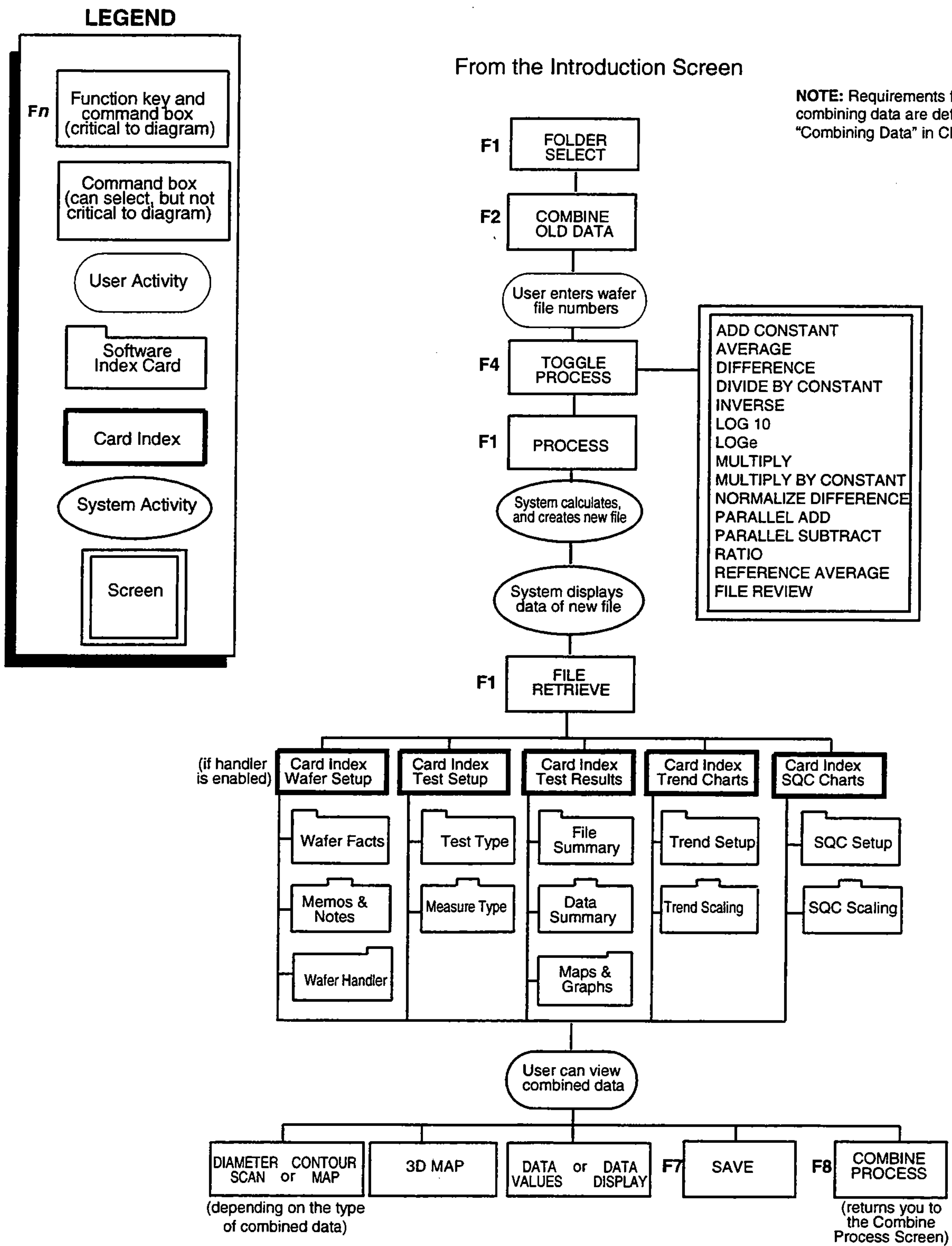


Figure 1-18: Combining Data, Operations Mode

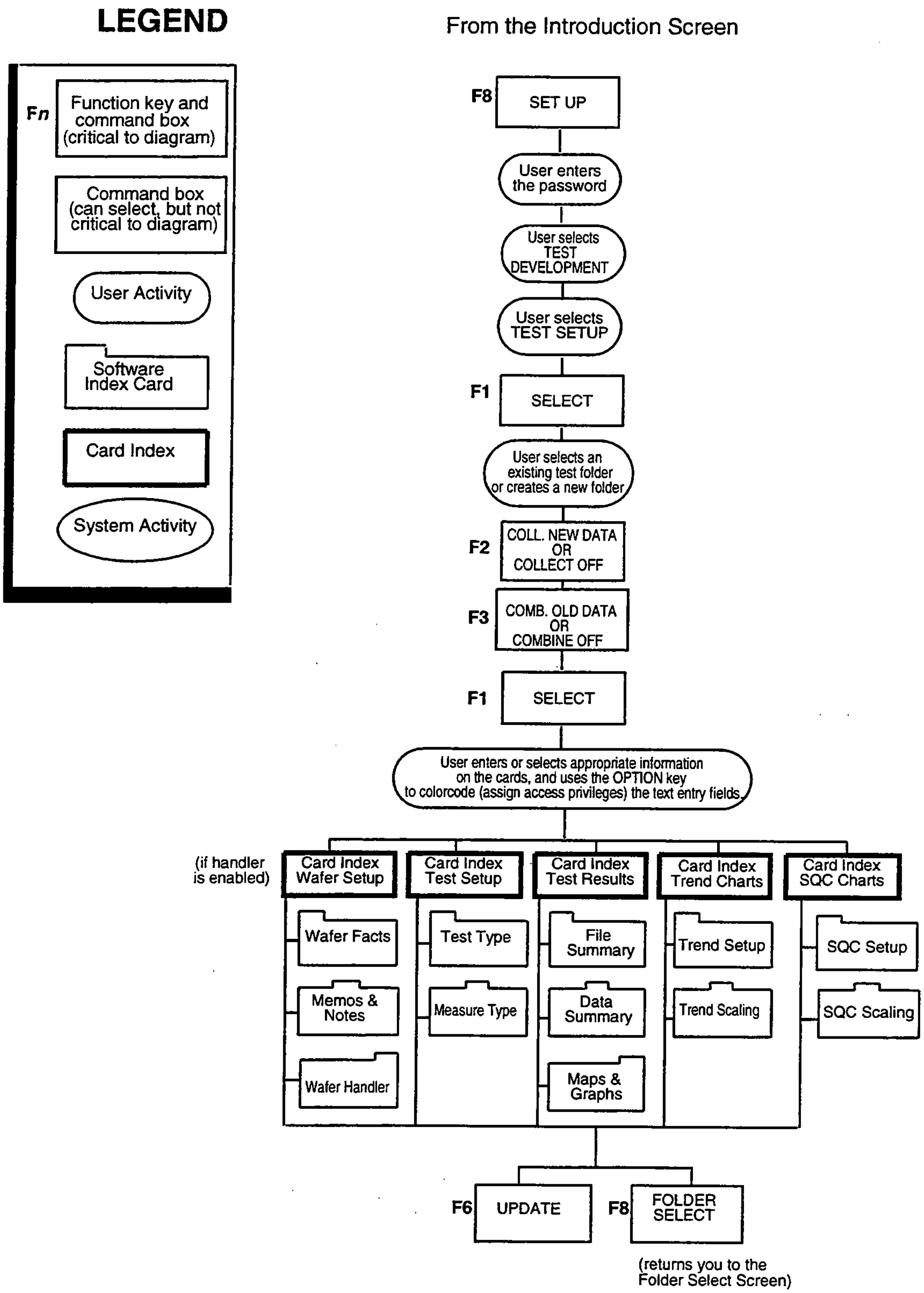


Figure 1-19: Setting Up a Test Folder, Engineering Mode

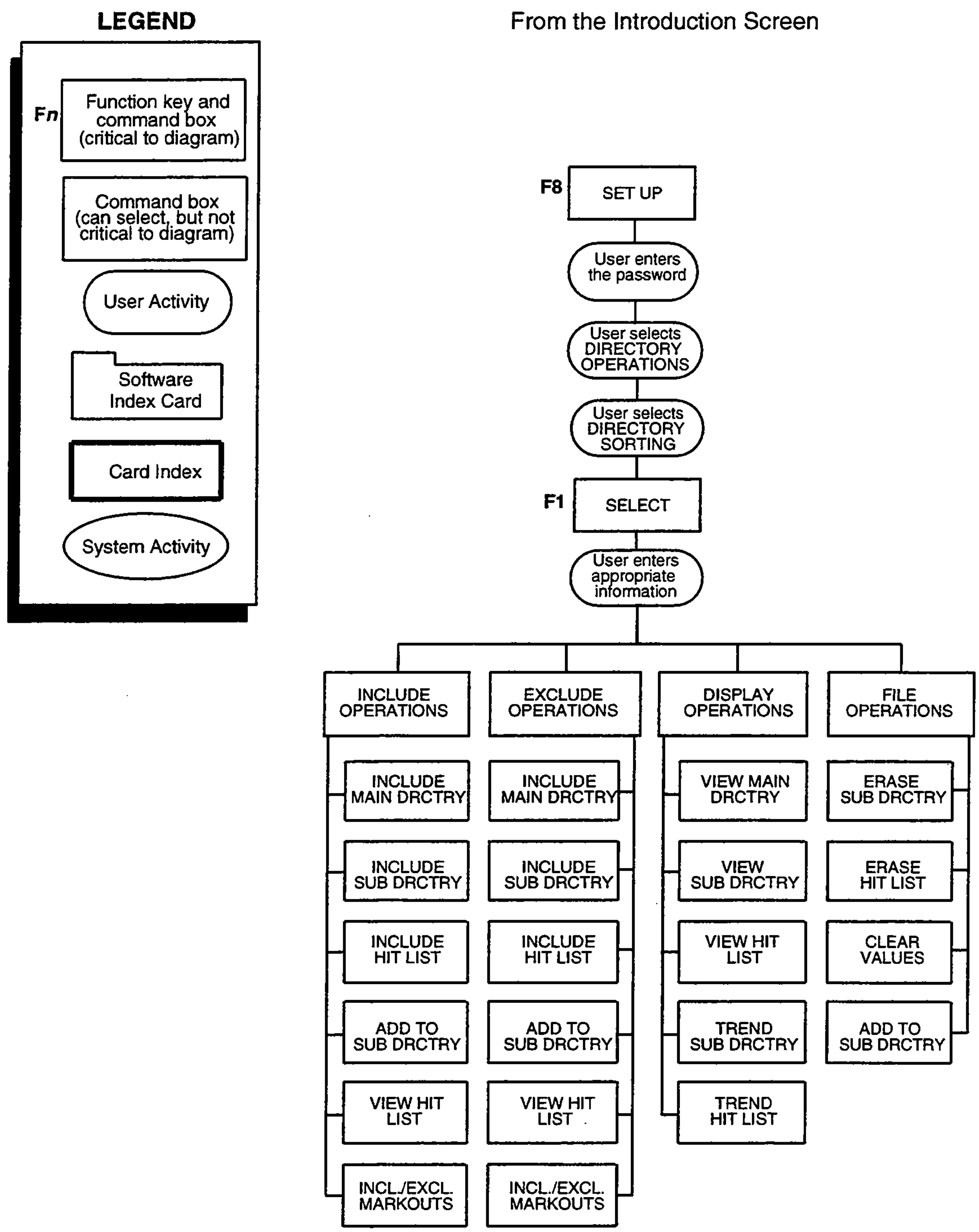


Figure 1-20: Directory Sorting, Engineering Mode

Chapter 2
Tutorial

Read This First

This tutorial, intended for the system operator, acquaints the first-time user with the basics of collecting data. Use the procedures in this chapter in conjunction with the tutorial cartridge that shipped with the system. Before beginning this tutorial, be sure to read the "Introduction" and "System Overview."

Typically, tests are set up in Engineering Mode and data is collected in Operations Mode (refer to Chapter 1 for information about Engineering and Operations Modes). However, the test parameters used in this tutorial have been predefined, enabling you to run simulated tests and collect randomly generated data.

After you have finished this tutorial, refer to other chapters in this manual to learn about additional features. Refer to the chapters, "Setting Up Standard Tests," and "Setting Up Advanced Tests" for information about test parameters and customizing your tests in Engineering Mode.

Collecting Data

If you have never used the system before, we recommend that you read each section in this tutorial in sequence. The section headings reflect the tasks you will accomplish. The section headings are

- Removing and Inserting Cartridges
- Enabling DEMO MODE
- Logging On to an Account
- Performing a Contour Map Test
- Retrieving Data from Files
- Generating a Trend Chart

The tutorial cartridge contains several test folders which include test setup information and generated data. The test folders include

- a Contour Map Test
- a Diameter Scan Test
- a Quick Test
- a Probe Qual Test (also called a Qual Procedure)

You can use these test folders to observe how different types of tests are set up, and to generate maps and charts from collected data.

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You can use these test folders to observe how different types of tests are set up, and to generate maps and charts from collected data.

Removing and Inserting Cartridges

This Tutorial assumes that the system is powered on, and that the Introduction Screen is displayed on the monitor (see Figure 2-1). If there already is a cartridge in the drive (other than the Tutorial Cartridge), remove it as described in steps 1 through 5 below. If the drive is empty, follow steps 6 through 11 to insert the Tutorial Cartridge. The Tutorial Cartridge is identified as such on the cartridge's front label. See Chapter 1 for an illustration of the components of the cartridge drive.

Note *In order for the system to boot up correctly, a properly initialized cartridge must be in the cartridge drive. However, when running tests from a hard drive account, as is the recommended procedure, it is not necessary to have a cartridge in the cartridge drive at all times.*

To remove a cartridge

1. Make sure that the Introduction or Account Select Screen is displayed.
2. Press the Stop button. The green LED will go off, and the amber LED will start to flash. The cartridge load lever will pop out from the front panel. *Do not move the cartridge load lever yet!*
3. Wait for the amber LED to stop flashing.
4. Move the cartridge load lever to the right until it is flush with the front panel. The cartridge will eject immediately.
5. Remove the cartridge from the drive, and place it in its protective case.

To insert a cartridge

6. Insert the cartridge into the disk drive with the top label facing up and the front label and write protect indicator facing you. On the 200-MB model, you will first need to open the cartridge door.
7. Push the cartridge into the drive until it is completely inside the front panel and comes to a stop. The cartridge load-lever will pop out from the front panel.
8. Move the cartridge load-lever to the left until it is flush with the front panel. The Stop button will pop out slightly from the front panel, and the amber LED will start to flash.
9. Wait for the green LED to turn on and the amber LED to go off. You are now ready to log on to the cartridge or a fixed-drive account.
10. From the Introduction Screen, press F3 (ACCOUNT SELECT). Select the cartridge drive account you want to access, and then press F1 (LOG ON ACCOUNT). The system displays disk information and asks you to press any key.
11. Press any key. The system displays the Introduction Screen.

Note *The message CARTRIDGE IS LOCKED appears at the bottom of most StatTrax screens. This message means that you cannot turn the cartridge drive off and remove the cartridge from that screen. Locking the cartridge prevents any **File Open** errors that might occur if the system attempts to write information to a cartridge when the drive is turned off.*

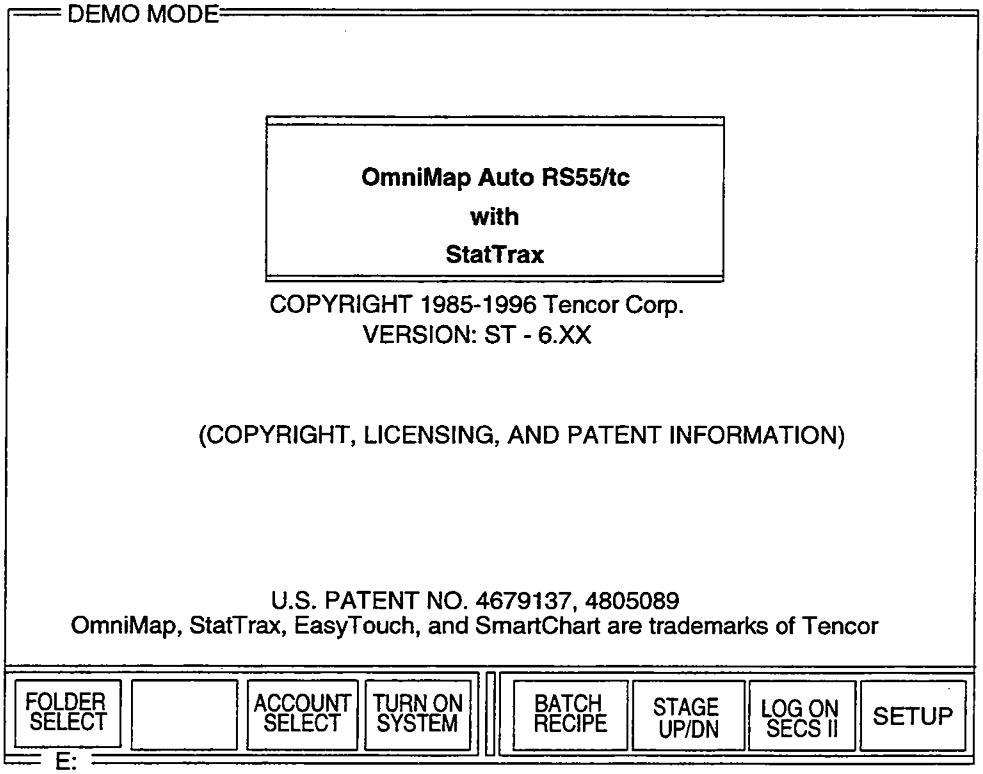

Figure 2-1: Introduction Screen

Enabling Demo Mode

If the screen saver is on, press any key to return to the StatTrax display. The computer monitor should display the StatTrax Introduction Screen. If any other screen is displayed, press the F8 key until the Introduction Screen appears. (In general, pressing F8 repeatedly will eventually return you to the Introduction Screen.)

This Tutorial assumes that you are operating the system in Demo Mode (as evidenced by the message DEMO MODE in the upper left corner of the screen) with the wafer handler disabled or off-line. (The handler automatically goes off-line when you place the system in Demo Mode.) The top right corner of the Introduction Screen should display the text HANDLER OFF LINE, or display no text at all.

Demo Mode is used only for the Tutorial session. It is never used to collect actual sheet resistance data. If the message DEMO MODE already appears in the left corner of the screen, go to the following section "Logging On to an Account." If the message DEMO MODE does not appear in the left corner of the screen, follow these instructions to enable DEMO MODE.

To enable DEMO Mode

1. From the Introduction Screen, press F4 (TURN ON DEMO).

   The following message appears:

```
WARNING . . . MEASUREMENT CAPABILITY WILL BE DISABLED!
                DO YOU WANT TO PROCEED?
```

2. Select YES by pressing the F1 function key. (Pressing F8 selects NO.)

   The words DEMO MODE appear at the upper left corner of the Introduction Screen.

Logging On to an Account

Before you can run the Tutorial program, you must log on to the account in which it is stored.

To log on to an account

1. From the Introduction Screen, press F3 (ACCOUNT SELECT).

   The Account Select Screen appears. See Figure 2-2.

Note *The screens displayed in this manual serve as examples only. Your displays will vary depending upon the names assigned to your system, accounts, cabinets, drawers, and folders and the entries made in editable text fields.*

2. Use the computer's up and down arrow keys or trackball to highlight the Tutorial account.
3. Press F1 (LOG ON ACCOUNT).

   The system will log on to the highlighted account and report the percent of the account already used.
4. Press any key to return to the Introduction Screen.

Now that you are logged on to the Tutorial account, you are ready to start collecting data. Proceed to "Performing a Contour Map Test."

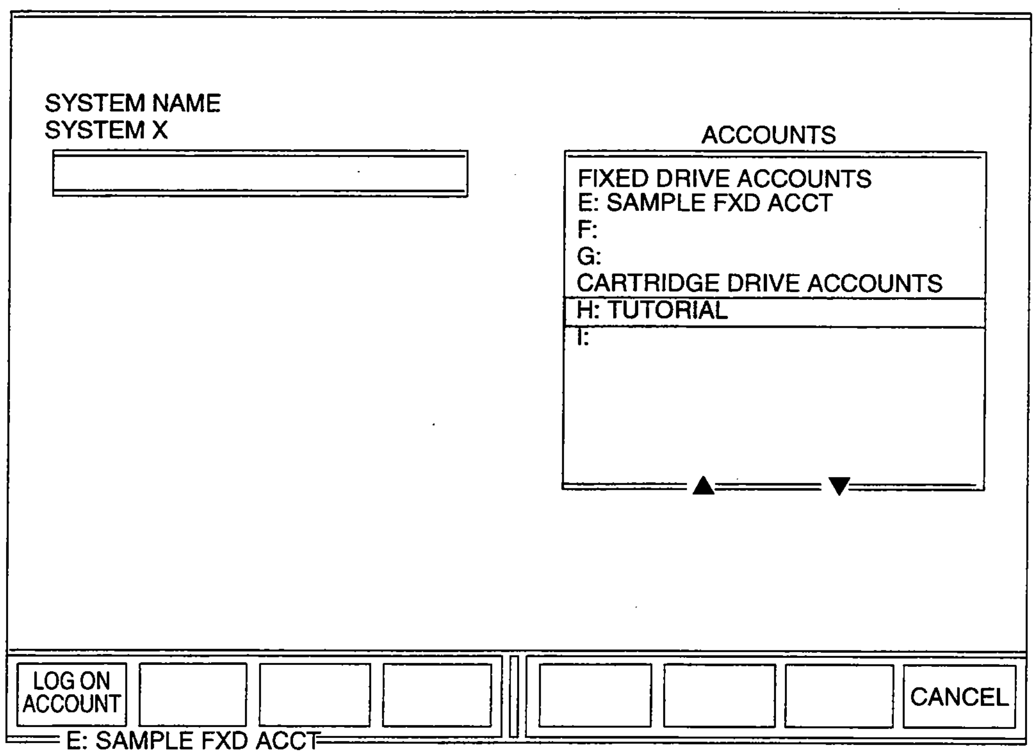

Figure 2-2: Account Select Screen

Performing a Contour Map Test

Contour map tests are useful for making statistical comparisons between wafers processed under different conditions. A Contour Map uses values collected in the test to display the variation of parameters such as sheet resistance.

First, you will generate a Contour Map. Then, you will learn different ways of viewing the data you have collected.

Important *Before performing this tutorial, make sure the parameters in the General System Data Screen of your system match those shown in Figure 2-3. To access the General System Data Screen*

1. *Press F8 (SETUP). The system displays the Main Engineering Menu. (Typically, pressing F8 (SETUP) prompts the system to display a message asking you for a password. The password is usually assigned by the process engineer. For this tutorial, the Tutorial account should have no assigned password.*
2. *Select SYSTEM OPERATION from the MENU list, and GENERAL SYSTEM data from the ITEM list.*
3. *Press F1 (SELECT), and edit the screen to match Figure 2-3.*
4. *Write down the current parameters in the General System Data Screen in case you change them for the tutorial and later need to re-enter the original parameters.*

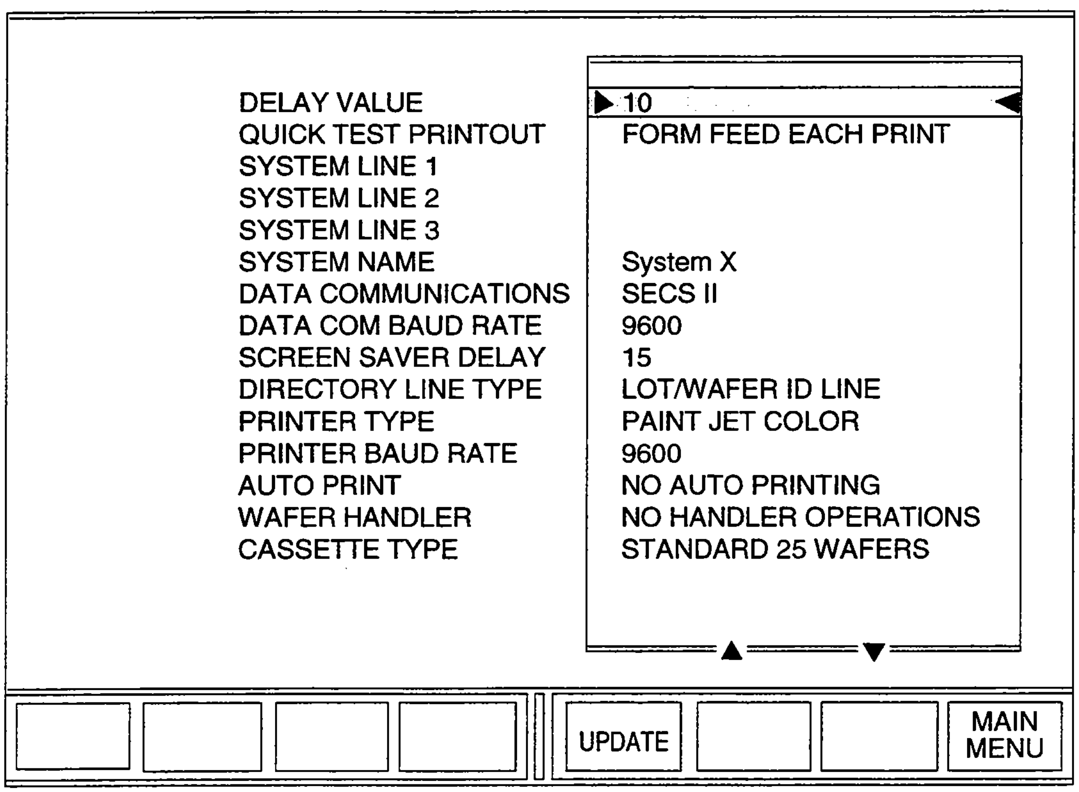

Figure 2-3: General System Data Setup for the Tutorial

To create a Contour Map

1. From the StatTrax Introduction Screen, press F1 (FOLDER SELECT).

   The Folder Select Screen appears.

2. Press the CONTOUR MAP test folder. You can either use the trackball or the arrow keys on the keyboard to select a cabinet, drawer, and folder.

3. Press F1 (COLLECT NEW DATA).

   The Wafer Facts Index Card appears with the title of this demonstration, "A Contour Map Demonstration Test," displayed in the TITLE field.

Note *Fields on the index cards are color coded. The engineer determines the color coding for each field in a test when he or she sets up the tests from Engineering Mode:*

- ❑ *A red field means that you must enter a Wafer ID before each test.*
- ❑ *Orange Lot ID and Operator fields mean that you must enter the appropriate Lot ID and Operator name (or initials) at least once for a series of wafer tests. (This entry can be circumvented by selecting the field and pressing the Enter key twice.)*
- ❑ *A blue entry field means that you can enter the information, but it is not mandatory.*

---

4. Type a wafer ID in the WAFER ID field, and press Enter.

5. Select the LOT ID field, type a lot ID (the ID can be a name or initials) and press Enter. (If you do not want to enter an ID, or if you want to accept the ID currently displayed in this field, press Enter twice.)

6. Now select the OPERATOR field, and press Enter twice.

Important *Before you can run a test, you must edit all required entry fields (red and orange) to blue.*

---

7. Select Test Setup from the Card Index at the left of the screen by pressing the PgDn key. The Test Type Index Card appears.

   Note the test parameter fields on this card. Typically, these are the fields for which the engineer defines what type of test he or she wants to run, as well as other attributes of the test. The engineer defines these test parameters in Engineering Mode, but you can view these parameters and change them temporarily in Operations Mode.

   For this Tutorial, you will only view these parameters in Operations Mode.

8. Select the Measure Type Index Card by selecting the index tab labelled, Measure Type (the shaded tab to the right of the Test Type index tab). The Measure Type Index Card appears.

   Typically, the engineer uses this card to select

   - A routine for determining measurement current for a test wafer of a given sheet resistance
   - A probe tip spacing value
   - A configuration for measuring the test wafer

9. Press F1 (LOAD WFR).

   If you were actually testing a wafer, you would now place the wafer on the stage. (If the wafer handler was set for operation, the wafer handler would automatically place the wafer on the stage.)

   The Contour Map Demonstration Test takes a few seconds. After the system completes the test, the Data Summary Index Card appears.

Important *Because these test data are randomly generated, some values occasionally exceed the engineer-specified warning limits. If this happens, acknowledge the message by pressing any key.*

---

10. Press F1 (CONTOUR MAP) to view the data as a Contour Map. A Contour Map of the data appears. The heavy contour line of a Contour Map represents the mean sheet resistance, while the lighter contour lines differ from the mean in increments of 1%. The symbols + and - signify the location of measurement points with resistance values greater or less than the mean sheet resistance.
11. Press F8 (EXIT) to return to the Data Summary Index Card.
12. Press F2 (3D MAP) to view the data as a 3D Map.
13. Press F8 (EXIT) to return to the Data Summary Index Card.
14. Press F5 (DATA VALUES) to see a site-by-site listing of measurement values from the Contour Map Demonstration Test.
15. Return to the Data Summary Screen by pressing F8 (RETURN).

Now, you will collect more data to be viewed later in a Trend Chart.

1. Press F6 (NEW TEST).

   The Wafer Facts Index Card for the same test folder appears.

2. Type a wafer ID in the WAFER ID field, and press Enter. (Or, accept the wafer ID you had previously entered by pressing Enter twice.)
3. Press F1 (LOAD WFR).
4. If the screen displays a message that the mean value exceeds the warning limit, press any key. (This message can be disregarded during the tutorial.) After the system completes the test, the Data Summary Screen appears.

   Although this tutorial is set up so the system automatically saves the data, tests can be set up so that you must press F7 (SAVE) after each test is completed.

You have finished generating a Contour Map, viewing the data as a 3D Map, and displaying a list of measurement values for each site. Before you display data as a Trend Chart, perform the following task for displaying data from existing files.

Retrieving Data From a File

Now that you have collected files of data, you might want to retrieve and review the information in the files. At this point, the Data Summary Screen should be displayed on the screen. If it is not, follow the instructions in "Performing a Contour Map Test" again, or locate the Data Summary Screen on your own.

To retrieve data from files

1. From the Data Summary Screen, press F8 (FOLDER SELECT). The Folder Select Screen appears.
2. Press F7 (FOLDER DRCTRY). The Folder Directory Screen appears.
3. Scroll through the files using the Home, PgUp, PgDn, ↑, ↓, or End keys on the keyboard, or by using the trackball to select the ▲ or ▼.
4. Press F4 (TOGGLE DRCTRY) to view individual file information such as the mean and standard deviation values and process date. Continue toggling to view different information.
5. Select a file, and then press F1 (DATA DISPLAY).

   Your folder directory contains only Contour Map test folders, so a Contour Map appears after you press F1 (DATA DISPLAY). (Depending on the test type in the file you select, data can appear as a Diameter Scan, Quick Test, or Probe Qual Test.)
6. Press F8 (FOLDER DRCTRY) to return to the Folder Directory Screen.
7. Press F8 (FOLDER SELECT) to return to the Folder Select Screen.

Refer to Chapter 7 for additional information about viewing data.

Generating a Trend Chart

Now that you have collected Contour Map data, and learned how to retrieve the data you've collected, your next step is to generate a Trend Chart. With the exception of the data you have collected during this tutorial, most of the data you will see in the Trend Chart has already been collected for you.

To display a Trend Chart

1. From the Folder Select Screen, select the Contour Map folder.
2. Press F4 (TREND CHART).
3. A Trend Chart for the Contour Map data you have collected appears (see Figure 2-4). Table 2-1 briefly describes each command box available from the Trend Chart Screen.

   Notice the position of the long vertical bar. It is centered on the average value from the last wafer test. The error bars above and below each point represent the standard deviation of the data points that produced the average value.

Refer to Chapter 7 for additional information about analyzing data.

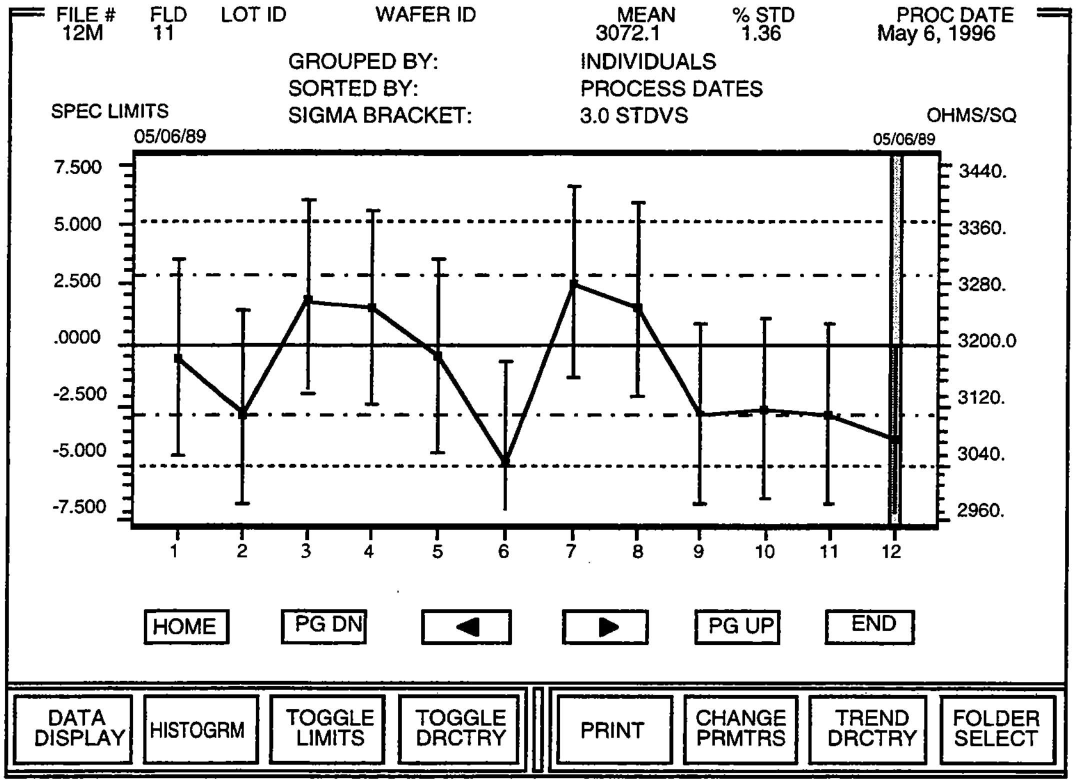

Figure 2-4: Trend Chart Screen

***Table 2-1:** Command Box Functions in Trend Chart Screen*

Command Box	Function
F1 (DATA DISPLAY)	Displays the test data for the selected file on the Trend Chart.
F2 (HISTOGRM)	Displays the collected data for all wafers in the Trend Chart directory in histogram form.
F3 (TOGGLE LIMITS)	Toggles the trend display limits between full scale, specification limits, and user-defined limits.
F4 (TOGGLE DRCTRY)	Toggles the file and test information at the top of the screen.
F5 (PRINT)	Prints a copy of the Trend Chart.
F6 (CHANGE PRMTRS)	Displays the Trend Setup Index Card.
F7 (TREND DRCTRY)	Displays the files shown on the Trend Chart as a directory listing, with each file occupying a single line.
F8 (FOLDER SELECT)	Returns to the Folder Select Screen.

Continue the tutorial by performing the other predefined (already set up) tests on the Tutorial cartridge using the same basic method you have just learned for generating a Contour Map. Other predefined tests include a Diameter Scan Test, a Quick Test, and a Probe Qualification (Probe Qual) Test. Practice retrieving the new data files and generating a Trend Chart of the new data. When you are finished with this tutorial, refer to the Table of Contents or Index of this manual to locate information about other features of the system.

Chapter 3
Setting Up the System

Read This First

This chapter is intended for the process engineer. Having read the introductory material presented in the previous chapters, you have a basic understanding of how StatTrax works. However, before you begin setting up tests on the system, you must first set up the user account you'll be working with, configure the system's operating parameters, and bring the wafer handler online.

You should also routinely run a Probe Qual test to assess the performance of the probe head and condition the probe head, if necessary, to ensure that it measures accurately. If you have just changed the probe head, you need to edit the probe data in StatTrax before you proceed with setting up your tests.

This chapter describes the following procedures for setting up your system:

- Selecting and logging on to a user account
- Initializing, naming, and password-protecting the account
- Establishing system generation parameters
- Bringing the wafer handler online
- Editing probe data
- Performing a Probe Qual test
- Conditioning the probe head

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User Accounts

As mentioned in Chapter 1, the User Account feature creates distinct user accounts on both the internal fixed drive and the removable cartridges. These accounts can be individually password-protected, allowing several users to work on the same system without risk to their test setups and data.

The following sections provide instructions for initializing, naming, and password-protecting an account. Chapter 4 and Chapter 5 describe how to set up tests in an account, while Chapter 8 contains instructions for managing files stored in existing accounts.

Selecting and Logging On to a User Account

If the screen saver is on, press any key to return to the StatTrax display. The computer monitor should display the StatTrax Introduction Screen. If any other screen is displayed, press the F8 key until the Introduction Screen appears.

To select and log on to a user account

1. Press F3 (ACCOUNT SELECT) to display the Account Select Screen depicted in Figure 3-1.

   In this figure, the system and account name fields are empty because the system and accounts have not yet been named.

Note *The screens displayed in this manual serve as examples only. Displays will vary depending upon the names assigned to the system, accounts, cabinets, drawers, and folders and the entries made in editable text fields.*

2. Highlight the account you want to log on to.
3. Press F1 (LOG ON ACCOUNT).

   The system logs on to the highlighted account and reports the percent of the account already used. If the system reports that the account is 75% or more full, back up the data, and re-initialize the account. (See Chapter 8.)
4. Press any key to return to the Introduction Screen.

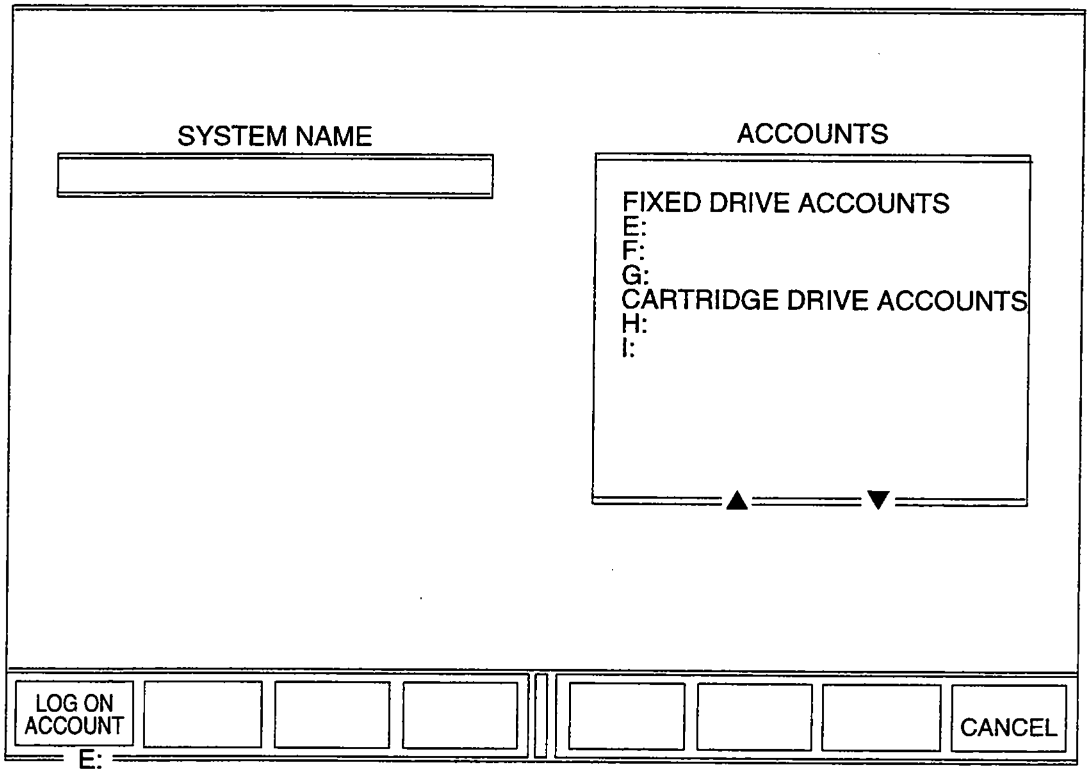

Figure 3-1: Account Select Screen

The Account Ops Menu

To access the Account Ops Menu from the Introduction Screen

1. From the Introduction Screen, press F8 (SET UP).

   The system asks you to enter the current account password.

2. Press Enter.

   The orange-bordered Main Engineering Menu appears (Figure 3-2).

   Because our example is a new account, it does not have a password. If the account had already been assigned a password, you would have to type in the password before pressing the Enter key.

3. From the Main Engineering Menu, select ACCOUNT OPS in the Menu list on the left.

   The Account Ops Menu appears with EDIT ACCOUNT ID highlighted in the ITEM listing.

Account Preparation Items in the Account Ops Menu

Several items in the Account Ops Menu are used to prepare an account. These items, described in the Table 3-1, include

- EDIT ACCOUNT ID
- INITIALIZE ACCOUNT
- SET PASSWORD

The following sections provide instructions for using these items. Refer to "The Account Ops Menu, File Management Items," in Chapter 8, for information about the other items in this menu.

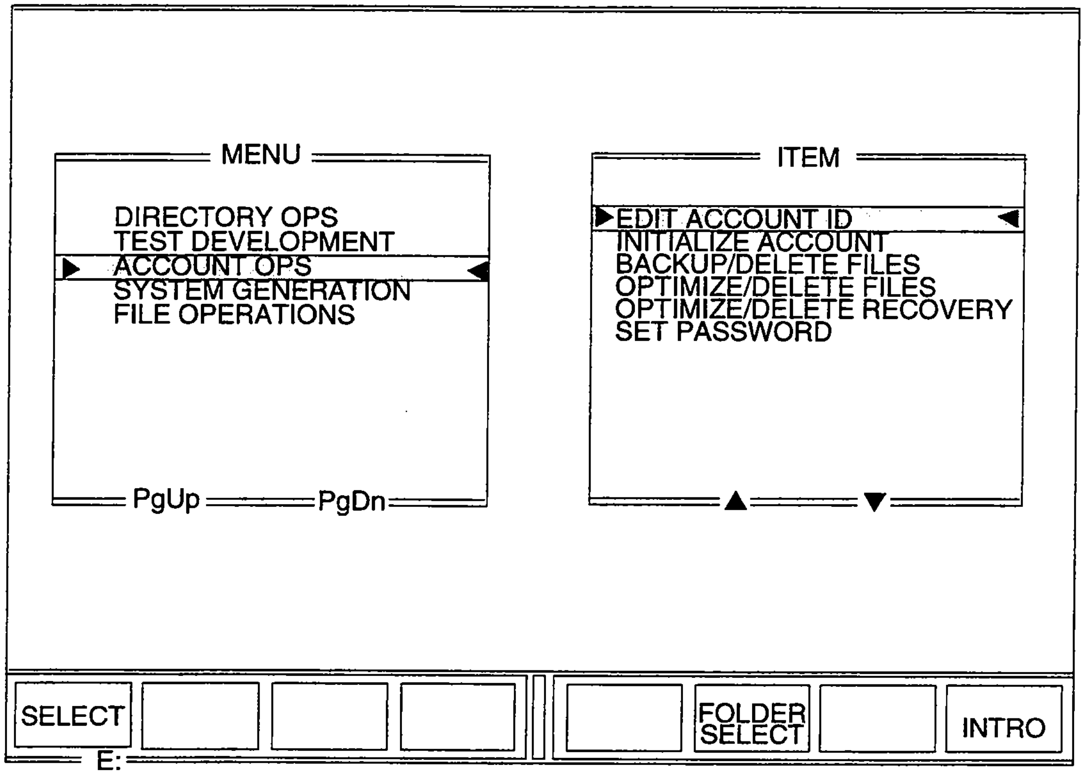

Figure 3-2: Main Engineering Menu, Account Ops

Table 3-1: Account Preparation Items in the Account Ops Menu

Item	Function
EDIT ACCOUNT ID	Used to assign a name to the active (currently logged-on) account (The name of the active account is displayed in the lower left corner of the screen.)
INITIALIZE ACCOUNT	Used to initialize the active account. You need only initialize an account if it has not previously been initialized or if you wish to remove the data stored in it.
SET PASSWORD	Used to password-protect an account, thus preventing unauthorized access to data in the account.

Initializing an Account

StatTrax provides you with two initialization procedures. You can

- Temporarily copy test setups from the active account to the hard drive, initialize the account, and then copy the test setups back to the account.
- Initialize the active account, permanently removing test setups and data.

To begin the initialization

1. From the Main Engineering Menu, highlight ACCOUNT OPS and INITIALIZE ACCOUNT.
2. Press F1 (SELECT) to display the Account Initialize Screen (Figure 3-3).

WARNING ***Initializing the account will remove all test data stored in it.*** *If you do not want to initialize the currently active account (identified at the bottom left of the screen), press F8 (MAIN MENU). You can then return to the Introduction Screen and select a different account.*

---

3. To retain current test setups, follow step 4, otherwise go directly to step 5.

WARNING *If you do not select F4 (SAVE CONF'S) as described in step 4, your test setups, account name, and password will be erased.*

---

4. Select SAVE CONF'S (F4).

   The system transfers the test setups (configurations) from the active account to the hard drive. When the system displays the message `TRANSFER COMPLETED`, go to step 5.

5. Press F1 (CONTINUE).

   The system initializes the active account. (If you selected the SAVE CONF'S option, the system will initialize the account and then transfer the test setups from the hard drive back to the account.)

6. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

Typically, after initializing an account, you would name the account. Refer to the following section, "Naming an Account."

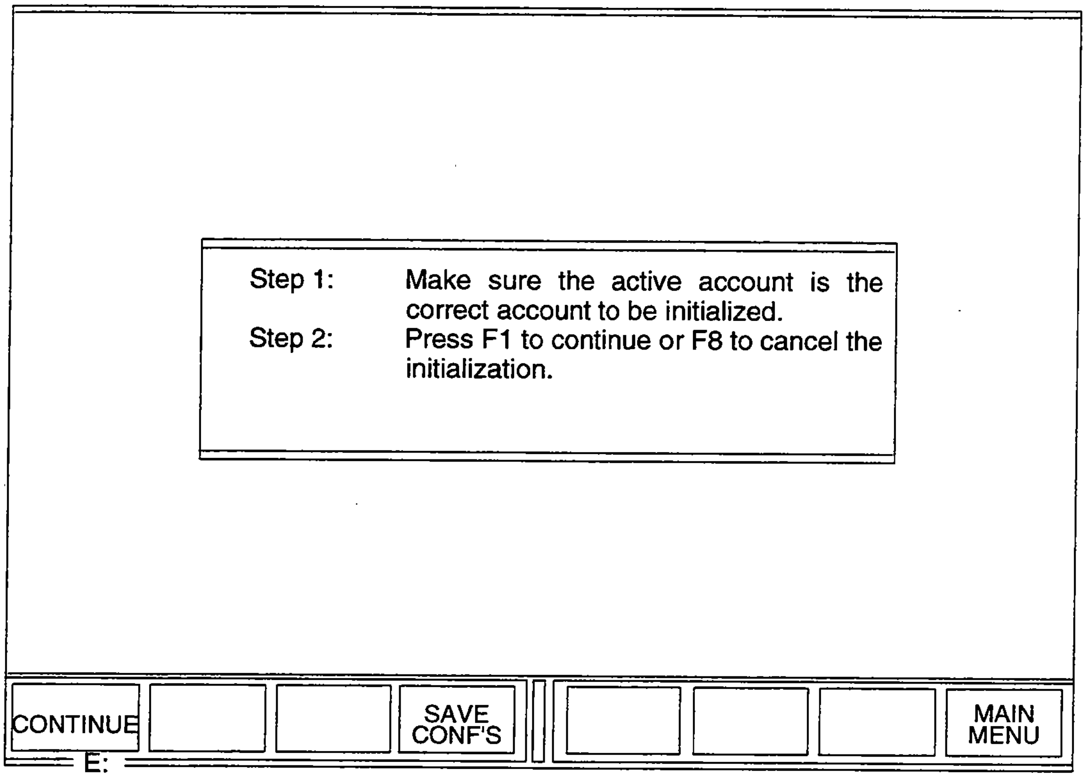

Figure 3-3: Initialize Account Screen

Naming an Account

You name an account to identify the account's owner and/or function. You name an account by assigning it an *Account ID*. This ID will subsequently be displayed in the lower left corner of the StatTrax screens following the colon (see Figure 3-4).

To assign an Account ID to the active (currently logged-on) account

1. From the Main Engineering Menu, highlight ACCOUNT OPS and EDIT ACCOUNT ID.
2. Press (F1) SELECT to display the Account ID Screen (Figure 3-4).
3. Type the account name of your choice into the ACCOUNT ID field, and press (F5) UPDATE to record the name.
4. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

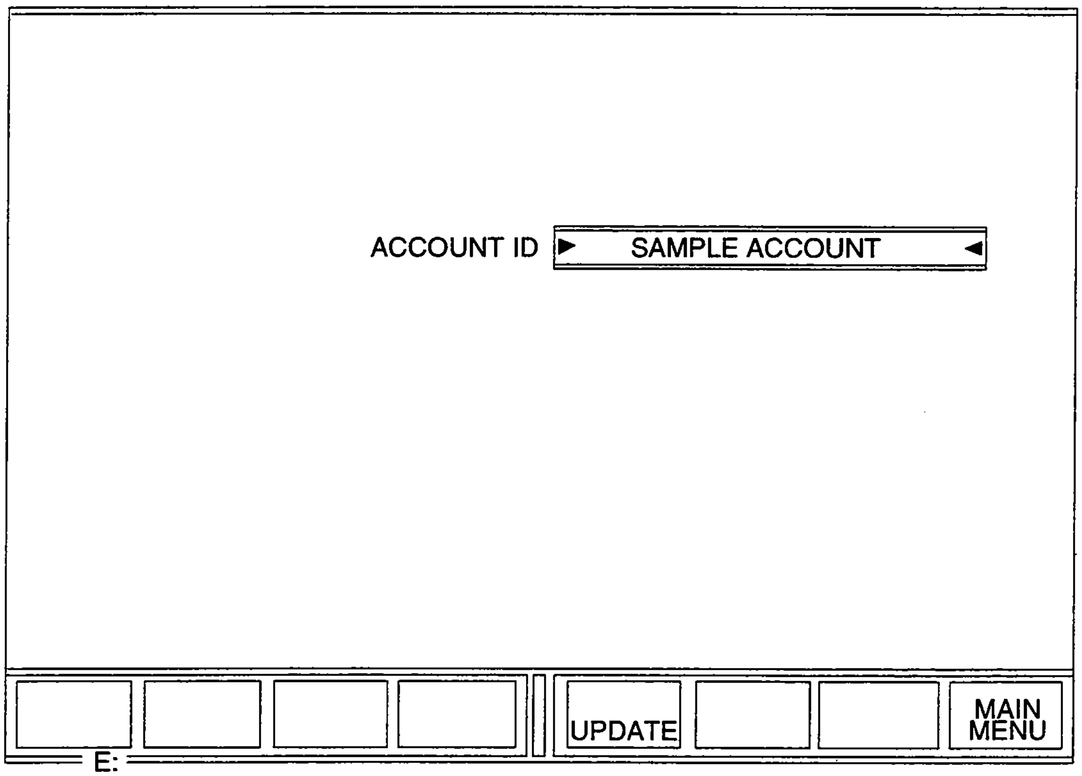

Figure 3-4: Account ID Screen

Password-Protecting an Account

Each account can have its own password. Use any alphanumeric combination up to 20 characters in length, keeping in mind that the system distinguishes between upper- and lowercase characters.

To password-protect an account

1. From the Main Engineering Menu, highlight ACCOUNT OPS and SET PASSWORD.
2. Press F1 (SELECT) to display the Password Entry Screen (Figure 3-5).
3. Type in the current password, and press Enter. (For a new or unprotected account, just press Enter.)

   If you make an error when entering the password in steps 3 or 5, the system immediately returns you to the Main Engineering Menu.
4. At the prompt, type in the new password, and press Enter.
5. At the prompt, type in the new password again, and press Enter.

   The message `PASSWORD VERIFIED. UPDATE OR EXIT` appears on the screen.
6. To save the new password, press F5 (UPDATE).

   (If you decide not to save the new password, go directly to the next step without selecting UPDATE.)
7. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

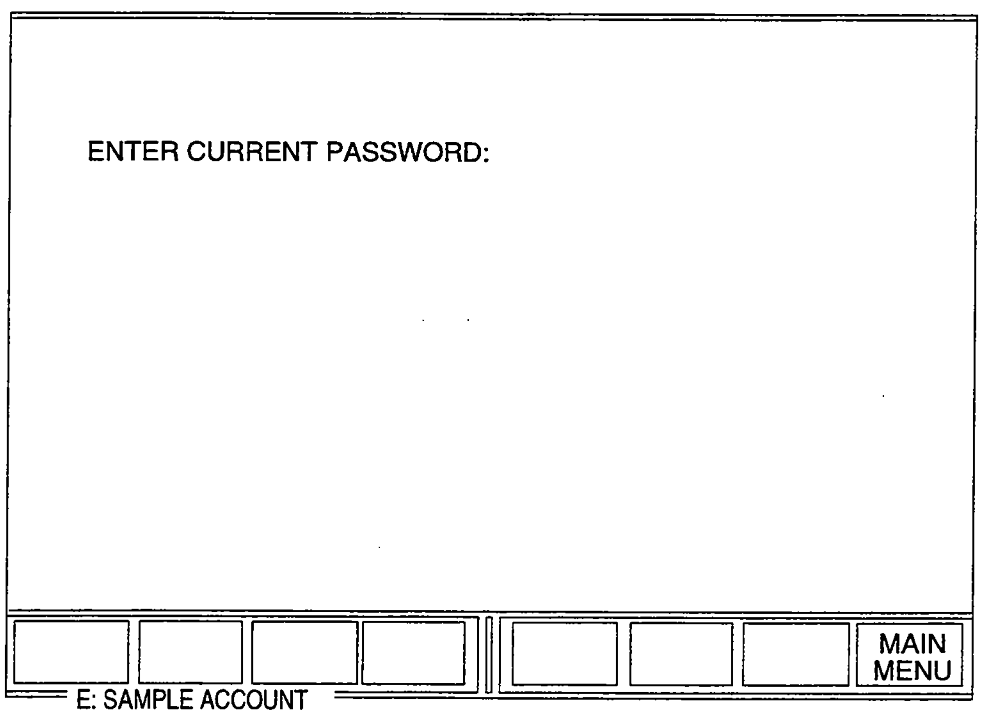

Figure 3-5: Password Entry Screen

The System Generation Menu

The System Generation Menu contains items that direct system and data upload operations. The items are

- SETTING DATE & TIME
- GENERAL SYSTEM PARAMETERS
- SECS-II PARAMETERS

To access the System Generation Menu

1. From the Main Engineering Menu, select SYSTEM GENERATION in the MENU list on the left.

   The items shown in Figure 3-6 appear. Table 3-2 describes them.

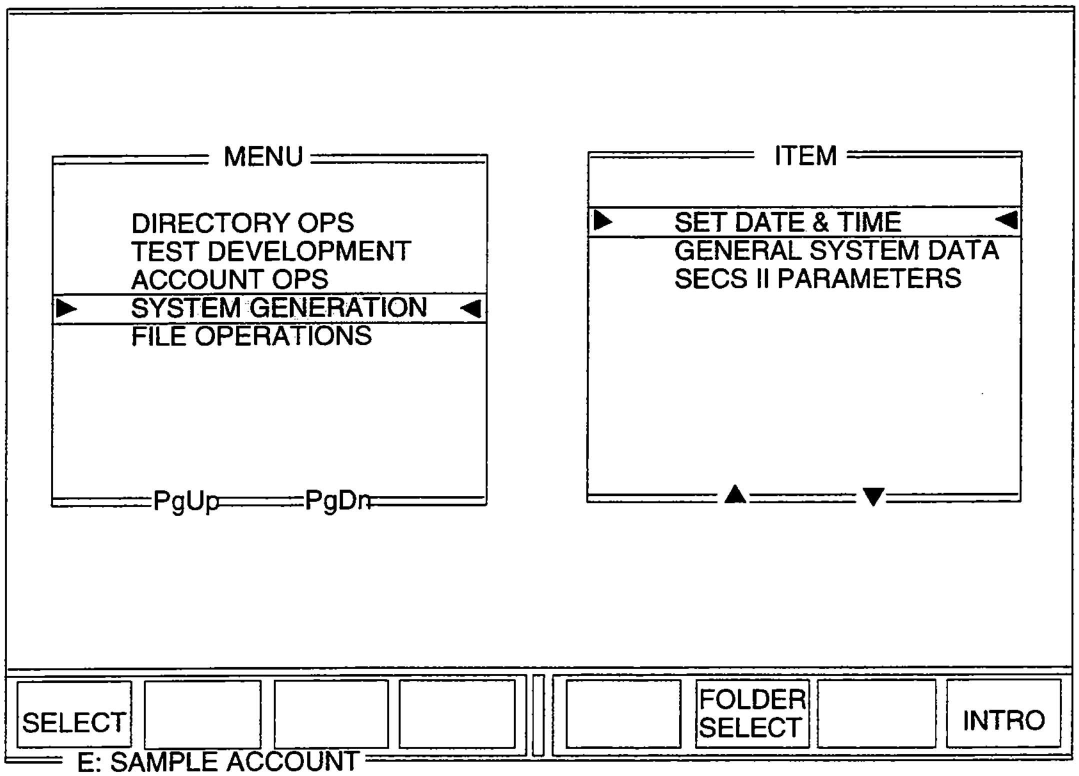

Figure 3-6: Main Engineering Menu, System Generation

Table 3-2: Items in the System Generation Menu

Item	Function
SET DATE & TIME	Used to set the system clock to the correct date and time. *The system assigns a date and time to wafer tests based on the settings in this screen.* This date and time appears at the top of each test page printed. (Refer to the section "Setting the Data and Time," in this chapter.)
GENERAL SYSTEM DATA	Used to set system I.D., system delays, and printer and wafer handler settings. (Refer to the section "Setting General System Parameters," in this chapter.)
SECS-II PARAMETERS	Used to set up data transmission parameters. (Refer to the section "Setting SECS-II Parameters," in this chapter.)

Setting the Date and Time

The Set Date & Time item is available after you choose System Generation from the Engineering Main Menu. This feature enables you to set the system clock to the correct date and time. The system assigns a date and time to wafer tests based on the settings in the Set Date & Time Screen.

To set the date and time

1. From the Main Engineering Menu, highlight SYSTEM GENERATION and SET DATE & TIME.
2. Press F1 (SELECT) to display the Set Date & Time Screen (Figure 3-7).
3. Press F3 (EDIT DATE).

   The command boxes display a new set of functions.
4. Toggle the keys that represent the month, day, and year until the correct date is displayed.
5. Press F1 (ACCEPT) to set the date.
6. Press F8 (RETURN).
7. Press F4 (EDIT TIME).

   The command boxes display a new set of functions.
8. Toggle the keys that represent the hour and minute until the correct time is displayed.
9. Press F1 (ACCEPT) to set the time.
10. Press F8 (RETURN).
11. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

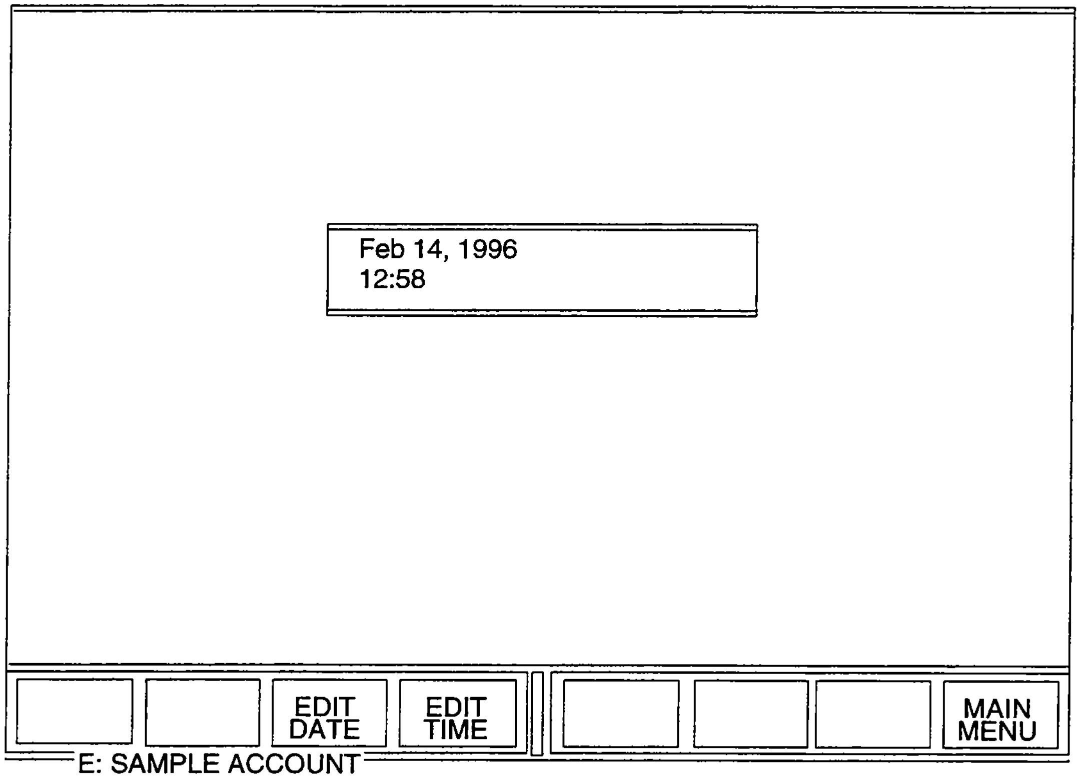

Figure 3-7: Set Date & Time Screen

Setting General System Parameters

Use this screen to enter a system ID, system delays, and settings for the printer and wafer handler. The parameters in the General System Data Screen were set up when your system was installed. You can change the parameters displayed on this screen at any time.

To change the General System Data parameters

1. From the Main Engineering Menu, highlight SYSTEM GENERATION and GENERAL SYSTEM DATA.
2. Press F1 (SELECT) to display the General System Data Screen (Figure 3-8).
3. Referring to Table 3-3, change the parameter settings by either typing in the value or pressing (F4) TOGGLE ACTIVE as appropriate.
4. Press F5 (UPDATE) to save these changes.
5. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

DELAY VALUE	▶ 5 ◀
QUICK TEST PRINTOUT	FORM FEED EACH PRINT
SYSTEM LINE 1	Applications Lab
SYSTEM LINE 2	5432A1
SYSTEM LINE 3	
SYSTEM NAME	System X
DATA COMMUNICATIONS	SECS II
DATA COM BAUD RATE	9600
SCREEN SAVER DELAY	40
DIRECTORY LINE TYPE	TITLE LINE
PRINTER TYPE	PAINT JET MONOCHROME
PRINTER BAUD RATE	9600
AUTO PRINT	AUTO PRINTING *ON*
WAFER HANDLER	SET FOR OPERATIONS
WAFER CASSETTE TYPE	STANDARD 25 WAFERS
ASCII DELIMITER	I: Cr + Lf P: PMX Rec

UPDATE | MAIN MENU

E: SAMPLE ACCOUNT

Figure 3-8: General System Data Screen

Table 3-3: General System Data Parameters

Parameter	Description
DELAY VALUE	Defines the system's response rate to selections made with the keyboard Enter a value between 0 and 99. Decrease this value for a faster response; increase it for a slower response. The default setting is 25.
QUICK TEST PRINTOUT	Defines how often the system will form feed when printing out Quick Test data (This option applies only to Quick Test data printouts; all other data listings are automatically form fed at the end of each printout.) The two choices are Form Feed Each Print and Form Feed on Exiting. The default setting is Form Feed Each Print.
SYSTEM LINES 1-3	These three lines, each 20 characters long, identify the test system. They appear at the top of every printout.
SYSTEM NAME	A common name shared by accounts generated on the system. This name is displayed at the top of printouts and in the Account Select Screen.
DATA COMMUNICATIONS	Selects RS232, SECS-II, or NONE.
DATA COM BAUD RATE	Selects any of the values from 150 through 9600 baud. The default setting is 9600.
SCREEN SAVER DELAY	After the specified number of minutes, following the last keystroke, the system returns the display to the Screen Saver. Enter any value between 1 and 99999. In general, you should set the screen saver delay to a value between 25 and 30 minutes.
DIRECTORY LINE TYPE	The directory lines are displayed in the large box in the center of the directory screen, or as a summary of test information for the cursor-selected wafer on a trend chart. The directory lines can be displayed in three ways which present different items of information: • LOT/WAFER ID LINE • STATISTICS LINE • TITLE LINE. The default setting is LOT/WAFER ID LINE.
PRINTER TYPE	Identifies your system printer. Options include: Dot Matrix, PaintJet Monochrome, PaintJet Color, Journal—All Data, Journal—Summary. For DeskJet 1200, and DeskJet 1600, select PaintJet Color.
PRINTER BAUD RATE	Selects a printer baud rate. Options are 9600 for PaintJet and Journal, and 19200 for Dot Matrix.

Table 3-3: General System Data Parameters (Continued)

Parameter	Description
AUTO PRINT	With AUTO PRINTING *ON* selected, the system automatically prints test results. • For a Diameter Scan, it prints a diameter scan. • For a Contour Map Test or Patterned Wafer Test, it prints a Contour Map. • For a Quick Test or Qualification Procedure, it prints the raw data. The default selection is NO AUTO PRINTING.
WAFER HANDLER	Determines whether or not the system will use the wafer handler. • When SET FOR OPERATIONS is selected, the Wafer Handler Index Card can be programmed to direct the handler. • When NO HANDLER OPERATION is selected, the Wafer Handler Index Card does not appear. • When NO OPERATOR ACCESS is selected, the Handler Menu cannot be accessed from the Introduction Screen. (To regain access to the Handler Menu, deselect this option, and reboot StatTrax.)
WAFER CASSETTE TYPE	Describes the wafer cassette you will use in conjunction with the wafer handler. Select the standard 25-slot wafer cassette, the extended 26-slot wafer cassette, or the 20-slot wafer cassette. The 26-wafer cassette option is available for 200-mm wafers only, and testing is limited to 25 wafers (except for certain Batch Recipe setups). During test setup, you direct the system to measure the wafers in slots 1–25 or the wafers in slots 2–26. When you edit the cassette type selection, the Cassette Offset (Pitch) in the Wafer Handler Index Card and the display in the Cassette Slot Editor automatically change to reflect your selection. However, the default pitch might not be correct for the cassette you are using. Be sure to edit the pitch selection if necessary. The default setting is Standard 25 Wafers.
LEFT CASSETTE ROTATE	Enables the Cassette Rotation option.

Table 3-3: General System Data Parameters (Continued)

Parameter	Description
ASCII DELIMITER	Indicates how items and records will be separated (delimited) when exporting ASCII data from StatTrax. (Formerly, CR+LF was exclusively used for delimiting items, and PXREC was the record delimiter. The new options facilitate export into spreadsheet programs.) The following options are available for delimiting items (I) and rows (R) during ASCII data transmissions: I: CR+LF* R: PMXREC† I: TAB R: PMXREC I: SPACE R: PMXREC I: COMMA R: PMXREC I: CR+LF R: CR+LF I: TAB R: CR+LF I: SPACE R: CR+LF I: COMMA R: CR+LF

* CR+LF indicates a carriage return and line feed.

† PXREC indicates a non-printing character.

Setting SECS-II Parameters

You can modify the parameters for data transmission within the SECS-II Parameters Screen. If you received the optional Enhanced SECS-II package to support the system, refer to the "Enhanced SECS-II Communications Package Reference Manual" that accompanies your Enhanced SECS-II application.

To change the SECS-II parameters

1. From the Main Engineering Menu, select SYSTEM GENERATION and SECS-II PARAMETERS.
2. Press F1 (SELECT) to display the SECS-II parameters described in Table 3-4.

   Pressing F7 (ENHANCED OPTIONS) displays the Enhanced Options Screen. This screen provides access to the features described in Table 3-5. Press F7 (HELP) for additional information.
3. Choose the appropriate values for your host system, or press F1 (DEFAULT) to return to the default values.
4. Press F5 (UPDATE) to store the newly selected parameters.
5. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

Table 3-4: *SECS-II Parameters*

Parameter	Description
T1	Inter-character timeout in seconds. The system uses T1 to detect interruptions between characters during data transmission. Enter a value between 0.1 and 10.0. The default is 1.0.
T2	Protocol timeout in seconds. The system uses T2 to detect a lapse in protocol response. Enter a value between 0.2 and 25.0. The default is 1.0.
T3	Reply timeout in seconds. The system uses T3 to detect the lack of a reply message. Enter a value between 1 and 120. The default is 45.
T4	Inter-block timeout in seconds. The system uses T4 to detect an interruption in a multi-block message. Enter a value between 1 and 120. The default is 45.
RETRY	Retry limit. This parameter sets the maximum number of send retries allowed. Enter a value between 0 and 31. The default is 1.
BAUD RATE	The speed at which data are transferred over the communications port data line of the RS232 or SECS-II data link. The available baud rates are 150, 300, 1200, 2400, 4800, and 9600. The default is 9600.
Device IDs	Specifies the identifier assigned to the system.
UPPER ID	Enter a value between 0 and 127. The default is 0.

Table 3-4: SECS-II Parameters

Parameter	Description
LOWER ID	Enter a value between 0 and 255. The default is 0.
EOC* MSG (end of cassette message)	Directs the system to send a message after measuring the last test wafer in the cassette(s). Use the TOGGLE ACTIVE command to select NO or YES.

Table 3-5: SECS-II Enhanced Options

Option	Description
Host Run	This option allows operator intervention during host-initiated tests. Choose FULL-AUTO to run all tests without operator input. Choose SEMI-AUTO to allow for operator intervention. In SEMI-AUTO mode, you must press F1 (MEASURE) at the host computer to start each test. Before initiating a test, the operator can change Wafer and Lot IDs and handler slot selection.
Wafer Event Message	When this option is turned on, an event message will be appended at the end of a SECS data upload to alert the user of bad measurements.
Pattern Test Die Info	When this option is turned on, pattern test die data is transmitted and displayed on the Data List Screen in measurement order rather than by die location. At the end of every SECS pattern test data upload, a message is appended to identify each measured die by its row and column number in the StatTrax pattern die grid.

Bringing the Wafer Handler Online and Recovering from Handler Errors

During normal operation, the wafer handler automatically places a wafer on the tester's platen and returns the wafer to the designated location after testing.

Remember *In order to use the Wafer Handler, the Wafer Handler field in the General System Data Screen must read* `Set For Operations`*, and the correct Cassette Type must be selected.*

You can use the Wafer Handler Menu to bring the wafer handler online and to direct certain wafer handler and tester operations. If a simple wafer handler error occurs during system operation, this menu allows you to recover without restarting the tester or touching the wafer.

If the wafer handler is offline, you can put it online using the Wafer Handler Menu

1. From the Introduction Screen, select the Wafer Handler Menu (F2).

   The Wafer Handler Menu/Error Recovery Screen appears (Figure 3-9). Table 3-6 describes the text fields displayed in the screen. The command boxes, at the bottom of the screen, perform the functions described in Table 3-7.
2. Highlight PUT WAFER HANDLER ON LINE, and press F1 (SELECT) to execute a full mechanical (hard) reset.

   The system will beep twice upon successfully completing the reset.
3. Press F8 (RETURN) to return to the Introduction Screen.
4. Verify that the message `WAFER HANDLER ON LINE` appears in the upper right corner of the screen.

Recovering from a Wafer Handler Error

When the system recognizes an error, the computer beeps and displays a Wafer Handler Error Code at the bottom of the screen. After you press a key, as requested, the wafer handler clears the error and displays the Wafer Handler Error Recovery Screen. (If the wafer handler cannot complete the reset, it goes off line before the screen appears.)

The EXPECTED STATUS line indicates the condition which must exist before the test can resume. For example, if the EXPECTED STATUS line displays L24 ALIGNED you must *align* the wafer which was originally in slot #24 of the *left* cassette before continuing the test. Refer to the section "Using the Wafer Handler Menu/Error Recovery Commands" for an example of how to recover from a wafer handler error.

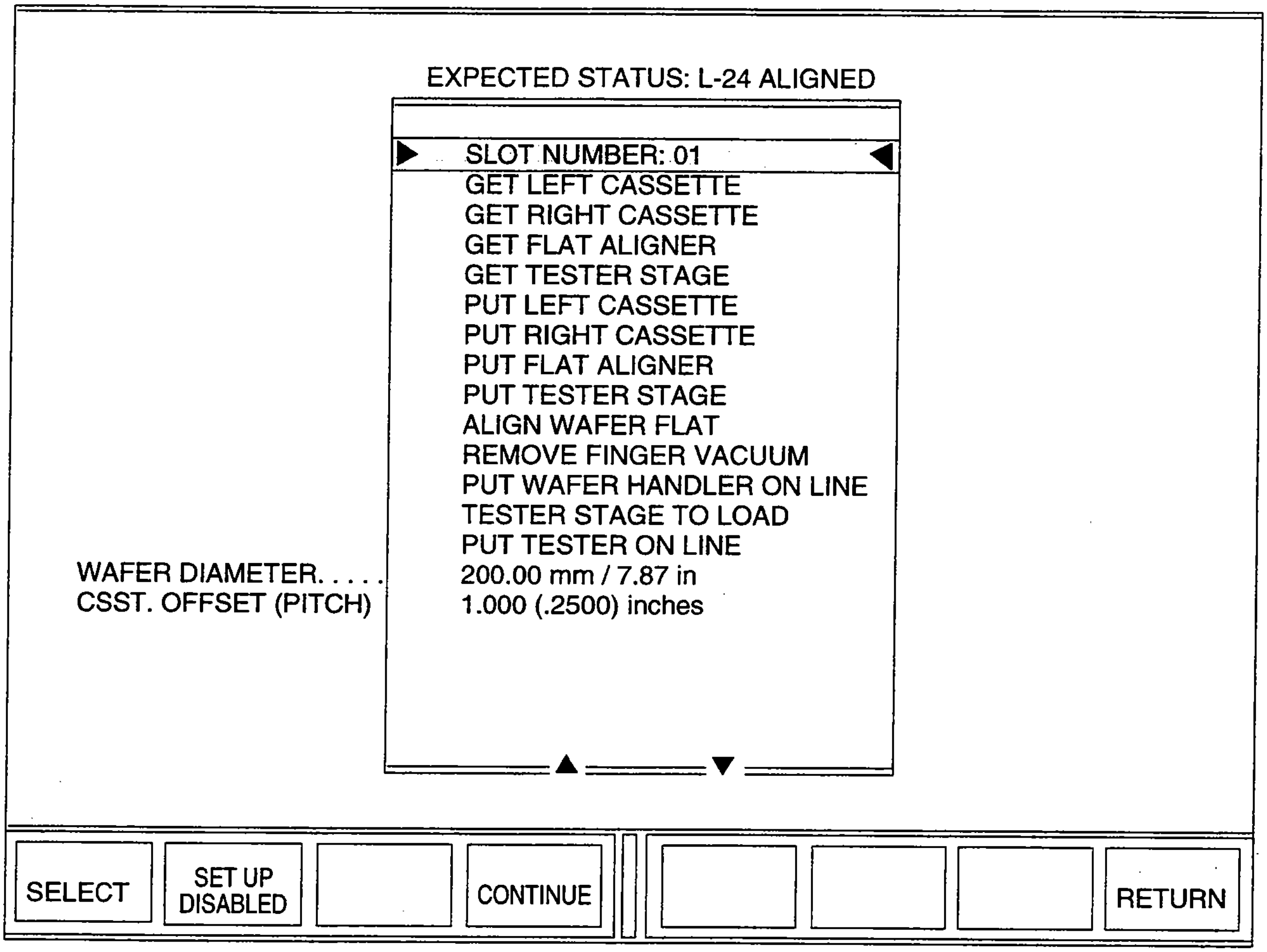

Figure 3-9: Wafer Handler Menu/Error Recovery Screen

Table 3-6: Text Fields in the Wafer Handler Menu/Error Recovery Screen

Text Field	Function
SLOT NUMBER	Indicates the *currently selected* cassette slot. Slots are numbered 1–25 (or 2–26) from the bottom to the top of the cassette. The default entry is 1.
GET - LEFT CASSETTE	Retrieves the wafer from the currently selected slot in the left cassette. The vacuum finger then retracts and awaits the next command.
GET - RIGHT CASSETTE	Retrieves the wafer from the currently selected slot in the right cassette. The vacuum finger then retracts and awaits the next command.
GET - FLAT ALIGNER	Retrieves the wafer from the flat aligner stage. The vacuum finger then retracts and awaits the next command.
GET - TESTER STAGE	Retrieves the wafer from the tester's wafer platen. The vacuum finger then retracts and awaits the next command.

Table 3-6: *Text Fields in the Wafer Handler Menu/Error Recovery Screen (Continued)*

Text Field	Function
PUT - LEFT CASSETTE	Puts the wafer in the currently selected slot in the left cassette. The vacuum finger then retracts and awaits the next command.
PUT - RIGHT CASSETTE	Puts the wafer in the currently selected slot in the right cassette. The vacuum finger then retracts and awaits the next command.
PUT - FLAT ALIGNER	Puts the wafer on the flat aligner stage. The vacuum finger then retracts and awaits the next command.
PUT - TESTER STAGE	Puts the wafer on the tester's wafer platen. The vacuum finger then retracts and awaits the next command.
ALIGN WAFER FLAT	Aligns the wafer's major flat or notch. (A wafer must be in the flat aligner for the system to accept this command.) Note that notches take alignment priority over flats.
REMOVE FINGER VACUUM	Shuts off the finger vacuum and resets the vacuum status **CAUTION** *Use the REMOVE FINGER VACUUM command only when the wafer handler* ***mistakenly*** *believes there is a wafer on the vacuum finger. If you execute this command with a wafer on the vacuum finger, the wafer handler will drop the wafer!*
PUT WAFER HANDLER ONLINE	Resets the wafer handler and puts it on line if it was previously off line.
PUT TESTER ON LINE	Resets the tester and brings it on line if it was previously off line. This command also resets the flat aligner if the status indicates that there is a wafer on the flat aligner stage when one is not actually present.
WAFER DIAMETER	Tells the handler what size wafer you want to load onto the wafer platen. The handler needs to know this size so that it can select wafers from the correct slot. Wafer cassettes for 8-inch (200-mm) wafers are taller than cassettes for smaller wafers. ***Be careful to select the correct wafer size,*** otherwise wafers might be damaged. **CAUTION** *If you select the wrong wafer size, the handler finger might crash into the wafer and break it.*
CASS. OFFSET	Establishes the wafer cassette offset. The Cassette Size Offset represents the distance from the bar end of the cassette (lower end) to the center of the lowest wafer slot (slot #1). For 3-inch to 6-inch cassettes, this value typically equals 0.572-inch; however, 0.550-inch cassettes are also used in the industry. For 200-mm (7.87-inch) wafer cassettes, this value equals 1.0 inch.

Table 3-7: Command Boxes in the Wafer Handler Menu/Error Recovery Screen

Command Box	Function
SELECT (F1)	Executes the highlighted command.
SET UP DISABLED/ENABLED(F2)	Directs the wafer handler to perform the full command (SET UP DISABLED) or the initial step in the command (SET UP ENABLED). For example, if you highlight GET TESTER STAGE, and choose SELECT (F1) with SET UP DISABLED displayed, the handler picks up the wafer from the tester stage and returns the wafer handler arm to its home position. With SET UP ENABLED displayed, the handler would approach the stage and stop. You would then have to use the CONTINUE command (F4) to instruct the handler to complete the command. This might be useful if you want to visually check the alignment between the tester and the wafer handler.
RETURN/CANCEL TEST(F8)	Returns you to the Introduction Screen and cancels any test currently in progress.

Using the Wafer Handler Menu/Error Recovery Commands

Let's use the Wafer Handler Menu/Error Recovery Screen shown in Figure 3-9 as our starting point. This screen was preceded by the message `UNABLE TO PICK UP WAFER` at the bottom of the Data Collection Screen. When the operator pressed a key as requested, the system displayed the Wafer Handler Menu/Error Recovery Screen. The message L24 ALIGNED in the EXPECTED STATUS field indicates that you must align the wafer which was originally in slot #24 of the left cassette before continuing the test.

This error can have one of two causes

- the vacuum finger's inability to remove the wafer from slot #24 in the left cassette
- the handler's inability to complete a flat alignment

Among the conditions that can cause this are

- a wafer missing from the slot
- a wafer tilted in the slot
- a momentary loss of vacuum

To fix the condition (assuming that the wafer is still in slot 24 in the left cassette)

1. Highlight the command GET LEFT CASSETTE, and press F1 (SELECT).

   The vacuum finger retrieves the wafer from slot 24 in the left cassette.
2. Highlight the command PUT FLAT ALIGNER, and press F1 (SELECT).

   The vacuum finger places the wafer on the flat aligner stage.
3. Highlight the command ALIGN WAFER FLAT, and press F1 (SELECT).

   The vacuum finger aligns the wafer.
4. Press F4 (CONTINUE).

   The handler removes the wafer from the flat aligner and places it on the tester's wafer platen. At this point the system resumes the test program.

Probe-Head Data

Each time you change the four-point probe, you must enter the appropriate probe ID and tip space into the Probe Data Editing Screen. The following section describes how to edit probe data in Engineering and Operations Modes. For information on checking probe head calibration, choosing the right probe head, and changing probe heads, refer to Appendix D.

Editing Probe Data in Engineering Mode

To edit probe data

1. Starting from the Main Engineering Menu, select TEST DEVELOPMENT in the MENU box, and select EDIT PROBE DATA in the ITEM box.
2. Press F1 (SELECT). The Probe Data Editing Screen appears. The cursor is positioned at the first field, PROBE ID. The probe ID is typically the serial number that appears on the probe itself.
3. Type in the probe ID, and press Enter. You can enter up to 20 characters in the PROBE ID field.
4. Select the TIP SPACE field. Standard tip spaces include
   - 0.025 inches (0.635 mm) . . . . . types F, G, and H
   - 0.040 inches (1.016 mm) . . . . . types A, B, C, and D
   - 0.0625 inches (1.587 mm) . . . . type E

   These values are indicated on the probe under the label PITCH.
5. Type in the correct tip space, then press Enter.
6. Press F5 (UPDATE) to store the new probe information, and press F8 (MAIN MENU) to exit to the Main Engineering Menu.

Qual Procedures

One of the main sources of noise in the sheet resistance measurement is the probe itself. To obtain accurate and repeatable results, the probe head pins must make good electrical contact each time they touch the surface of the wafer.

The OmniMap Probe Qualification Procedure (Qual Procedure) checks the short-term repeatability of the probe head. Performing a Qual Procedure before each shift can help you monitor probe head repeatability and accuracy. Qual Procedures are helpful in determining the repeatability of the probe head and, if necessary, the amount of conditioning the probe might need.

Using a Qual Procedure to Check Repeatability of the Probe Head

You use the Probe Qualification results to estimate probe head measurement errors. During a Qual Procedure, the system uses the Probe Qualification results to make four separate estimates of the measurement errors associated with the probe head. Each measurement in a Qual Procedure consists of a group of 5 readings with each group of readings taken $\frac{1}{4}^{\circ}$ apart.

After running the test, you can view the results of a Qual Procedure from any of the test's index cards (in Operations Mode) by pressing F1 (DATA VALUES). The R_S standard deviation (STDV) values for each of the four probe locations should be less than 0.2%:

Note *The number of conditioning counts required to condition a probe head depends on the type of probe head and the monitor wafer. Use the following conditioning counts and standard deviations only as general guidelines when evaluating your own probe heads. Refer to the following section, "Probe Conditioning," for instructions.*

1. Perform a Qual Procedure test. If the standard deviation of the R_S values for each site is less than 0.2%, the probe does not need conditioning.
2. If the standard deviation is ±0.2% but <0.5%: Probe approximately 25 times on the ceramic tile, and then perform *two* Qual Procedures. The second set of STDV values should be within specification.
3. If the standard deviation is ±0.5% but <1%: Probe approximately 75 times on the ceramic tile, and then perform *two* Qual Procedures. The second set of STDV values should be within specification.
4. If the standard deviation is ±1%: Probe approximately 150 times on the ceramic tile. Then, perform *two* Qual Procedures. The second set of STDV values should be within specification.
5. Once the probe head is qualified (STDV <0.2%), perform a Qual Procedure once more to ensure the readings are consistent.

Refer to "Standard Test Setup" in Chapter 4 for information on setting up a Qual Procedure.

Probe Conditioning

Typically, you condition a probe only if a Qualification (Qual) Procedure indicates poor repeatability or measurement errors. You need only condition a probe when necessary, not at the beginning of every shift. The number of conditioning counts required to condition the probe head is defined by the Probe Qual results as described in the previous section.

You will need a ceramic tile (included in the system's startup kit) for the following procedure. To order a new ceramic tile, call Tencor at 1-800-722-6775.

To condition a probe

1. From the Main Engineering Menu, select TEST DEVELOPMENT in the MENU box.
2. Select PROBE CONDITIONING in the ITEM box.
3. Press F1 (SELECT).

   The system displays the Probe Conditioning Setup Screen.
4. Ensure that the value in the first field, DISTANCE FROM CENTER, is small enough that the probe pins will contact the ceramic tile within its boundaries (two inches by two inches).
5. Select the ROTATE STAGE field.

   Depending on your selection, the stage will rotate ¼° after each probe contact or remain fixed throughout the conditioning cycle.
6. Press F4 (TOGGLE ACTIVE).
7. Select the CONDITIONING COUNT field.
8. Type in the number determined by the Probe Qual, and press Enter.
9. Place the white ceramic tile at the center of the stage.
10. Press F1 (BEGIN) to start the conditioning routine.
11. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

CAUTION *Overconditioning can dull probe tips and cause long-term drifts in measurements. It is very important to first perform a Probe Qual to determine if probe conditioning is required.*

4 SETTING UP STANDARD TESTS

Chapter 4
Setting Up Standard Tests

Read This First

This chapter, intended for the process engineer or wafer fab technician, describes how to set up wafer tests. This chapter assumes that you have

- Logged on to an account
- Initialized, named, and password-protected the account
- Set general system parameters
- Put the wafer handler online

This chapter describes some of the ITEM selections found in the TEST DEVELOPMENT MENU. You will learn about

- Setting up cabinets, drawers, and folders
- Restricting access privileges for data collecting or combining
- Entering test parameters for
  - Polar coordinate map tests
  - Manual tests
  - XY Die Map Tests
  - Optimizing current selection
  - P/N typing
- Entering display parameters for test results
- Copying test setups from one cabinet, drawer, or folder to another

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- Copying test setups from one cabinet, drawer, or folder to another

The Test Development Menu

The Test Development Menu contains several items that direct specific test operations.

To access the Test Development Menu

1. From the Main Engineering Menu, use the page up or page down key to highlight TEST DEVELOPMENT in the MENU list on the left.

   The ITEM selections displayed in Figure 4-1 appear. Table 4-1 describes the items. Use the up- and down-arrow keys to highlight the item you want to select.

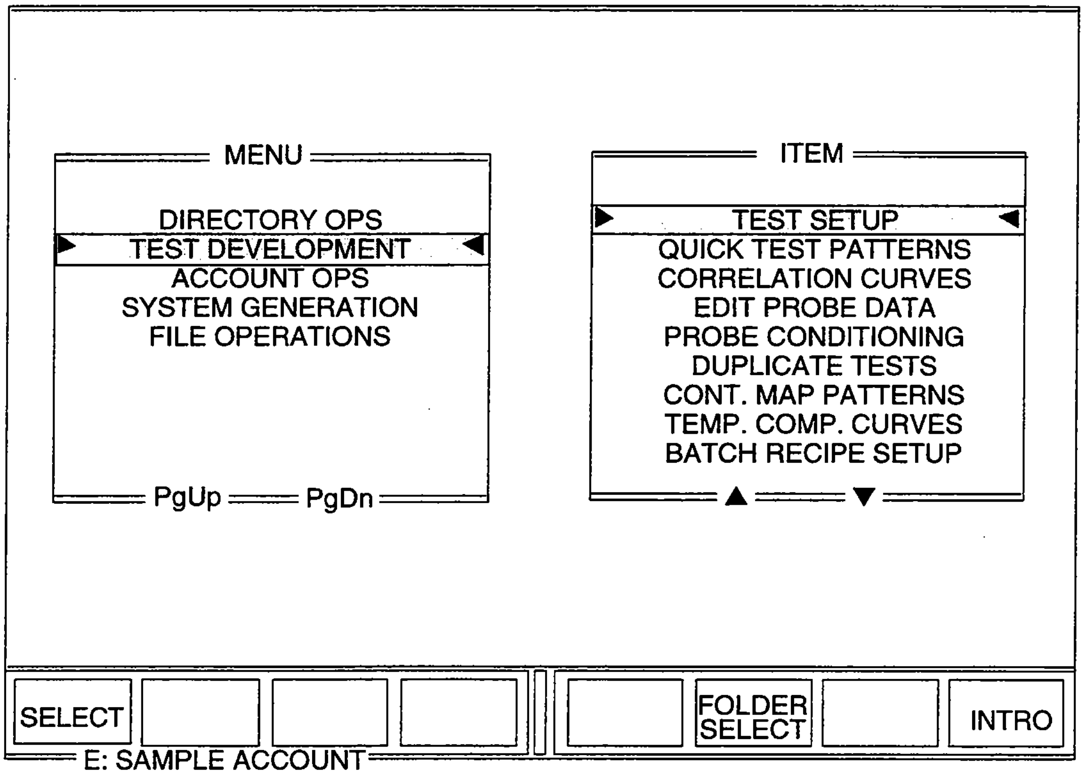

Figure 4-1: Main Engineering Menu, Test Development

Table 4-1: Test Development Items in the Main Engineering Menu

Item	Description
TEST SETUP	Used to enter wafer test parameters for specific tests
QUICK TEST PATTERNS	Used to create your own Polar- or Cartesian-coordinate Quick Tests. You can create as many as 15 Custom Quick Test Patterns (see Chapter 5). (The system comes with 15 pre-established Quick Test Patterns.)
CORRELATION CURVES	Used to enter correlations which can be referenced in a test, enabling the system to adjust or convert measurements (see Chapter 5).
EDIT PROBE DATA	Used to enter a probe ID and probe-tip space value after changing the probe head.
PROBE CONDITIONING	Used to condition a probe head to ensure accurate measurement repeatability.
DUPLICATE TESTS	Used to copy test setups from one folder into another folder.
CONT. MAP PATTERNS	Used to create your own Contour Map patterns (see Chapter 5). (The system comes with seven pre-established Contour Map patterns.)
TEMP. COMP. CURVES	Used to enter temperature coefficient of resistance values (TCR values) which can be referenced in a test (see Chapter 5). The TCR value enables the system to correct measurements for temperature variation.
BATCH RECIPE	Used to automatically run different tests on wafers in the same cassette (see Chapter 5).

Setting Up Cabinets, Drawers, and Folders

Before setting up tests, you should name the cabinets, drawers, and folders that will contain the test setups. You can also assign access privileges to the test setups. (Refer to "Using Color-Coding to Restrict Access to Cabinets, Drawers, and Folders," in Chapter 1.)

1. From the Main Engineering Menu (Figure 4-1), use the page up or page down key to highlight TEST DEVELOPMENT. Use the up- or down-arrow key to highlight TEST SETUP.
2. Press F1 (SELECT) to display the Engineering Folder Select Screen (Figure 4-2).
3. Use the left or right-arrow key to move to the list of ***cabinets***, and use the up- or down-arrow key to highlight an open field in the list. Then type in a significant name, and press Enter.
4. Use the right-arrow key to move to the list of ***drawers***, and use the up- or down-arrow key to highlight an open field in the list. Then type in a significant name, and press Enter.
5. Use the right-arrow key to move to the list of ***folders***, and use the up- or down-arrow key to highlight an open field in the list. Then type in a significant name, and press Enter.
6. Use the OPTION (for color-coding), COLLECT NEW DATA, and COMBINE OLD DATA command boxes to restrict access privileges. Refer to the following section "Restricting Access Privileges for Data Collecting or Combining."
7. Repeat steps 3 through 6 as necessary.
8. Press F5 (UPDATE) to save the entries.
9. The cabinets, drawers, and folders are now prepared to hold test setups and store collected data.
10. Press F1 (SELECT) to set up a test in the currently highlighted folder, or press F8 (MAIN MENU) to return to the Main Engineering Menu.

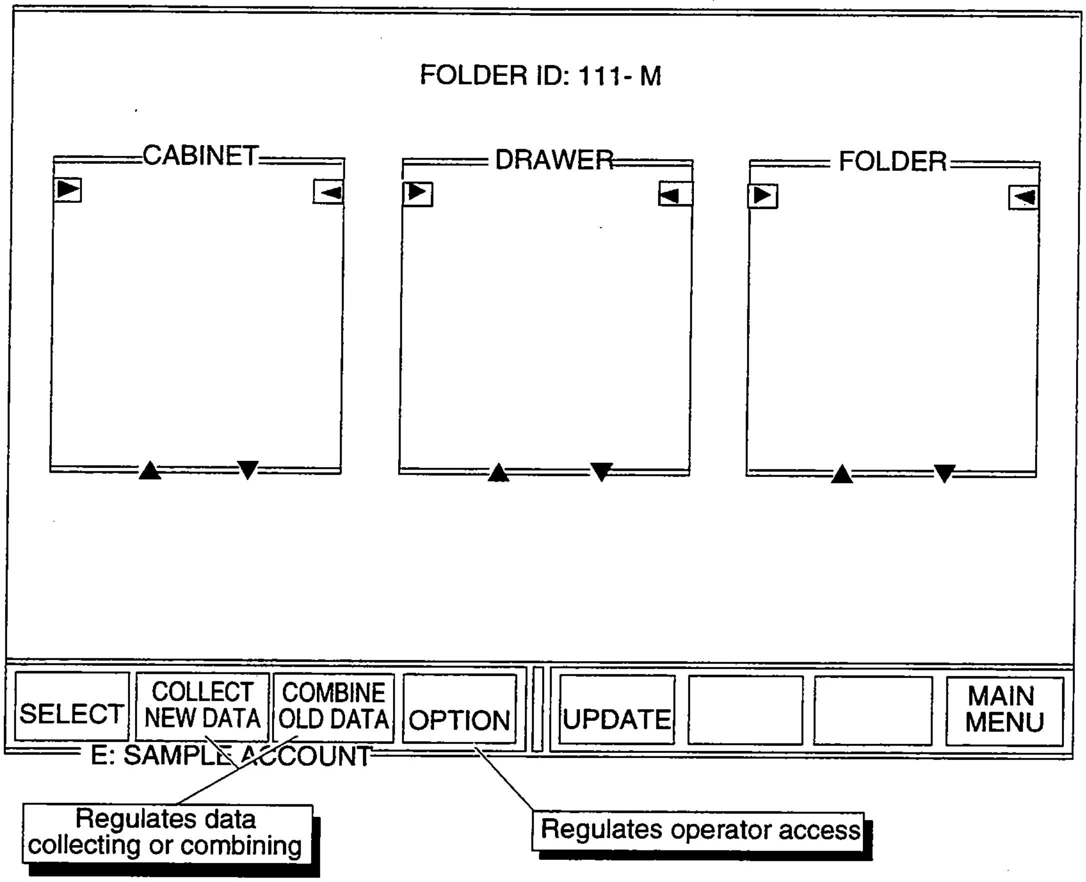

Figure 4-2: Engineering Folder Select Screen

Restricting Access Privileges for Data Collecting or Combining

The Engineering Folder Select Screen provides two command boxes for enabling or prohibiting data combining and/or data collection in a folder:

- F2 (COLLECT NEW DATA or COLLECT OFF)
- F3 (COMBINE OLD DATA or COMBINE OFF)

The defaults are COLLECT NEW DATA and COMBINE OLD DATA. When the command boxes for the currently selected folder display their defaults, the process operator can collect and combine data within the folder. When the commands display OFF, an operator can view the selected folder but cannot collect/combine data within the folder. (To regulate viewing access, refer to the section "Using Color-Coding to Restrict Access to Cabinets, Drawers, and Folders" in Chapter 1.)

To change privileges

1. From the Engineering Folder Select Screen, highlight the folder you want to change and toggle the selections:
   - Press F2 (COLLECT NEW DATA) to prevent data collection in the highlighted folder.
     - The command label changes to COLLECT OFF.
   - Press F3 (COMBINE OLD DATA) to prevent data combination in the highlighted folder.
     - The command label changes to COMBINE OFF.
2. Press F6 (UPDATE) to save your selections.
3. Press F1 (SELECT) to set up a test in the currently highlighted folder, or press F8 (MAIN MENU) to return to the Main Engineering Menu.

Standard Test Setup

StatTrax records your wafer test parameters (setups/recipes) on index cards stored within the individual test folders. You access these index cards through the Test Setup Item in the Test Development Menu. Sets of related index cards are grouped in a series of Card Indexes.

Individual index cards record different types of parameters. For example, the Measure Type Index Card records the measurement settings for your tests, while the Maps & Graphs Index Card records your choice of display parameters for the maps and graphs available in StatTrax. Table 4-2 lists the card indexes (directories) and the index cards grouped within them. Refer to Appendix E for the default test configurations.

Table 4-2: *Index Cards for Standard Test Development*

Card Index	Index Cards
Wafer Setup	Wafer Facts, Memos & Notes, Wafer Handler (optional)
Test Setup	Test Type, Measure Type
Test Results	Maps & Graphs, Data Summary, File Summary*
Trend Charts	Trend Setup, Trend Scaling
SQC (statistical quality control) Charts	SQC Setup, SQC Scaling

* The Data Summary and File Summary Index Cards summarize test data. They appear after the system collects data.

Selecting a Test Folder

Before creating a test setup, you must select the folder that will store the setup. To select the folder

1. From the Main Engineering Menu, use the page up or page down keys to highlight TEST DEVELOPMENT. Use the up- or down-arrow keys to highlight TEST SETUP.
2. Press F1 (SELECT) to display the Engineering Folder Select Screen.
3. Use the arrow keys to highlight the cabinet, drawer, and folder that you created to contain the test, and press F1 (SELECT).
4. The monitor displays the Wafer Setup Card Index with the Wafer Facts Index Card selected.
5. Proceed to the next section, "Entering Parameters in the Wafer Facts Index Card."

Remember *The screens displayed in this manual serve as examples only. Your displays will vary depending upon the names assigned to the system, accounts, cabinets, drawers, and folders and the entries made in the text fields.*

Entering Parameters in the Wafer Facts Index Card

Use the Wafer Facts Index Card (Figure 4-3) to record details about the wafers being tested. Information displayed in the Wafer Facts Index Card is included on printouts of the wafer map. The operator who runs the test enters most of the information recorded in this card. Setting up the card consists of assigning an identifying title to the test and color-coding the text fields. Remember, you can color code a field to prevent, allow, or force the operator to enter text into the field.

If the monitor is not currently displaying the Wafer Facts Index Card, follow the procedure in the previous section, "Selecting a Test Folder," to select a test folder and display the Wafer Facts Index Card.

To set up the Wafer Facts Index Card

1. Move the cursor to the Title field, and type in a name for the test.

   Table 4-3 describes the fields in the Wafer Facts Index Card.

2. Press F1 (OPTION) to color-code the fields as required.
3. Press F6 (UPDATE) to save your entries.
4. Continue setting up the test in the remaining index cards, or press F8 (FOLDER SELECT) to return to the Folder Select Screen.

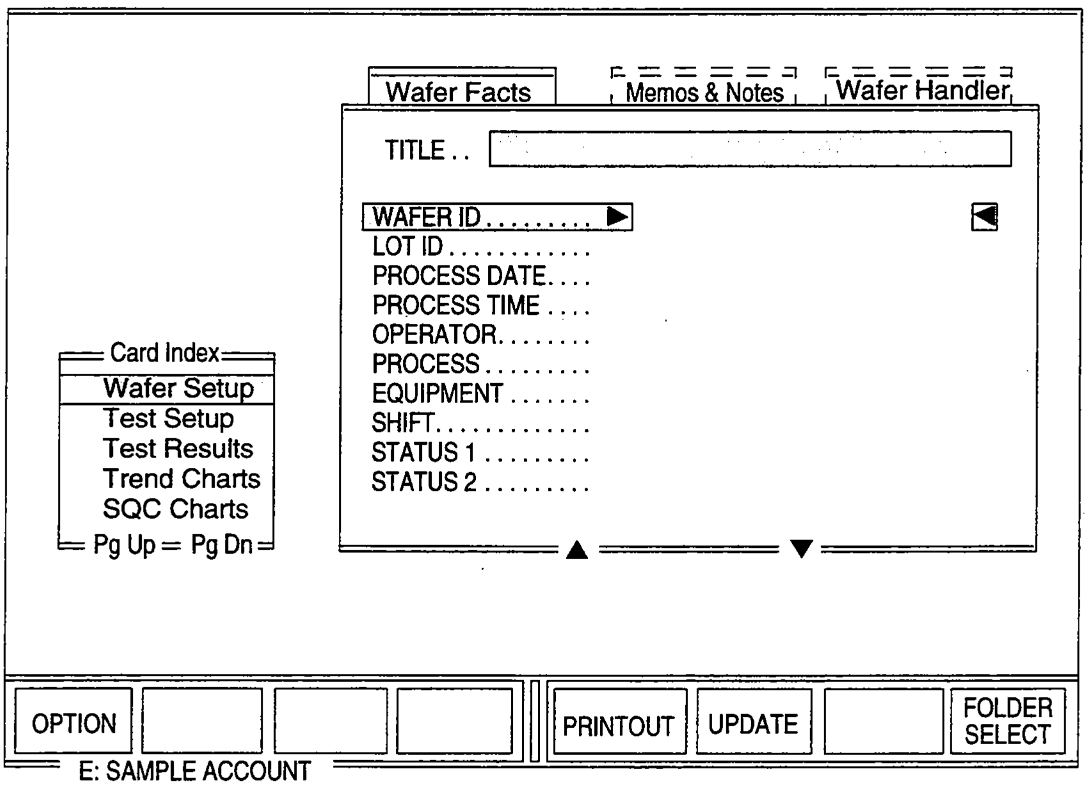

Figure 4-3: Wafer Facts Index Card, Engineering Mode

Table 4-3: Text Fields in the Wafer Facts Index Card

Text Field	Description
TITLE	Any significant name you choose to assign to the test
WAFER ID	The wafer's identifying name or number. If you do not enter an ID, the system will create an ID consisting of the test date and time, and the cassette slot number.
LOT ID	The identifying name or number of the wafers' process lot
PROCESS DATE	The date the wafers were processed. If no entry is made, this field defaults to the test date (as defined by the system's internal clock).
PROCESS TIME	The time the wafers were processed. If no entry is made, this field defaults to the test time (as defined by the system's internal clock).
OPERATOR	The operator running the test
PROCESS	The process being tested
EQUIPMENT	The equipment used in the process being tested
SHIFT	The work shift during which the test is run
STATUS 1 & STATUS 2	Any additional information you wish to record on the Wafer Facts Index Card. This information is included on wafer-map printouts.

Entering Parameters in the Memos & Notes Index Card

You use the Memos & Notes Index Card to communicate with other system users. Each text line holds up to 20 characters.

This procedure assumes you have already opened the folder that will store the setup. If you have not, refer the earlier section "Selecting a Test Folder" to access the folder.

To enter parameters in the Memos & Notes Index Card

1. From the Wafer Setup Card Index, select the Memos & Notes Index Card (Figure 4-4).
2. Type in notes or directions, to the operators and/or their supervisors, in the appropriate fields.

   For messages of more than 20 characters, press Enter when you reach the end of the text line, and then use the down-arrow key to move to the next line.
3. Press Enter after completing the messages.
4. To force the operator or supervisor to read the message, select the field(s), and press F1 (OPTION) to color-code the field(s) orange or red.

   The color-coded field ensures that the message is viewed, because the operator or supervisor will be forced to respond to the message by either entering a response in the field or by highlighting the field and pressing Enter twice.

Note *Remember that because such color-coded fields require operator input, you should not color-code fields in automated tests (i.e., SECS/GEM remotely-initiated tests, Batch Recipes).*

5. Press F6 (UPDATE) to save the entries.
6. Continue setting up the tests in the remaining index cards, or press F8 (FOLDER SELECT) to return to the Folder Select Screen.

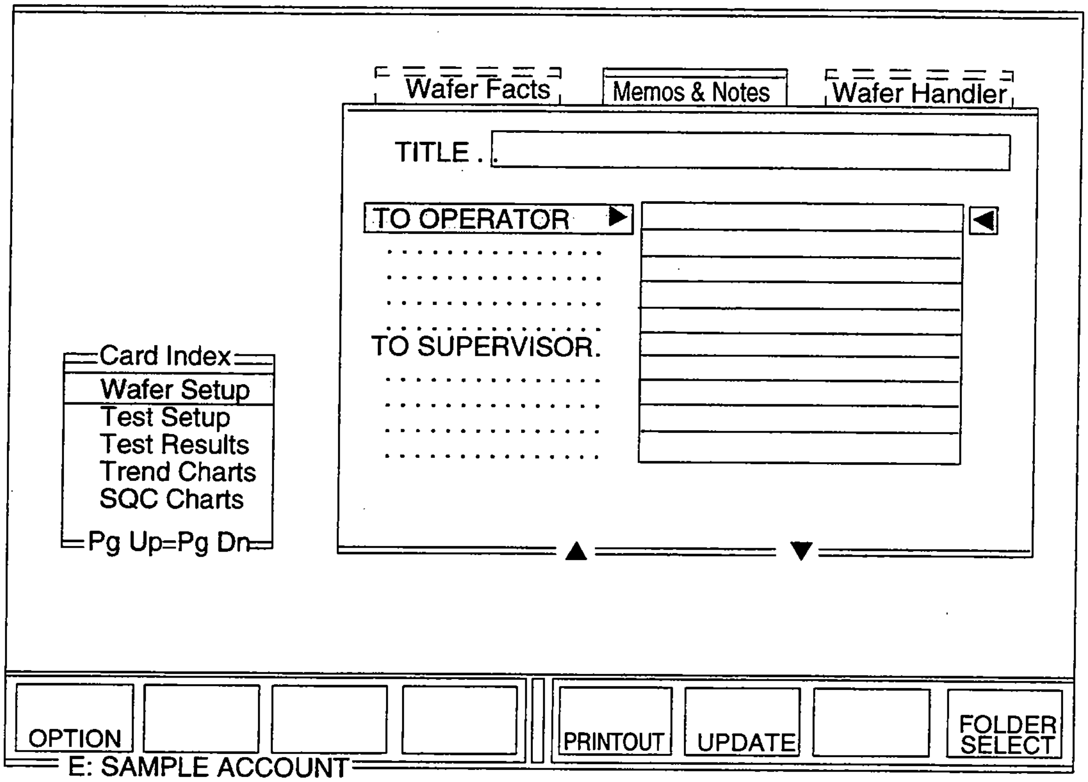

Figure 4-4: Memos & Notes Index Card, Engineering Mode

Entering Parameters in the Wafer Handler Index Card (for systems equipped with the optional wafer handler)

Use the Wafer Handler Index Card to record the information that directs the wafer handler's operation. If you want to use the wafer handler during measurement, but the wafer handler index card does not appear on the screen, the Wafer Handler is not set for operations. Refer to "Setting General System Parameters" in Chapter 3.

To enter parameters in the Wafer Handler Index Card

1. With the Wafer Setup Card Index highlighted, select the Wafer Handler Index Card (Figure 4-5).
2. Skip the CASSETTE SLOT EDITOR field for now, and return to it later if necessary.

   The CASSETTE SLOT EDITOR field accesses the Cassette Slot Editor Screen, described in the later section "Selecting Individual Wafers Using the Cassette Slot Editor." Use the Cassette Slot Editor if

   - you do not wish to test all of the wafers in the cassette(s)
   - some of the cassette slots are empty.
3. Move the cursor to the next field, and press F4 (TOGGLE ACTIVE) to select one of the options described in Table 4-4.
4. Repeat step 3 for each of the remaining fields.

CAUTION *Make sure that you select the correct cassette offset and pitch. If you choose the wrong selection, the wafer handler can collide with and damage a wafer! Tencor uses the SEMI standard offset and pitch for default values. Table 4-4 lists these values.*

5. If you selected OFF: USE SLOT EDITOR or ON: SRCH SLCT WAFERS in the AUTO SLOT field, follow the instructions for using the Cassette Slot Editor to indicate which slots contain the wafers you want tested.
6. Press F1 (OPTION) to color-code the fields as required.
7. After completing the entries in this index card, press F8 (UPDATE) to store the setup for the wafer handler.
8. Continue setting up the test in the remaining index cards, or press F8 (FOLDER SELECT) to return to the Folder Select Screen.

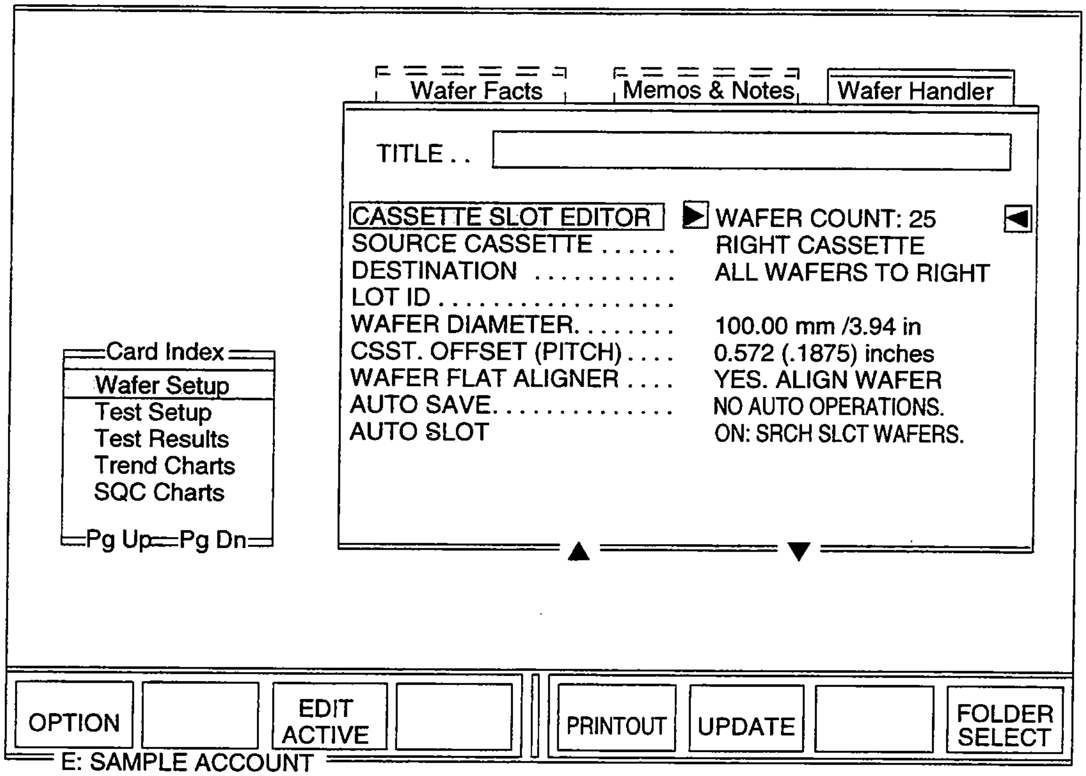

Figure 4-5: Wafer Handler Index Card

Table 4-4: Text Fields in the Wafer Handler Index Card

Text Field	Options	Description
CASSETTE SLOT EDITOR	User defined	This field accesses the Cassette Slot Editor Screen (Figure 4-6). Use the Cassette Slot Editor Screen to individually select wafers for testing. Select the wafers by selecting or deselecting wafer slot numbers. Also use this screen to assign individual wafer IDs The WAFER COUNT displayed in this field indicates the number of wafers selected in the Cassette Slot Editor Screen.
SOURCE CASSETTE	RIGHT CASSETTE BOTH CASSETTES NOT ENABLED	The cassette from which the wafers will be taken. Choose NOT ENABLED when loading wafers manually. You do not need to put the wafer handler off line from within the General System Data Screen. (Wafers must be loaded manually when using one of the PAUSE options for SAMPLE TYPE. Refer to the section "Entering Parameters in the Measure Type Index Card.")
DESTINATION		The cassette that receives the wafers after measurement.
	ALL WAFERS TO SOURCE	Returns the wafers to the same cassette from which they were taken.
	GOOD WAFERS TO LEFT (BAD WAFERS TO LEFT)	Sorts the wafers according to the specifications entered in the Trend Scaling Index Card (the MEAN-TARGET and STDV-SPEC determine if wafers are "good" or "bad").
	ALL INVERSE TO LEFT	Places the wafers into the left cassette in reverse order: R1 to L25, R2 to L24, and so on. This selection reduces contamination from above by keeping all wafer motion below the wafers already in the cassette.
LOT ID	User-defined	The identifying name or number of the wafers' process lot

Table 4-4: *Text Fields in the Wafer Handler Index Card (Continued)*

Text Field	Options	Description
WAFER DIAMETER	50.80 mm/2.00 in. 57.15 mm/2.25 in. 76.20 mm/3.00 in. 82.55 mm/3.25 in. 100.00 mm/3.94 in. 125.00 mm/4.92 in. 150.00 mm/5.91 in. 200.00 mm/7.87 in.	Identifies the wafer diameter.
CSST. OFFSET (PITCH)		OFFSET is the distance from the bar end of the cassette (lower end) to the center of the lowest wafer slot (slot 1). PITCH is the distance between slots.
	For 50.80-mm (2-inch) to 150-mm (6-inch) cassettes: 0.550-0.7441 inches	The default offset value is 0.572 inches.
	For 200-mm (8-inch) cassettes: 1.00 (WAFERS 1–25) 1.25 (WAFERS 2–26)	The default selection is 1.00 (WAFERS 1–25). When used with a 26-wafer cassette, testing is limited to the wafers in slots 1 through 25 The option 1.25 (WAFERS 2–26) is used only for 26-wafer cassettes. Testing is limited to the wafers in slots 2 through 26.
WAFER FLAT ALIGNER		Determines whether or not the wafer's major flat or notch will be aligned before testing begins. (Notches take alignment priority over wafer flats.)
	YES. ALIGN WAFERS.	The handler centers and aligns the wafers before placing them on the tester.
	NO. DO NOT ALIGN.	Used only with monitor (unpatterned) wafers. The system places the wafers on the tester without locating the flat or notch.

***Table 4-4:** Text Fields in the Wafer Handler Index Card (Continued)*

Text Field	Options	Description
AUTO SAVE		Tells the system when to save collected data. If you do not use one of the Auto Save options, the system pauses after each wafer measurement and asks if you wish to save the data. For fully automated tests, you must use one of the Auto Save options.
	NO AUTO OPERATIONS	Data not saved unless you press F7 (SAVE) after each wafer test. (For use when testing wafers manually.)
	AUTO SAVE, NO UPLOAD	The system automatically saves the collected wafer data to the account, but does not upload data to the host computer.

Note *To use the following Auto Save selections, you must first select RS232 or SECS-II in the Data Communications field in the General System Data Setup Screen.*

Text Field	Options	Description
	AUTO SAVE AND UPLOAD	The system automatically saves the collected data to the account and uploads the file to the host computer.
	AUTO UPLOAD IF SAVED	The system uploads the collected wafer data to the host computer if you press F7 (SAVE) to save the file.
	AUTO UPLOAD	The system uploads the collected wafer data to the host computer. No data is saved to the account.

Table 4-4: Text Fields in the Wafer Handler Index Card (Continued)

Text Field	Options	Description
AUTO SLOT		Auto Slot offers automatic cassette searching during the wafer test sequence. The choices in this field tell the wafer handler how to choose wafers from the cassette(s).
	OFF: USE SLOT EDITOR	Defers to the selections in the CASSETTE SLOT EDITOR. If the wafer handler does not find a wafer in the selected slot, it generates an "`Unable to Pick Up Wafer`" error message and halts the test program.
	ON: SRCH SLCT WAFERS	Checks only the slots selected in the CASSETTE SLOT EDITOR. If the wafer handler does not find a wafer, it continues to the next selected slot.
	ON: SRCH WHOLE CSSTE	Searches each cassette slot. If the wafer handler does not find a wafer, it continues to the next slot.

Selecting Individual Wafers Using the Cassette Slot Editor

Use the Cassette Slot Editor field to select or deselect individual wafers for testing. The handler bypasses wafers in deselected slots.

1. Select CASSETTE SLOT EDITOR in the Wafer Handler Index Card.
2. Press F3 (EDIT ACTIVE) to display the Cassette Slot Editor Screen (Figure 4-6).
   - The Cassette Slot Editor Screen shows either the right cassette or both cassettes, depending on the selection you made in the Source Cassette field in the Wafer Handler Index Card.
   - The SLOT fields are shown to the left of the WAFER ID field. Slots are numbered 1 through 25 (or 20) or 2 through 26 starting from the bottom of the cassette. Use the cursor keys (Home, Page Up, and so on) to scroll up or down through these fields.
     - If you wish to switch between the 1–25 slot option and the 2–26 slot option, press F7 (TOGGLE CASS. 25/26).

Note *The TOGGLE CASS. 25/26 command is linked to the CSST. OFFSET (PITCH) field in the Wafer Handler Index Card. If you toggle the cassette selection using this command, the CSST. OFFSET selection automatically changes.*

When you change from the 1–25 option to the 2–26 option, the wafer ID and other slot-dependent information for slot 1 will be lost. Similarly, when changing from the 2–26 option to the 1–25 option, the wafer ID and other slot-dependent information for slot 26 will be lost.

   - The SELECTED status is represented to the right of the slot field. The status indicates if the wafer in the corresponding slot is selected (YES) or not selected (NO). (The default setting selects all slots.)
3. Press F4 (SELECT) to toggle the selection status of the highlighted slot.
   - A selected slot will be deselected.
   - A slot that is not selected will be selected.

   To indicate that a slot is reserved for a particular wafer (an oxide standard, for example), enter the wafer's ID, and select OPTION (F3) to lock the WAFER ID at the selected SLOT position. (This prevents an operator from assigning a different wafer ID to the reserved slot during the test sequence.)

   When selecting wafers from both cassettes, press F2 (CHANGE SOURCE) to move from one SOURCE field to the other (see Figure 4-6).
4. After you have finished selecting slots, press F5 (UPDATE). (Changes to the Slot Editor must be updated separately from the general Wafer Handler setup.)
5. Press F8 (RETURN) to return to the Wafer Handler Index Card.

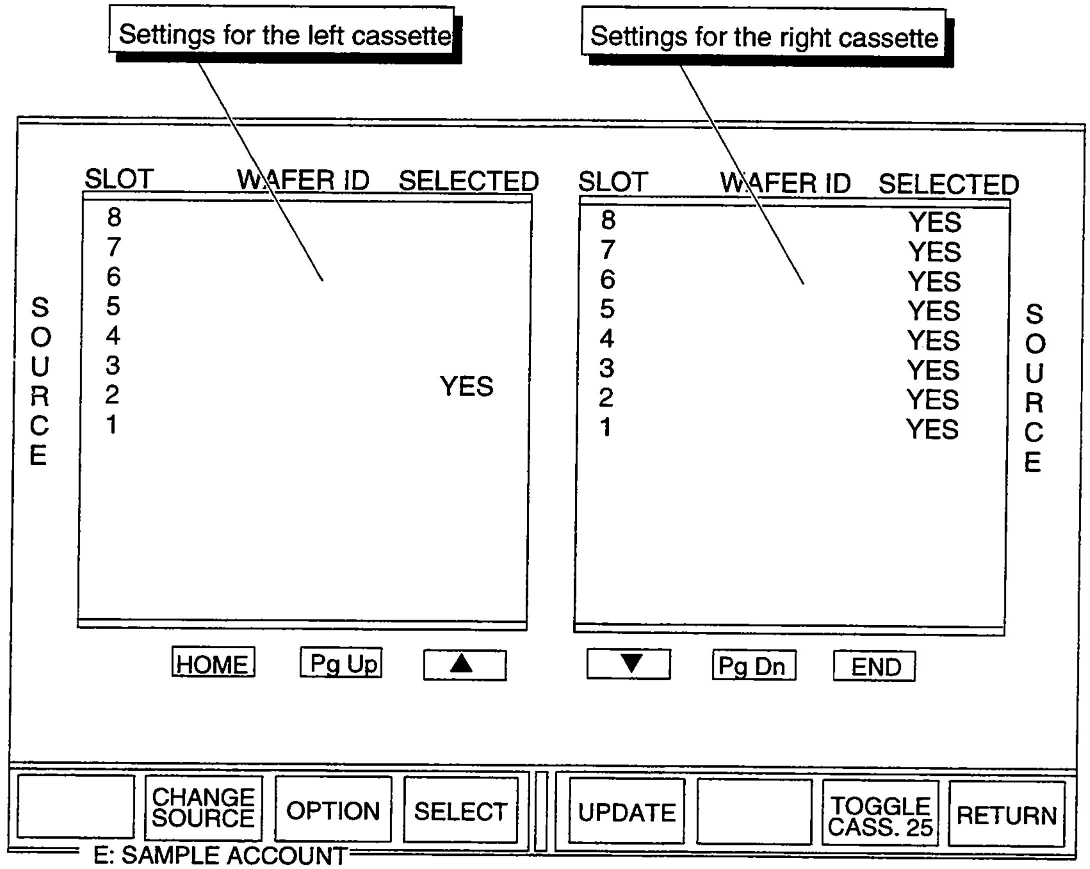

Figure 4-6: Cassette Slot Editor Screen

Entering Parameters in the Test Type Index Card

Use the Test Type Index Card to describe the type of test you want performed. The system offers the following test types:

- Polar Coordinate Map Tests such as
  - Contour/3D Maps
  - Diameter Scans
  - Quick Tests
  - Qual Procedures
- X-Y Map Tests (Pattern Testing)

For both Contour Map and Quick Tests you can select from one of the pre-defined tests described in Appendix B or create a custom test as described in Chapter 5.

To enter parameters in the Test Type Index Card

1. From the Test Setup Card Index, use the page down key to highlight the Test Type Index Card (Figure 4-7).
2. With the Test Type field selected, press F4 (TOGGLE ACTIVE) to select one of the Test Types described in Table 4-5.

   The remaining text fields are automatically customized for your Test Type selection.
3. Move the cursor to the next field, and press F4 (TOGGLE ACTIVE) to select one of the options for the field.
   - For most Test Types, this field reads TEST SITES. (Skip this field when using the QUAL PROCEDURE option.)
   - For the PATTERN TESTING option, this field reads MODE.

   Refer to Table 4-6 for a description of the options for the fields.
4. Move the cursor to WAFER DIAMETER, and press F4 (TOGGLE ACTIVE) to select one of the options.

Important *If you change the WAFER DIAMETER or STEP SIZE entries after setting up a X-Y Map pattern, the pattern is erased and the number of sites selected returns to zero.*

5. Move the cursor to the next field, and type in the appropriate value(s).
   - For most Test Types, this field reads TEST DIAMETER.
   - For PATTERN TESTING, this field reads STEP SIZE. Enter x and y step size dimensions equal to, or multiples of, the wafer's die size.
6. Move the cursor to the Sorting Sigma field, and type in the appropriate value (typically 3.0).

   If you've selected PATTERN TESTING as your Test Type, skip over the Pattern field for now. The PATTERN field accesses the Die Selection Screen, described later in this chapter.

7. Complete your entries in the remaining fields using the TOGGLE ACTIVE command (F4) to display your selection.
8. If you selected the PATTERN TESTING option, return to the Pattern field, press F3 (EDIT ACTIVE), and follow the instructions for "Creating a Die (XY) Map Pattern" later in this chapter.
9. Press F1 (OPTION) to color-code the fields as required.
10. Press F6 (UPDATE) to save your entries.
11. Continue setting up your test in the remaining index cards, or press F8 (FOLDER SELECT) to return to the Folder Select Screen.

Remember *The screens displayed in this manual serve as examples only. Your displays will vary depending upon the names assigned to the system, accounts, cabinets, drawers, and folders and the entries made in the text fields.*

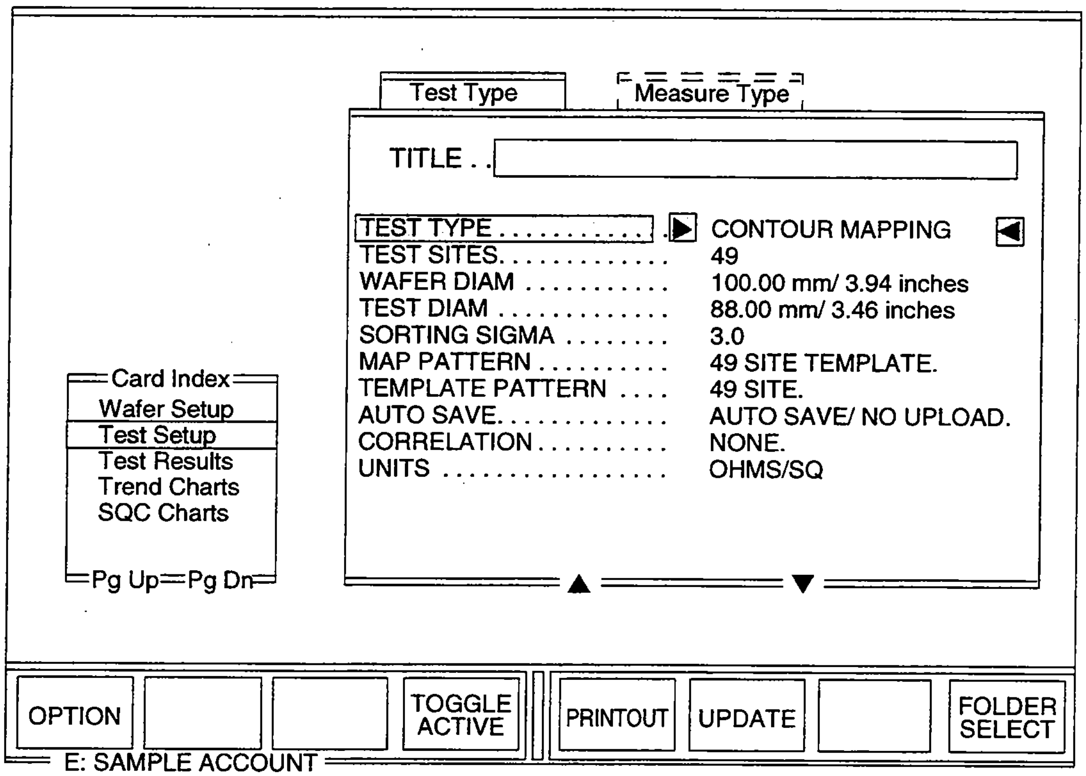

Figure 4-7: Test Type Index Card

Table 4-5: Test Type Options

Test Type	Description
CONTOUR MAPPING	Provides a picture of wafer uniformity. Contour lines enclosing pluses (+) and minuses (-) on the wafer map indicate gradients from the mean value (indicated by a bold contour line). Refer to Appendix B for a description of the standard Contour Mapping patterns. (For instructions on creating custom Contour Mapping patterns, refer to the section "Custom Contour Maps" in Chapter 5.)
DIAMETER SCAN	Provides a picture of wafer uniformity along a single diameter line (selected as a radial angle between 0 ° and 360 °). Refer to Appendix B for a description of the standard Diameter Scan patterns.
QUICK TEST	Provides a quick wafer measurement using 1, 3, 4, 5, 6, 8, 9, or 10 test sites in standard patterns, or up to 30 sites for customized patterns. Use a Quick Test when you are more interested in an overall measurement of sheet resistance on a wafer rather than in variations in sheet resistance across a wafer (process characterization). A Quick Test is best when the average sheet resistance of your films varies from wafer to wafer, but the sheet resistance across single wafers does not vary substantially. Refer to Appendix B for a description of the standard Quick Test patterns. (For instructions on creating custom Quick Test patterns, refer to "Custom Quick Test Patterns" in Chapter 5.)
QUAL PROCEDURE	Used to monitor short- and long-term variation of the system's measurement repeatability using a series of standard wafers. During a Qualification (Qual) Procedure, the system takes five measurements, each ¼° of a degree apart, at four different sites on the wafer. This test qualifies the precision of our measurement. This is also the test used to determine if the probe needs conditioning and, if so, to determine the appropriate ***conditioning count***. We recommend that you create a cabinet dedicated to Qual Procedures. Within this cabinet, create a drawer for each layer type you are testing. Within each drawer, set up a test folder for each of your wafer standards. Perform a Qual Procedure of your standards on a daily or weekly basis. For more information on probe qualification, refer to Appendix D.
PATTERN TESTING	Used for automatic testing of patterned wafers. Automatic mode controls both stage motion and site measurement. PATTERN TESTING allows you to *pre-select* individual test die from an x-y grid map display. Refer to Appendix B for a description of Die (X-Y) Map Patterns for measuring patterned wafers.

Table 4-6: Text Fields in the Test Type Index Card

Test Type	Field	Description
CONTOUR MAPPING	TEST SITES	Indicates the number of sites that will be measured using the currently selected test pattern. Changing this field causes corresponding changes in the MAP PATTERN and TEMPLATE PATTERN fields. Refer to Appendix B for additional information.
	WAFER DIAM	Indicates the diameter of the wafer. (This field is identical to the WAFER DIAMETER field in the Wafer Handler Index Card).
	TEST DIAM	Used for edge exclusion. Testing is limited to the region within this diameter. The test diameter must be less than the wafer diameter! For most tests, we suggest a value equal to 12 mm (0.47 inches) less than the wafer diameter. If the test diameter is not at least 6 mm smaller than the wafer diameter, the system will issue a warning message each time it measures a wafer.
	SORTING SIGMA	Determines which test values should be included in calculating test results. A SORTING SIGMA of 3.0, for example, includes all test values within three standard deviations of the wafer mean (99.7 percent of a normal or Gaussian distribution). Any test site with a value outside these limits is excluded from the calculations. Such values are identified by an asterisk (*) on the wafer map and appear in red in the raw data display.

Table 4-6: Text Fields in the Test Type Index Card (Continued)

Test Type	Field	Description
CONTOURMAPPING, continued.	MAP PATTERN	Identifies the currently selected MAP PATTERN You can select one of the standard tests, described in Appendix B, or a customized test. For standard tests, the MAP PATTERN is identical to the TEMPLATE PATTERN. For custom tests, the MAP PATTERN is a modification of the identified TEMPLATE PATTERN. Changing the entry in the MAP PATTERN field causes corresponding changes in the TEST SITES and TEMPLATE PATTERN fields.
	TEMPLATE PATTERN	Identifies the map that serves as a template for the currently selected pattern.
	AUTO SAVE	Determines the AUTO SAVE operations.
	CORRELATION	Used to convert resistivity measurements to units other than ohms/sq or to introduce an offset or slope. Correlations are defined using the Correlation Curves utility (see Chapter 5). Highlighting this field, and pressing F3 (EDIT ACTIVE) displays the Correlation Curves Screen.
	UNITS	Displays the unit of measurement for the current test. This field is not selectable.
DIAMETER SCAN	TEST SITES, WAFER DIAM, TEST DIAM, and SORTING SIGMA	See the descriptions under CONTOUR MAPPING.

Table 4-6: Text Fields in the Test Type Index Card (Continued)

Test Type	Field	Description
DIAMETER SCAN, continued	ROTATION	Defines the rotational angle in which the measurements will be taken: • If you enter 0 °, the measurements will be taken across the wafer from top to bottom (from the back to the front of the tester). • If you enter 90 °, the measurements will be taken across the wafer from right to left. The system rotates the test pattern counterclockwise by the entered value. (Refer to "Diameter Scan Probing Patterns (Polar Coordinates)" in Appendix B for additional information.)
	AUTO SAVE, CORRELATION, and UNITS	See the descriptions under CONTOUR MAPPING.
QUICK TEST	TEST SITES, WAFER DIAM, TEST DIAM, and SORTING SIGMA	See the descriptions under CONTOUR MAPPING. Note that changing the selection in the Test Sites field produces a corresponding change in the Quick TEST field.
	QUICK TEST	Identifies the currently selected MAP PATTERN You can select one of the standard tests, described in Appendix B, or a customized test.
	ROTATION	See the description under DIAMETER SCAN.
	AUTO SAVE, CORRELATION, and UNITS	See the descriptions under CONTOUR MAPPING.

Table 4-6: *Text Fields in the Test Type Index Card (Continued)*

Test Type	Field	Description
QUAL PROCEDURE	TEST SITES	Fixed at 20
	WAFER DIAM, TEST DIAM, SORTING SIGMA, AUTO SAVE, CORRELATION, and UNITS	See descriptions under CONTOUR MAPPING. For TEST DIAM, use a value that will place the probe in a known uniform area of the wafer (usually the center). The system always takes five measurements, each 1/4° of a degree apart, at four sites on a wafer (refer to Figure D-1).
PATTERN TESTING	MODE	Defines the level of automatic operation AUTOMATIC: The system controls both stage motion and site measurement.
	WAFER DIAMETER	See the description under CONTOUR MAPPING.
	STEP SIZE	Defines the wafer's x- and y-step size in millimeters.
	PATTERN	Accesses the Die Selection Screen for reference die and the test die selection.
	FLAT ORIENTATION	Defines the clockwise angle at which the wafer handler will rotate the wafer before placing it on the platen die pattern you select. The orientation of the die pattern you select remains fixed, only the flat is rotated The flat orientation will be displayed on the die map when you plot or display the test results.
	SORTING SIGMA	See the description under CONTOUR MAPPING.
	AUTO SAVE	See the description under CONTOUR MAPPING.
	CORRELATION	See the description under CONTOUR MAPPING.
	UNITS	See the description under CONTOUR MAPPING.

Creating a Die (XY) Map Pattern

You use a Die (XY) Map Pattern to indicate the die you want tested. If you select PATTERN TESTING in the Test Type Index Card, you must create a die map.

Creating a die map pattern involves selecting a reference die, and then selecting a test die. The reference die is the site where the system performs the initial current and voltage setup.

1. In the Test Type Index Card, move the cursor to the PATTERN field, and press F3 (EDIT ACTIVE) to display the Die Selection Screen (Figure 4-8).

   Table 4-7 describes the command boxes displayed in the Die Selection Screen.

To select a reference die

2. Move the cursor (crosshairs) to the center of the die map using the keyboard keys (Home, End, Page Up, and so on).
   - The Home and End keys move the cursor horizontally to the left and right edges of the die map.
   - The Page Up and Page Down keys move the cursor vertically to the top and bottom edges of the map.
   - The arrow keys move the cursor step-wise in the indicated direction.
3. Press F3 (SET REFRNC) to select the Reference Die (indicated by diagonal striping).

To select test die

4. Indicate the dies you want to test. (You do not have to test the Reference Die.)
   - To select all dies for testing, press F4 (CHANGE MODE) to display INSERT MODE, then select MULTIPLE CHANGE (F2).
   - To deselect all dies, press F4 (CHANGE MODE) to enable DELETE MODE, and then press F4 (MULTIPLE CHANGE) again.
   - To select individual dies for testing, press F4 (CHANGE MODE) to enable MOVE MODE, step the cursor to the die you want to measure, and press Enter. (To deselect a die, place the cursor on the die, and press Enter again.)
   - To select several adjacent dies for testing, select CHANGE MODE (F4) to enable INSERT MODE, and move the cursor in the desired direction(s). To deselect several adjacent dies, enable DELETE MODE, and move the cursor in the desired direction(s).

   The box in the upper right corner of the screen displays the location of the cursor, the total number of dies on the wafer map, and the number of dies selected and not selected.

When you finish your selection

5. Press F4 (RETURN) to return the display to the Test Type Index Card.

   The PATTERN field displays the number of dies you have selected.

Reminder *If you change the step size or wafer diameter after creating a die map pattern, the pattern is erased and the number of sites selected returns to zero.*

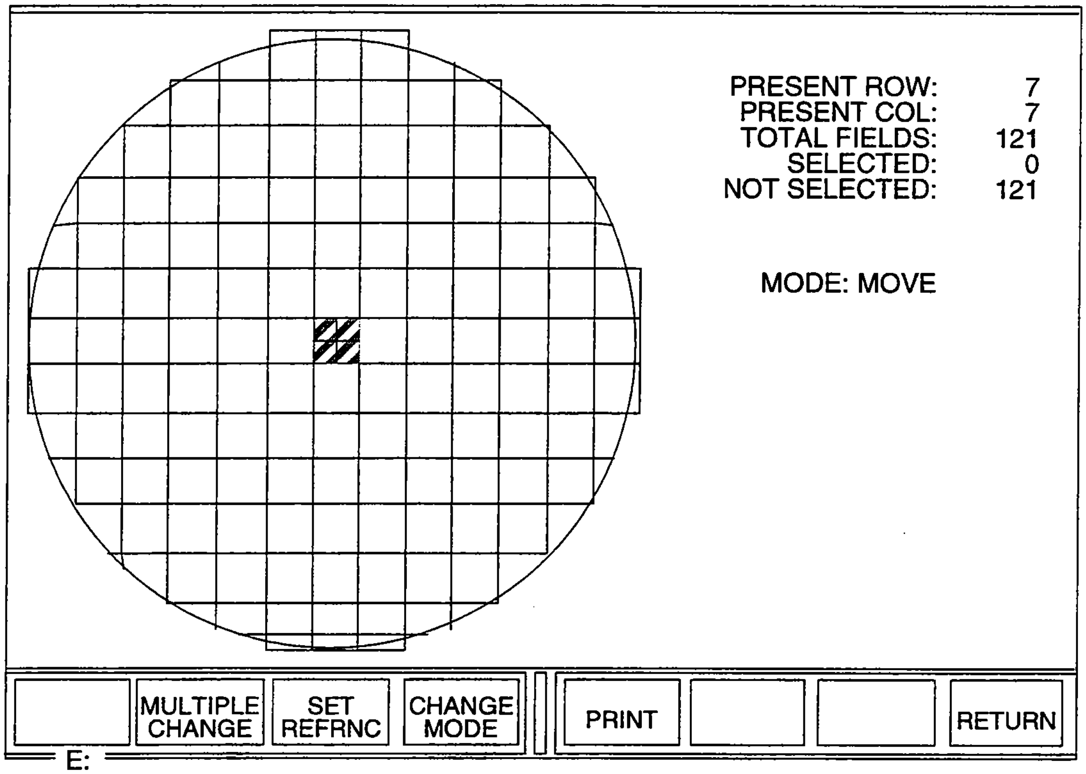

Figure 4-8: Die Selection Screen

Table 4-7: Commands in the Die Selection Screen

Command	Function
F2 (MULTIPLE CHANGE)	Selects or deselects all dies, depending on the selected MODE
F3 (SET REFRNC)	Assigns the Reference Die to the location indicated by the cursor. The system establishes the Reference Die as the location to set the voltmeter.
F4 (CHANGE MODE)	Select MOVE, DELETE, or INSERT. • MOVE lets you move the cursor without selecting dies. • INSERT lets you select adjacent dies by moving the cursor. • DELETE lets you deselect adjacent dies by moving the cursor.
F5 (PRINT)	Prints the Die Selection Screen
F8 (RETURN)	Returns to the Test Type Index Card

Entering Parameters in the Measure Type Index Card

Use the Measure Type Index Card to specify the measurement current or target voltage for a given test setup.

To display and use the Measure Type Index Card

1. From the Test Setup Card Index, select the Measure Type Index Card (Figure 4-9).
2. Press F4 (TOGGLE ACTIVE) to choose one of the options in the SAMPLE TYPE field (see Table 4-8).
3. Highlight the AMPERAGE field, type in a value between 0.0001 mA and 200.0 mA, and press Enter. (For the Auto Range sample types, the system uses the amperage you provide as a starting value.)
4. If you selected AUTO RANGE—AUTO RUN, OR AUTO RANGE and PAUSE as the routine, enter a voltage:
   - Move the cursor down to the VOLTAGE field. Type in a value between 0.01 mV and 999.9 mV, then press Enter.

Note

You cannot change the Probe ID and Probe Spacing in this index card. However, you can change the entry status of each field so that the operator must enter a Probe ID and/or Probe Spacing for each test. For example, if you are setting up a test folder for a procedure that requires a different probe head than normal (implant as opposed to metals, for instance), you should make these two fields orange. This tells the operator that a different probe head is required for the selected test. (To review editing text fields, refer to "Editing Color-Coded Text Fields.")

To change the Probe ID and Probe Spacing in Engineering or Operations Mode, refer to the section "Editing Probe Data in Engineering and Operations Modes" in Chapter 3.

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5. Highlight the PROBE ID field. Use the OPTION command to change the field's entry status as required.
6. Highlight the PROBE SPACING field. Use the OPTION command to change the field's entry status as required.
7. Highlight the CONFIGURATION field. Use the TOGGLE ACTIVE command to select a measurement configuration (see Table 4-9).
8. If you wish to correct measurements for temperature variations, highlight the TEMP. COMP. CURVE field, and use the EDIT ACTIVE or TOGGLE ACTIVE commands to select the curve file you want to reference. (Refer to Chapter 5 for detailed instructions on creating a curve file and setting up a test that references the file.)
9. When you have finished, be sure to select the UPDATE command to store the setup information.

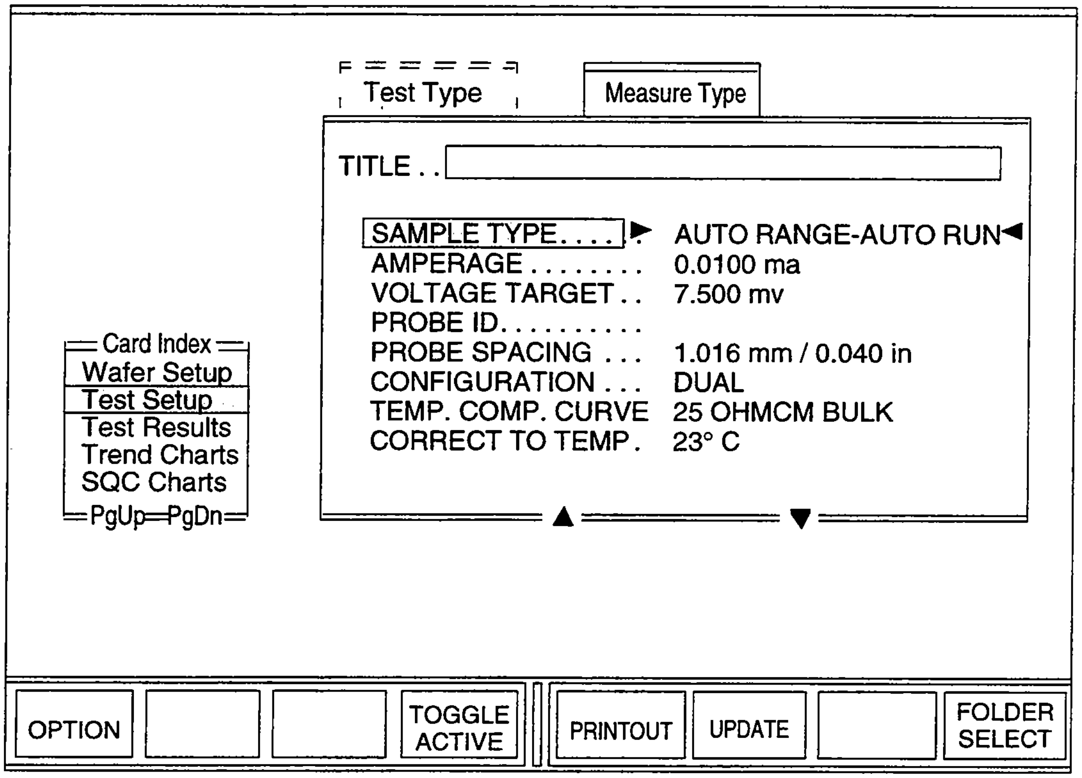

Figure 4-9: Measure Type Index Card

Table 4-8: Descriptions of Sample Type Options

Option	Description
AUTO RANGE–AUTO RUN	Before the measurement sequence begins, the probe contacts the wafer at either the center or the Set Reference location (for X-Y pattern and Custom Contour Maps). The system then automatically searches the full current range, beginning with the value in the AMPERAGE field, until it finds a current that results in a voltage drop equal to the target voltage entered in the VOLTAGE field. The system replaces the value in the AMPERAGE field with this new value and immediately begins the measurement (*Auto Run*). The system will continue to use this new current for subsequent test sites on the wafer until you start another test. AUTO RANGE AUTO RUN is the quickest and most common method of current selection used in a production environment.

Table 4-8: Descriptions of Sample Type Options (Continued)

Option	Description
MANUAL–PAUSE	MANUAL PAUSE enables you to enter a specific test current for a given wafer. Before the measurement sequence begins, the probe contacts the wafer at either the center or the Set Reference location (for X-Y pattern and Custom Contour Maps). The tester uses the current you enter in the AMPERAGE field to determine the resulting voltage. The system then pauses, allowing the operator to enter a different current in the AMPERAGE field before beginning wafer measurement. When using the MANUAL–PAUSE option, you must load wafers manually. If you attempt to use the wafer handler, the system will error out.
MANUAL–AUTO RUN	MANUAL AUTO RUN enables you to input a specific test current for a given wafer. Before the measurement sequence begins, the probe contacts the wafer at either the center or the Set Reference location (for X-Y pattern and Custom Contour Maps). The tester uses the current you entered in the AMPERAGE field to determine the resulting voltage. The system then begins the measurement sequence without pausing (Auto Run).
Note	*Selecting improper current values can produce erroneous results.*
AUTO RANGE AND PAUSE	Before the measurement sequence begins, the probe contacts the wafer at either the center or the Set Reference location (for X-Y pattern and Custom Contour Maps). The system automatically searches the full current range. It begins with the value in the AMPERAGE field, until it finds a current that results in a voltage drop equal to the target voltage entered in the VOLTAGE field. The system then replaces the value in the AMPERAGE field with this new value and displays the Measure Type Index Card so you can see the result and, if you want, enter a different current before initiating the wafer measurement. When using the AUTO RANGE–PAUSE option, you must load wafers manually. If you attempt to use the wafer handler, the system will error out.
Note	*Typically, you would use PAUSE to experiment with current and voltage settings, make measurements, review results, and change settings (or proceed with measurements). See the following section "Current Optimization."*

Table 4-9: *Descriptions of Measurement Configuration Options*

Measurement Configuration	**Description**
DUAL	Use DUAL for most measurements. The dual-configuration method uses the ratio of the two measured voltages Va and Vb to correct for geometric sources of error. Refer to Appendix A for a discussion of the dual-configuration or ***paired resistance*** method.
SINGLE CONFIG	Use SINGLE CONFIG only when you have difficulty measuring wafers using the dual-configuration method (for instance, if the system is giving ratio errors). This configuration uses only the voltage Va to calculate sheet resistance and therefore does not employ the geometric correction factor.
P/N TYPING	Use only for bulk wafers having a resistivity between 0.01 ohm-cm and 180 ohm-cm. The tester determines the conductivity type by taking a single reading in the center of the wafer. When you select P/N TYPING, the measurement voltage automatically changes to 200 mV. For more information refer to "P/N Typing" later in this chapter.

Current Optimization

When establishing your test parameters, you can choose a fixed voltage or a fixed current. In the default Sample Type, AUTO RANGE–AUTO RUN, the voltage is usually set at 7.5 mV (directing the system to search until if finds a current that results in a voltage drop of 7.5 mV). The system then uses this current to measure the wafer.

The optimum current is achieved by slowly increasing the current while monitoring the sheet resistance. If sheet resistance remains constant, the highest current usually gives the most consistent results. (If sheet resistance decreases at higher currents, the probable cause is substrate leakage. If sheet resistance increases at higher currents, and the layer has a positive temperature coefficient of resistance, the probable cause is local heating. In either case, the current should be reduced.)

Occasionally, a high resistance layer requires only a very small current to meet the default voltage requirements. Additionally, if the substrate resistivity is very low, the potential for substrate leakage may be high. Under these circumstances, the leakage current may be an appreciable proportion of the measurement current, and the *apparent* sheet resistance will be low. Therefore, the highest substrate resistivity that can be practicably obtained should be used in conjunction with the lowest reasonable current.

The minimum noise is usually achieved with a trial-and-error method: using the MANUAL–PAUSE option, several measurements are taken at a set current (using the SAMPLE command), and the standard deviation is noted. The current is then increased, the measurements are taken again, and the standard deviation at the new current is noted. This process is repeated at several different currents until the current producing the minimum standard deviation is determined. (The current should, of course fall within the acceptable current range as determined above.) This process should be employed when trying to measure a problem wafer which you have been unable to measure successfully or when a problem occurs with a known measurement process.

To identify the optimum current

1. Set up a Probe Qual test using the AUTO RANGE–PAUSE option.
2. Begin the test. (Refer to Chapter 6 for instructions on running tests.)
3. When the system has selected a current, press the SAMPLE button, and note the mean and standard deviation.
4. Select and sample several different currents near the current automatically selected by the system.

   You might find that the mean changes at much lower or higher currents. Avoid these currents. Select the current that gives the lowest and most consistent standard deviation.
5. Complete the Probe Qualification test:
   - If the standard deviations of each group of five measurements is below 0.2%, you are done.
   - If the standard deviations of each group of five measurements is 0.2% or greater, select another type of probe or condition the probe if you suspect it is bad (see "Probe Conditioning" in Chapter 3.), and repeat this procedure. If you suspect that you do not have the proper probe, call your Tencor representative and arrange to send a sample wafer for testing.

P/N Typing

The P/N Typing technique uses the rectification of a metal semiconductor (ASTM standard F42-77, Method D*) to determine the conductivity type of the sample. P/N Typing should only be used for bulk wafers having a resistivity between 0.01 and 180-ohm-cm. Results on any other wafers are *not* meaningful.

The system determines P/N type as follows. During one half-cycle, a given contact is reverse-biased and experiences the major portion of the voltage drop. During the following half-cycle, this junction is forward-biased, and the voltage drop is small compared to that of the first half-cycle. This inequality of voltages results in a DC component which is a function of the semiconductor type (Figure 4-10).

The tester determines the conductivity type by taking a single reading in the center of the wafer. When determining P/N type, the measurement voltage automatically changes to 200 mV, which generally gives the best results.

To set up a P/N test

1. In the Measure Type Index Card, choose P/N TYPING in the CONFIGURATION field (Figure 4-11).
2. Set up the remaining parameters as appropriate, and save the test.

   Note that if the Auto Range–Pause or Manual–Pause Sample Type is selected, the system will stop the test after taking one measurement at the center of the wafer. At this point, the operator can press F6 (SAMPLE) (Figure 4-12) to display a list of voltage pairs, as well as the sum of the forward and reverse measurements used to determine the type. (Figure 4-13). Remember, in addition to requiring operator input to continue the test, these options require manual loading and unloading of wafers.

The operator initiates the test from the Measure Type Index Card by pressing F1 (LOAD WFR/TEST WFR). In the subsequent reports of test data, the system designates N-type, non-determinate type, and P-type as *1, 2, 3* respectively. This allows the system to handle type as a number for Combine Map operations.

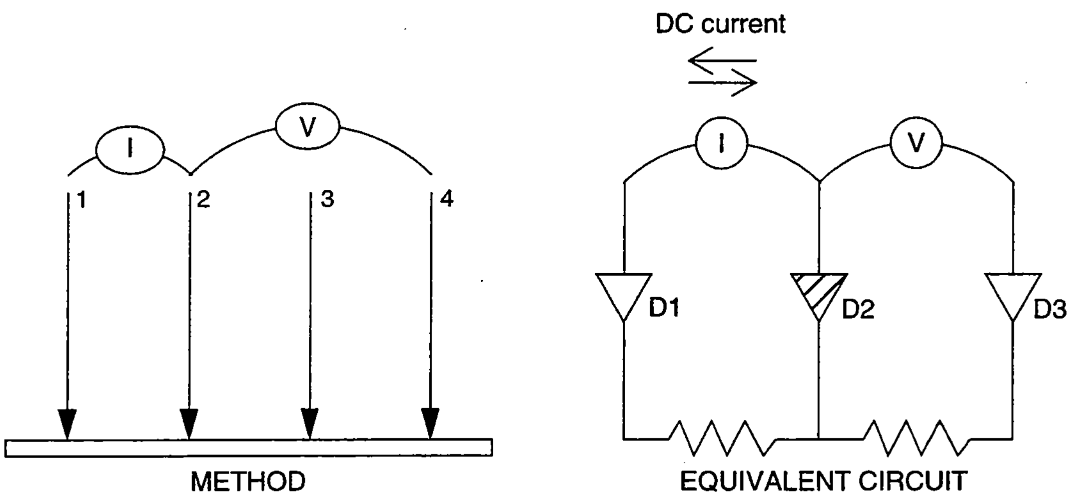

Figure 4-10: *P/N Typing Configuration on OmniMap Systems*

* American Society for Testing and Materials. 1977. *Annual Book of ASTM Standards*. Philadelphia, Pennsylvania.

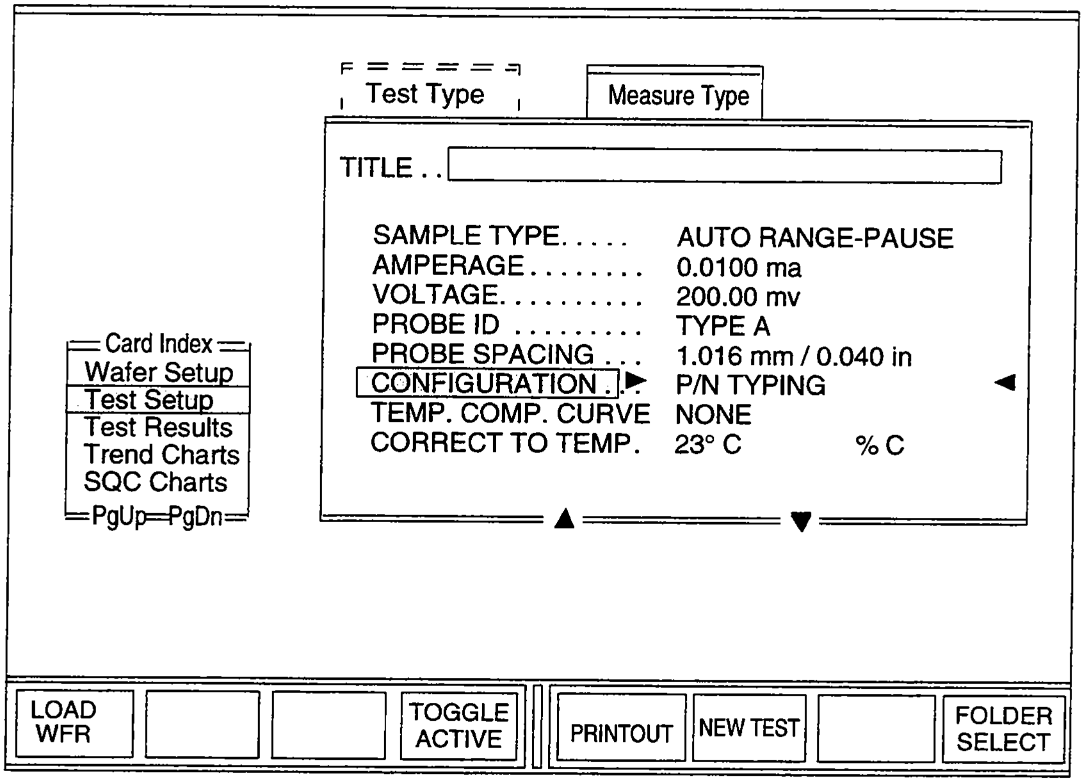

Figure 4-11: Measure Type Index Card for P/N Typing

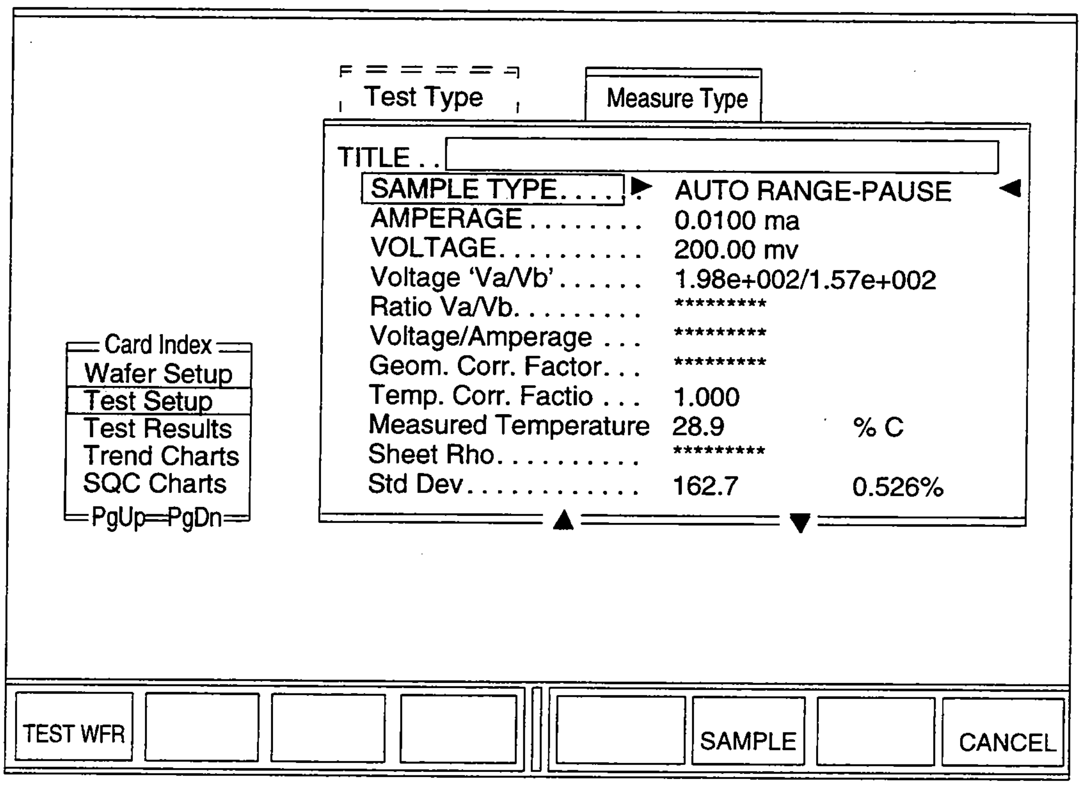

Figure 4-12: Measure Type Index Card (for a –PAUSE Sample Type)After Initial Measurement

#	Voltage (IP)	#	Voltage (IN)	Sum (IP+IN)
1:	-203.04	2:	198.43	-4.6083
3:	-202.92	4:	198.52	-4.3947
5:	-203.1	6:	198.58	-4.5167
7:	-203.01	8:	198.52	-4.4862
9:	-203.01	10:	198.46	-4.5473

P-TYPE

RETURN

Figure 4-13: P/N Type Screen

Test Result Formats

In addition to the index cards that contain your testing parameters, Test Setup includes the index cards which define how the system will display the test results. These index cards are located in the Test Results, Trend Charts, and SQC Charts Card Indices.

The Trend Charts and SQC Charts Card Indexes contain the setup and scaling parameters for their respective charts. The Test Results Card Index contains the Maps & Graphs Index Card which records the parameters that define the map displays. Table 4-10 lists the available map displays by Test Type.

Table 4-10: *Test Type and Associated Test Result Displays*

Test Type	Display
Contour Mapping	Contour Map 3D Map
Diameter Scan	Scan Display
Pattern Testing	Contour Map 3D Map Die Map

Refer to the next section, "Entering Parameters in the Maps & Graphs Index Card," to set viewing parameters for Contour Maps, 3D Maps, and Diameter Scans.

Entering Parameters in the Maps & Graphs Index Card

Use the Maps & Graphs Index Card to set the viewing parameters for Contour Maps, 3D Maps, and Diameter Scans. Refer to Chapter 7 for additional information on viewing and interpreting these displays.

This procedure assumes that you have opened the folder that will contain the setup. If you have not, refer to the earlier section "Selecting a Test Folder."

To enter parameters in the Maps & Graphs Index Card

1. Using the page down key, highlight the Test Results Card Index.

   The Maps & Graphs Index Card appears (Figure 4-14). Selections in this card vary depending on the Test Type selected in the Test Setup Card Index:

   - Table 4-11 describes the text fields for Contour and 3D Map displays.
   - Table 4-12 describes the text fields for a Scan Display.

2. Referring to the descriptions in the appropriate table, select individual fields, and press F4 (TOGGLE ACTIVE) to select from the options, or type in the required value.
3. Use the OPTION command to color-code the fields as required.
4. Press F6 (UPDATE) to save the entries.
5. Continue setting up the test in the remaining index cards, or press F8 (FOLDER SELECT) to return to the Folder Select Screen.

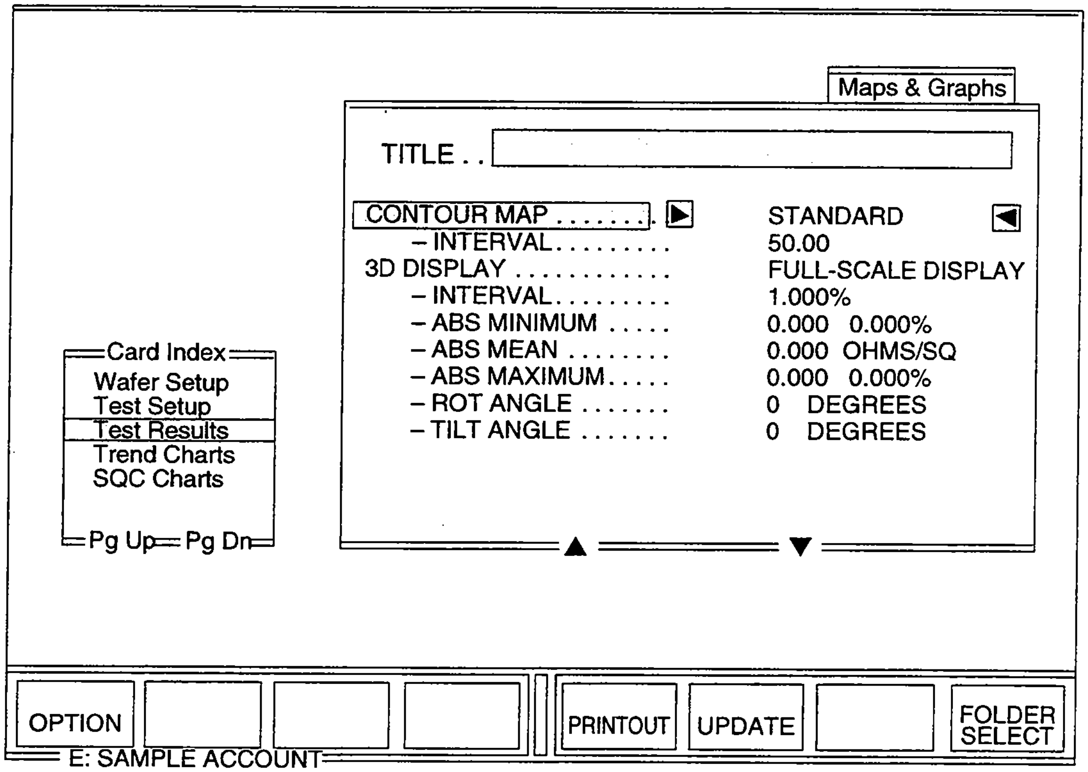

Figure 4-14: Maps & Graphs Index Card

Table 4-11: Text Fields in the Maps & Graphs Index Card for Contour Maps and 3D Displays

Text Field	Options	Description
CONTOUR MAP	None	This field cannot be edited
- INTERVAL	User-defined	Defines the distance between contour lines. Enter a value in ohms/sq or a percentage (type a % sign after the value.)
3D DISPLAY	FULL-SCALE DISPLAY	Shows the full 3D map from its maximum to minimum values plotted about the mean.
	ABSOLUTE DISPLAY	Sets the reference plane at the -ABS MEAN value you define and plots the values between the limits -ABS MINIMUM and -ABS MAXIMUM. To choose ABSOLUTE DISPLAY only, set the -ABS MINIMUM, -ABS MEAN, and -ABS MAXIMUM values. (The -ABS MEAN value refers to the reference plane; it does not have to be the actual mean sheet resistance, but can be the minimum spec sheet resistance [so all values appear positive] or the target spec sheet resistance.)
	NORMALIZED DISPLAY	Sets the reference plane at the true mean and plots all values within the percentage limits from the mean. To choose NORMALIZED DISPLAY only, move the cursor to the 3D-Interval field and enter the value as a percentage of the mean (type a % sign after the value).
– INTERVAL	User-defined	Defines the distance between contour lines. Enter a value (usually in ohms/sq, but can change depending on correlation equation) or a percentage. (Type a % sign after the value.)
– ABS MINIMUM	User-defined	Defines visual display cutoff points. A value (usually in ohms/sq, but can change depending on correlation equation) or a percentage. (Type a % sign after the value.)

Table 4-11: Text Fields in the Maps & Graphs Index Card for Contour Maps and 3D Displays

Text Field	Options	Description
–ABS MEAN	User-defined	Defines visual display cutoff points. A value (usually in ohms/sq, but can change depending on correlation equation) or a percentage. (Type a % sign after the value.)
–ABS MAXIMUM	User-defined	Defines visual display cutoff points. A value (usually in ohms/sq, but can change depending on correlation equation) or a percentage. (Type a % sign after the value.)
–ROT ANGLE	0 - 360°	The rotational angle at which the 3D wafer map is viewed. (90°, for example, moves the wafer map's flat 90° clockwise.)
–TILT ANGLE	0 - 360°	The map's angle of tilt toward the viewer. 0° gives an edge-on view of the wafer. 90° gives an overhead view. (Useful only if the data exceeds the specified sheet resistance values, resulting in a multi-colored Contour Map. The default value is 30°.)

Table 4-12: Text Fields in the Maps & Graphs Index Card for a Scan Display

Text Field	Option	Description
SCAN DISPLAY		Defines the Scan Display.
	FULL-SCALE DISPLAY	Displays the full scan.
	ABSOLUTE DISPLAY	Sets the reference line as described under the Contour Map entry.
	NORMALIZED DISPLAY	Sets the reference line as described under the Contour Map entry.
– INTERVAL, – ABS MINIMUM, – ABS MEAN, and – ABS MAXIMUM	See the descriptions under the Contour Map entry.	

Entering Parameters in the Trend Setup Index Card

Use the Trend Setup Index Card to record the statistical parameters for the Trend Chart's horizontal axis. Refer to Chapter 7 for additional information on viewing and interpreting Trend Charts.

This procedure assumes that you have selected a folder to store the setup. If you have not, refer to "Selecting a Test Folder."

To enter parameters in the Trend Setup Index Card

1. Using the page down key, highlight the Trend Setup Card Index.

   The Trend Setup Index Card appears (Figure 4-15).

2. Referring to the descriptions in Table 4-13, select individual fields, and press F4 (TOGGLE ACTIVE) to select from the options, or type in the required value.
3. Use the OPTION command to color-code the fields as required.
4. Press F6 (UPDATE) to save your entries.
5. Continue setting up the test in the remaining index cards, or press F8 (FOLDER SELECT) to return to the Folder Select Screen.

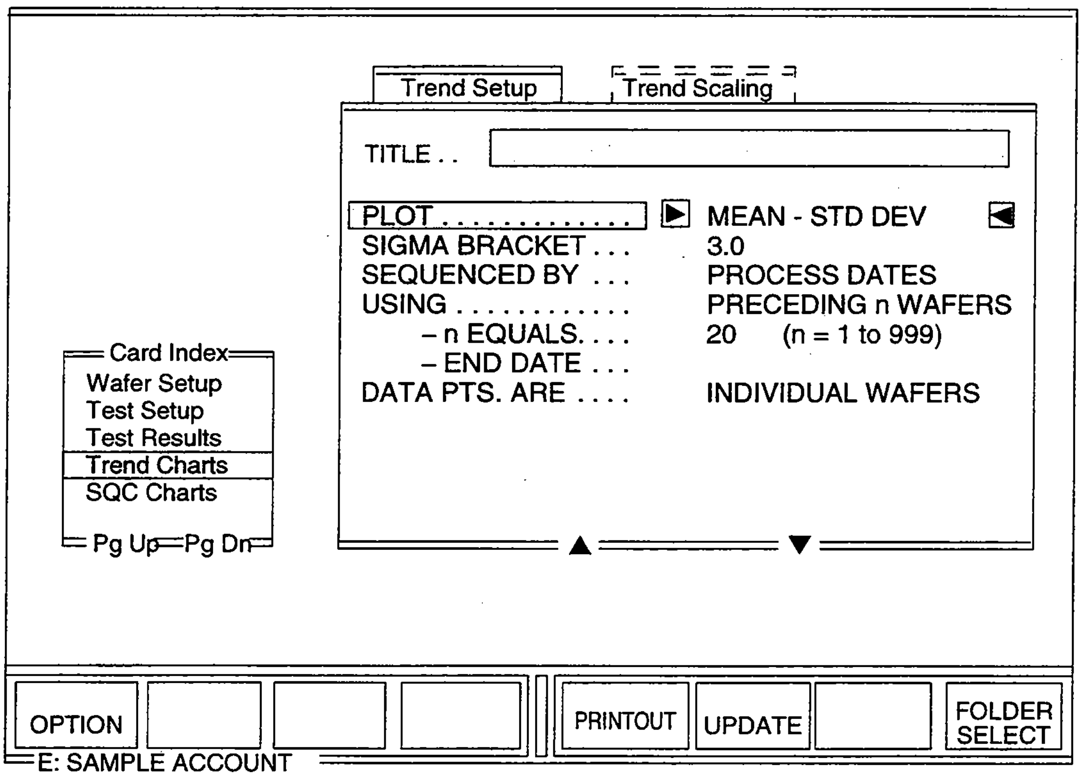

Figure 4-15: Trend Setup Index Card

Table 4-13: Text Fields in the Trend Setup Index Card

Text Field	Options	Description
PLOT	None	This field is locked at MEAN - STD DEV, because the chart always plots the mean and standard deviation of the test. Standard deviation is denoted by the symbol σ (sigma).
SIGMA BRACKET	User-defined (0.1 - 100.0)	The length of the error bars associated with each data point on the Trend Chart. The default value is 3.0. 3.0, for example, encloses a full 6σ range (±3σ) about the point; 3σ above and 3σ below
SEQUENCED BY	PROCESS DATES LOT ID COLLECTION DATES	The parameter used for ordering wafers
USING		The range of wafers you want ordered
	PRECEDING n WAFERS	The chart displays results from the last *n* wafers, as defined in - n EQUALS field
	DATE RANGE	The chart displays results from wafers tested during the date range defined in - START DATE and - END DATE fields.
	PRECEDING n DAYS	The chart displays results from wafers tested during last *n* days, as defined in - n EQUALS field.
— n EQUALS	User-defined (1 - 999)	The number of preceding wafers or days of testing included in the chart The screen displays the results for a maximum of 60 wafers at a time.
Note *To set the - START DATE and - END DATE,* • *Select the field and use the EDIT ACTIVE command (F3)* • *Adjust the settings using the command boxes at the bottom of the screen.*		
— START DATE	User-defined	The first date included in the Date Range
— END DATE	User-defined	The last date included in the Date Range
DATA PTS. ARE	INDIVIDUAL WAFERS GROUPED BY DAY GROUPED BY MONTH	Defines how data points are displayed

Entering Parameters in the Trend Scaling Index Card

Use the Trend Scaling Index Card to record the y-axis scaling limits for Trend Charts. The Trend Chart displays the scale in the specified units (such as ohms/sq) and as a percentage.

To enter parameters in the Trend Scaling Index Card

1. From the Trend Charts Card Index, use the right-arrow key to select the Trend Scaling Index Card (Figure 4-16).
2. Select individual fields, and use the TOGGLE ACTIVE command (F4) to choose from the options described in Table 4-14, or type in the required value.
3. Use the OPTION command to color-code the fields as required.
4. Press F6 (UPDATE) to save your entries.
5. Continue setting up the test in the remaining index cards, or press F8 (FOLDER SELECT) to return to the Folder Select Screen.

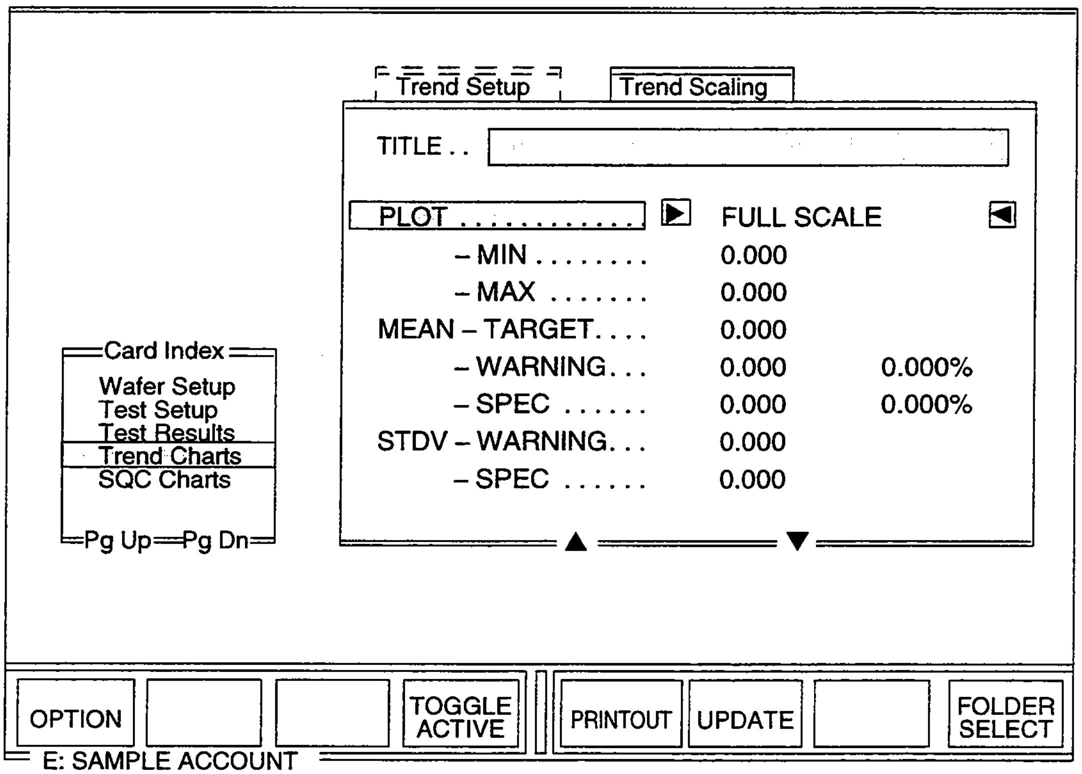

Figure 4-16: Trend Scaling Index Card

Table 4-14: *Text Fields in the Trend Scaling Index Card*

Text Field	Options	Description
PLOT		Defines the y-axis scale
	FULL SCALE	Plots the full range of file means about the value (max-min)/2 (taken from the wafer group selected in the USING field in the Trend Setup Index Card).
	SPEC SCALE	Plots the selected test file means and error bars about the MEAN-TARGET value. Select SPEC SCALE when setting up a Qual Procedure. Enter the MEAN and STDV values (all 1 σ) recommended later in this table.
	USER-DEFINED LIMITS	Plots the selected files about the average of the limits entered in the PLOT-MIN and PLOT-MAX fields
– MIN	User-defined	The lowest value to be plotted
– MAX	User-defined	The highest value to be plotted
MEAN TARGET	User-defined	Target value for test film When SPEC SCALE is selected, enter the MEAN-TARGET value in thickness units. For Qual Procedures, enter the actual resistivity of your wafer standard.
— WARNING	User-defined	The warning limits for the test film. Enter as a number or a percent. If you select SPEC SCALE, enter the MEAN-SPEC limits in sheet resistance units or as a percentage.Values that exceed these limits will be displayed in red.
— SPEC	User-defined	The specification limits for the test layer. Enter as a number or a percent.Values that exceed these limits will be displayed in yellow. If a wafer's mean thickness value exceeds the MEAN-WARNING and MEAN-SPEC values, the system issues a warning message to the operator.
STDV —WARNING	User-defined	The standard deviation warning limit. For Qual Procedures, enter 0.10%.

Table 4-14: Text Fields in the Trend Scaling Index Card (Continued)

Text Field	Options	Description
–SPEC	User-defined	The standard deviation specification limit. For Qual Procedures, enter 0.20%. The system checks these limits after collecting data and checking the MEAN-WARNING and MEAN-SPEC values. If the standard deviation of any wafer test exceeds these limits, the system issues a warning message to the operator.

Entering Parameters in the SQC Setup Index Card

Use the SQC Setup Index Card to record the statistical parameters for StatTrax SQC Charts. The SQC feature uses data collected over a specific period of time and calculates upper and lower control limits. These limits signify the point at which subsequent data exceeds the control limits. Refer to Chapter 7 for additional information on viewing and interpreting SQC Charts.

This procedure assumes that you have opened the test folder. If you have not, refer to "Selecting a Test Folder."

To enter parameters in the SQC Setup Index Card

1. Using the page down arrow key, highlight the SQC Charts Card Index.

   The SQC Setup Index Card appears (Figure 4-17).

2. Use the up- or down-arrow keys to select individual fields, and type in the required value, or use the TOGGLE ACTIVE command to choose from the options described in Table 4-15.

   For the - START DATE and - END DATE fields, use the EDIT ACTIVE command (F3), and adjust the setting using the newly displayed command boxes at the bottom of the screen.

3. Use the OPTION command to color-code the fields as required.
4. Press F6 (UPDATE) to save your entries.
5. Continue setting up your test in the remaining index cards, or press F8 (FOLDER SELECT) to return to the Folder Select Screen.

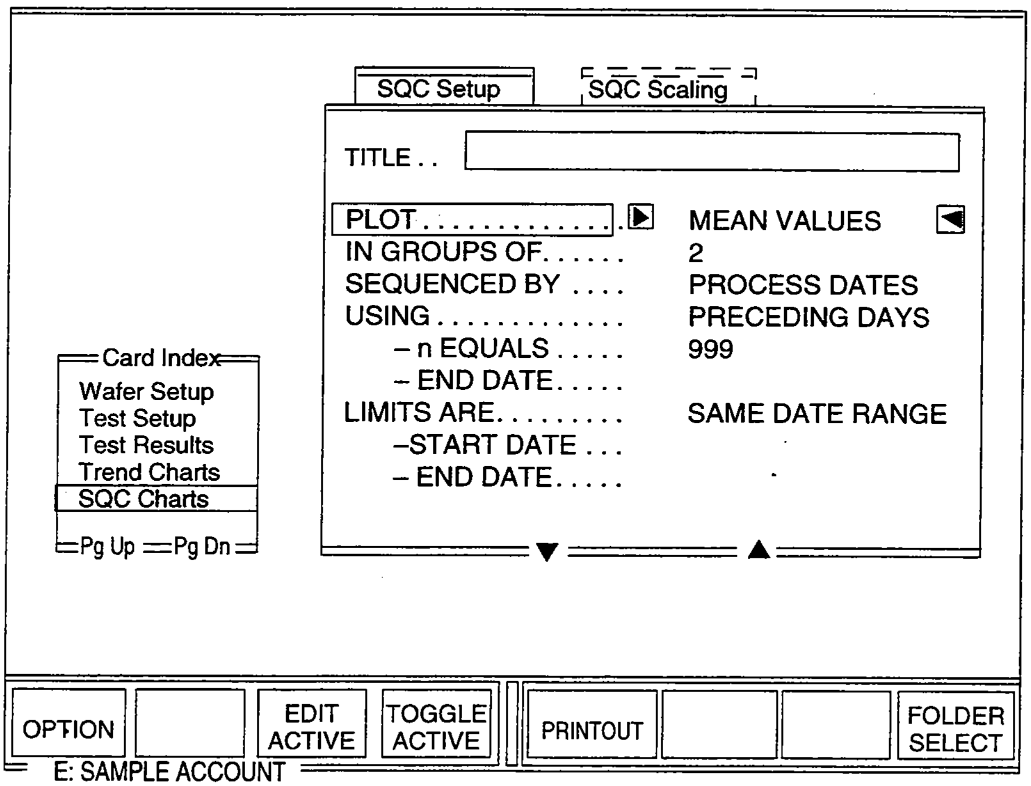

Figure 4-17: *SQC Setup Index Card*

Table 4-15: Text Fields in the SQC Setup Index Card

Text Field	Options	Description
PLOT	MEAN VALUES RANGE VALUES STANDARD VALUES	Identifies the values to be plotted
IN GROUPS OF	1 - 10	The number of wafers within a group. A WAFER POINT GROUP is a group of 1.
SEQUENCED BY	PROCESS DATES COLLECTION DATES	The parameter used for ordering wafers
USING	DATE RANGE	The chart displays results from wafers tested during the date range defined in the - START DATE and - END DATE fields.
	PRECEDING n DAYS	The chart displays results from wafers tested during the last *n* days, as defined in the -n EQUALS field.
– n EQUALS	User-defined 1 - 999	The number of preceding wafers or days included in the chart. The screen displays results from maximum of 60 wafers at a time.
– START DATE	User-defined	The first date included in the Date Range
– END DATE	User-defined	The last date included in the Date Range
LIMITS ARE		Defines the Upper Control Limit (UCL) and Lower Control Limit (LCL) for the SQC charts
	USER-DEFINED LIMITS	The user defines the limits. When you select USER-DEFINED LIMITS in the SQC Setup Index Card, you must also select USER-DEFINED LIMITS in the SQC Scaling Index Card.
	SAME DATE RANGE	The system considers measurements taken during the date range described in the USING field as *in control* and uses them in calculating the UCL and LCL for the charts
	DIFFERENT RANGE	The system considers measurements taken between – START DATE and – END DATE as *in control* and uses them in calculating the UCL and LCL for the charts.

Table 4-15: Text Fields in the SQC Setup Index Card

Text Field	Options	Description
– START DATE	User-defined	The first date included in the DIFFERENT RANGE
– END DATE	User-defined	The last date included in the DIFFERENT RANGE

Entering Parameters in the SQC Scaling Index Card

You use the SQC Scaling Index Card to record the upper and lower SQC control limits.

To enter parameters in the SQC Scaling Index Card

1. From the SQC Charts Card Index, use the right-arrow key to select the SQC Scaling Index Card (Figure 4-18).
2. Select individual fields, and type in the required value, or use the TOGGLE ACTIVE command (F4) to select from the options described in Table 4-16.
3. Use the OPTION command to color-code the fields as required.
4. Press F6 (UPDATE) to save your entries.
5. If you have finished setting up your test, press F8 (FOLDER SELECT) to return to the Folder Select Screen.

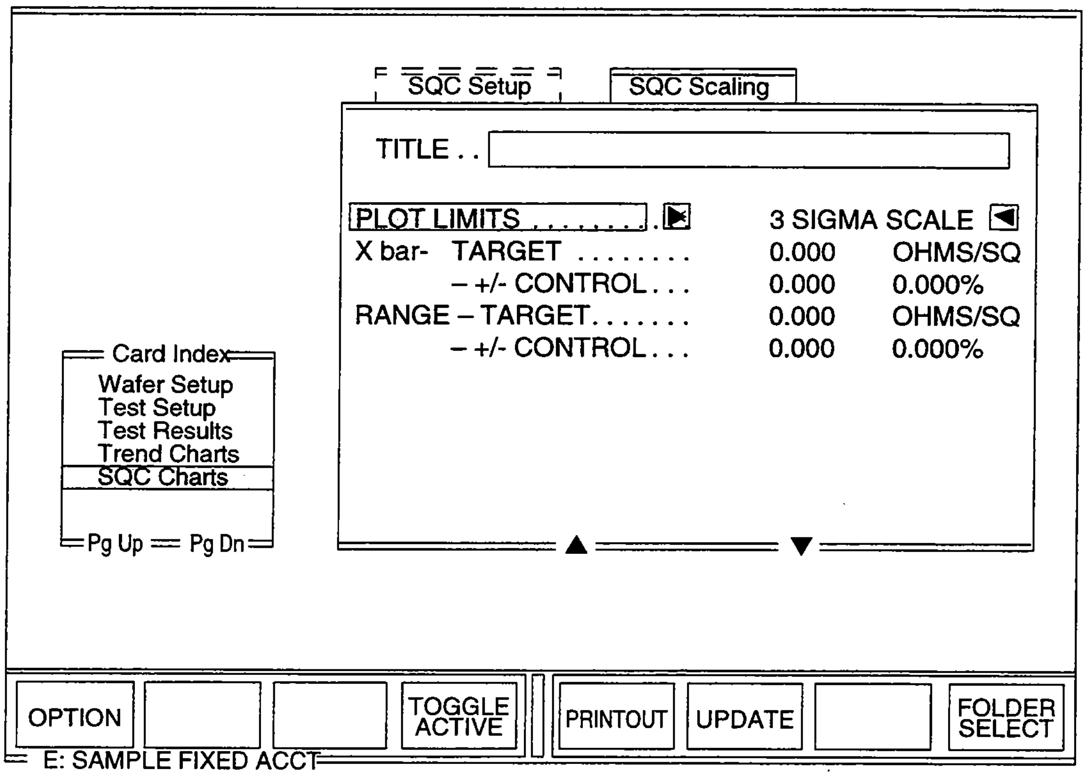

Figure 4-18: *SQC Scaling Index Card*

Table 4-16: Text Fields in the SQC Scaling Index Card

Text Field	Options	Description
PLOT LIMITS	3 SIGMA SCALE	Automatically uses the UCL (Upper Control Limit) and LCL (Lower Control Limit) shown in red on the SQC charts. These limits are equal to approximately three standard deviations (3 σ) of the total current data values. StatTrax plots the selected group means about their collective mean.
	FULL SCALE	Shows the full range of group values plotted about their collective mean
	USER-DEFINED	Target and control limits are defined in the following four fields StatTrax plots the selected group means about their collective mean. Make sure you have also selected USER-DEFINED Limits in the SQC Setup Index Card's LIMITS ARE field.
The following fields are for USER-DEFINED PLOT LIMITS only.		
X bar — TARGET	User-defined	The target measurement value
– +/- CONTROL	User-defined	The mean control limits in units or as a percentage of the target value. If specifying a percent, type a % sign after the value.
RANGE —TARGET	User-defined	The target range
– +/- CONTROL	User-defined	The range control limits in units or as a percentage of the target value

Print Outs of a Test Setup

To print a summary listing of the parameters for a particular test

1. Make sure the system printer is connected to the computer, switched on, and loaded with paper. Check that the Form Feed (FF) is properly set.
2. From the Introduction Screen, press SET UP.
3. Type the account password (if there is a password), and press Enter.
4. Use the page up or page down key to highlight the TEST DEVELOPMENT MENU. (The TEST SETUP ITEM selection should be selected.)
5. Press SELECT.
6. Use the arrow keys to highlight the desired cabinet, drawer, and folder.
7. Press F1 (SELECT).

   The Wafer Facts Index Card appears.
8. Press PRINTOUT.

The Duplicate Tests Item

Use the Duplicate Tests item in the Test Development Menu to copy test setups from one cabinet, drawer, or folder to another within the same account. This feature saves considerable time when setting up identical tests.

To copy the ***entire contents*** of one account to another account, refer to "Back Up/Delete Files" in Chapter 8. To copy ***test setups*** from one account to another account, refer to "Initializing an Account" in Chapter 3.

Important *The source and target storage type must be the same. That is, you can only copy information from cabinet to cabinet, drawer to drawer, or folder to folder.*

To copy test setups within an account

1. From the Main Engineering Menu, select TEST DEVELOPMENT and DUPLICATE TESTS, and press F1 (SELECT).

   The Folder Select Screen for duplicating tests (Figure 4-19) appears. This Folder Select Screen offers a different set of command boxes than the standard Folder Select Screen.

2. Use the arrow keys to highlight the *source* cabinet, drawer, or folder on the screen, and press F1 (SOURCE) to confirm your selection.

   The selected source field turns red.

3. Use the arrow keys to highlight the *target* cabinet, drawer or folder, and press F2 (TARGET) to confirm your selection.

   The selected target field turns blue. (You can select more than one field as a target.) The SELECTED SOURCE and TOTAL TARGETS fields keep track of your selections.

4. Select any of the four IGNORE/COPY commands to identify the source characteristics you want copied (or not copied) to the target. Table 4-17 describes the IGNORE/COPY commands.

5. Press F7 (BEGIN COPY) to start the copy process.

6. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

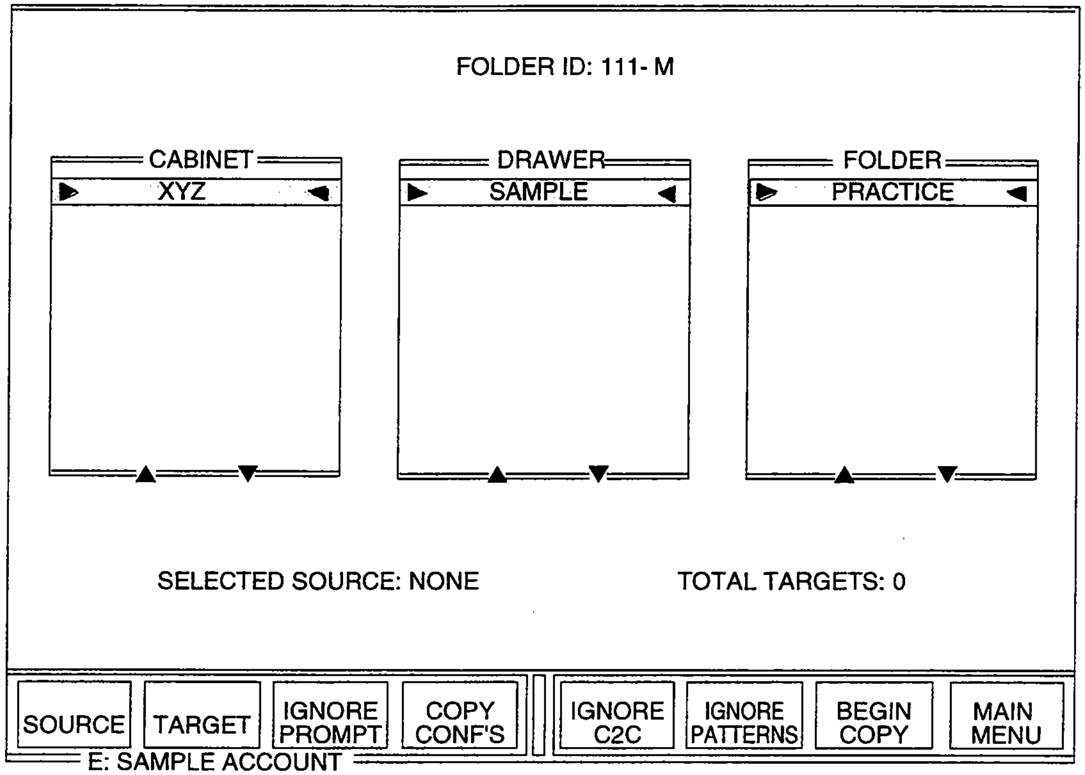

Figure 4-19: *Folder Select Screen for Duplicate Tests*

Table 4-17: *Command Boxes in Folder Select Screen for Duplicate Tests*

Command Box	Description
F1 (SOURCE)	The cabinet, drawer or folder you want to copy.
F2 (TARGET)	The cabinet, drawer or folder to receive the copy.
F3 (IGNORE PROMPT)/ (COPY PROMPT)	Ignore/Copy the cabinet, drawer, and folder names from the source to the target.
F4 (IGNORE CONF'S)/ (COPY CONF'S)	Don't copy/Copy the test configurations (setups) from the source to the target.
F5 (IGNORE HANDLER)/ (COPY HANDLER)	Don't copy/Copy the wafer handler specific, folder-level setups from the source to the target. This includes the information in the Wafer Handler Index Card.
F6(IGNORE PATTERNS)/ (COPY PATTERNS)	Don't copy/Copy the XY pattern setups in the die map tests from the source to the target.
F7 (BEGIN COPY)	Start the copy process.
F8 (MAIN MENU)	Return to the Main Engineering Menu.

Chapter 5
Setting Up Advanced Tests

Read This First

This chapter, intended for the process engineer or wafer fab technician, describes StatTrax advanced testing options. Before performing the setups described in this chapter, set up your system's operating parameters as outlined in Chapter 3. The instructions in this chapter assume that you are familiar with the Test Development Menu and know how to

- Enter test parameters for
  - Polar-coordinate map tests
  - Patterned wafer tests (XY Die Map Tests)
- Enter display parameters for Test Results, Trend Charts, and SQC Charts
- Duplicate tests from one cabinet, drawer, or folder to other cabinets, drawers, or folders in the same account

In this chapter you will return to the Test Development Menu and learn to create

- Custom Quick Tests
- Correlation Curves
- Temperature Coefficient of Resistance (TCR) Curves
- Contour Maps
- Batch Recipes

Chapter 5
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In this chapter you will return to the Test Development Menu and learn to create

- Custom Quick Tests
- Correlation Curves
- Temperature Coefficient of Resistance (TCR) Curves
- Contour Maps
- Batch Recipes

Custom Quick Test Patterns

With StatTrax you are not limited to the 15 standard Quick Test patterns. You can create as many as 15 additional Quick Tests of up to 30 sites each in polar or Cartesian coordinates. For a Cartesian-Coordinate Quick Test, the coordinate origin (0,0) lies in the center of the wafer with the test pattern measured in an *x-y* grid format (see Figure 5-1).

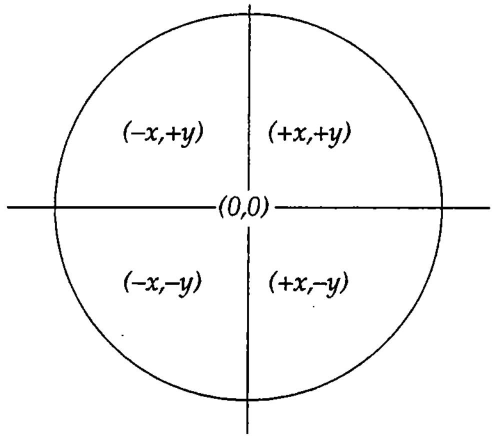

Figure 5-1: *Cartesian-Coordinates*

For a Polar-Coordinate Quick Test, the coordinate origin (0,0) lies in the center of the wafer with theta values measured in counter-clockwise degrees. Radial units are based on the test diameter, measured from the origin, as shown in Figure 5-2 (a). Refer to Appendix B for additional information.

The following radial-theta coordinates describe the test pattern shown in Figure 5-2(b):

Site	1	2	3	4	5	6	7	8	9
Coordinates									
Radial (fraction of test radius)	0	0.5	0.5	0.5	0.5	1	1	1	1
Theta (degrees)	0	0	90	180	270	0	90	180	270

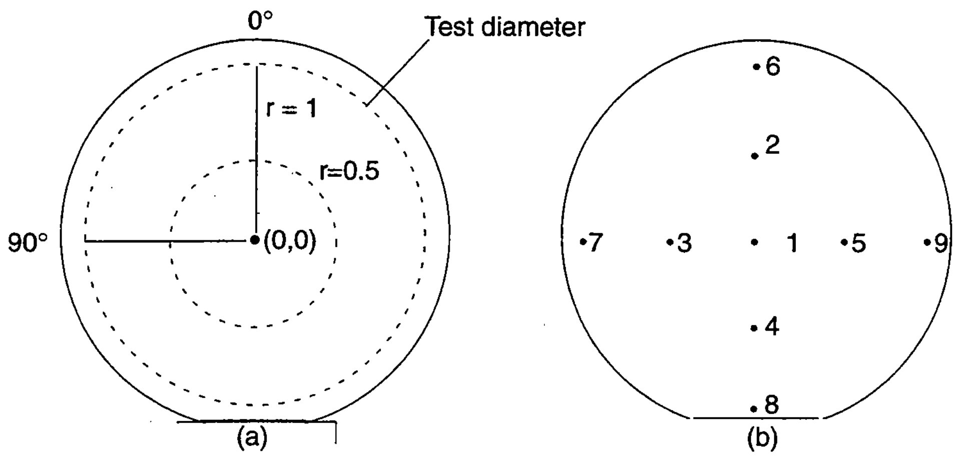

Figure 5-2: *Polar-Coordinates and Associated Pattern*

Viewing the List of Quick Test Patterns

To view the list of Quick Test Patterns

1. From the Main Engineering Menu, select TEST DEVELOPMENT and QUICK TEST PATTERNS.

2. Press F1 (SELECT) to display the Quick Test Setup Screen for Polar-Coordinate Quick Tests (Figure 5-3).

   The QUICK TEST table lists the names of the fifteen standard quick tests. The RADIAL and THETA table lists the radial and theta coordinates for the currently highlighted quick test. (Appendix B contains illustrations of the standard quick test patterns.)

   Pressing the down-arrow key or Page Down key will display blank fields for your custom Quick Tests setups.

With the list of Quick Test Patterns displayed, refer to any of the following sections for subsequent tasks.

- "Creating a Custom Polar-Coordinate Quick Test"
- "Creating a Custom Cartesian-Coordinate Quick Test"
- "Deleting a Test from the List of Quick Test Patterns"

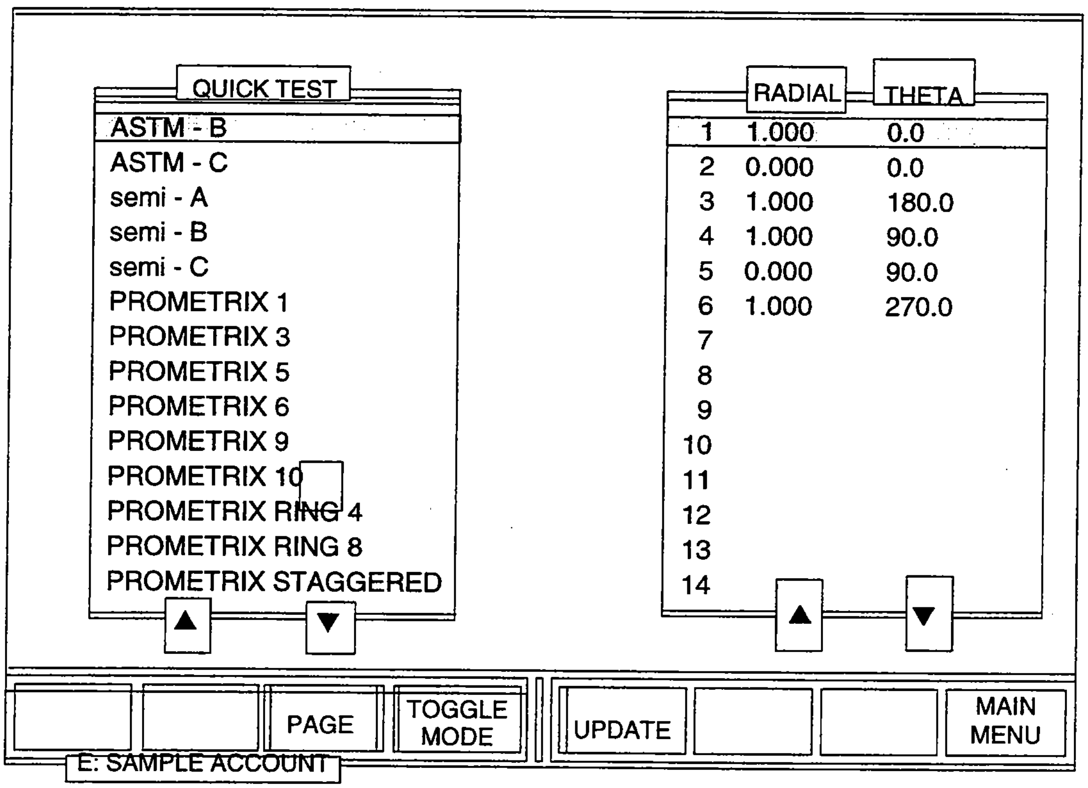

Figure 5-3: Quick Test Setup Screen, Polar-Coordinate Quick Test

Creating a Custom Polar-Coordinate Quick Test

This procedure assumes the Quick Test Setup Screen is currently displayed on the monitor. If it is not, refer to the previous section, "Viewing the List of Quick Test Patterns."

To create a custom polar-coordinate Quick Test

1. Press F3 (PAGE) to move to the next page in the Quick Test listing.
2. Select a blank field in the QUICK TEST table, type in a name for the new test, and press Enter.
3. Select the first blank field in the RADIAL column, type in the radial value (as a multiple of the test radius [0–1, in increments as small as 0.1]), and press Enter.
4. Move to the THETA column, type in the theta value (0–360°, in increments as small as 0.1°), and press Enter.
5. Repeat steps 3 and 4 to enter additional coordinates.
6. Press F5 (UPDATE) to store the information.
7. Press F8 (MAIN MENU) to return to the Main Menu.

Note *The tester measures sites on Customized Quick Tests in the order that you list the coordinates. In Figure 5-2, for example, point 1 could have been placed at 1, 270, and point 9 could have been placed at 0, 0.*

Creating a Custom Cartesian-Coordinate Quick Test

This procedure assumes the Quick Test Setup Screen is currently displayed on the monitor. If it is not, refer to the earlier section "Viewing the List of Quick Test Patterns."

To create a custom Cartesian-coordinate Quick Test

1. Select a blank field in the QUICK TEST table, and type in a name for the new test.
2. Press F4 (TOGGLE MODE) to display the Quick Test Setup Screen for Cartesian-coordinate Quick Tests.
3. Select the first blank field in the X POS column, type in the first *x* value (in mm), and press Enter.
4. Move to the Y POS column, type in the *y* value (in mm), and press Enter.
5. Repeat steps 3 and 4 to enter additional coordinates.
6. Press F5 (UPDATE) to store the information.
7. Press F8 (MAIN MENU) to return to the Main Menu.

Note *The origin of a Cartesian-coordinate Quick Test is the wafer center. The* x *value increases to the right, and the* y *value increases to the top of the wafer. The distance traveled is measured as an absolute value, and has no relationship to a test diameter. Therefore, these tests are wafer size specific.*

Deleting a Test from the List of Quick Tests

This procedure assumes the Quick Test Setup Screen is currently displayed on the monitor. If it is not, refer to the earlier section "Viewing the List of Quick Test Patterns."

To delete a test from the list

1. Highlight the entry, and press F7 (DELETE).

   The monitor displays a message warning you that the data will be lost:

   - Press F1 (YES) if you wish to delete the entry.
   - Press F8 (NO) to cancel the deletion.

Correlation Curves

Use the Correlation Curves feature to adjust or transform resistivity measurements. You can do the following:

- Convert resistivity measurements to units other than ohms/sq.
- Introduce an offset in your results by using the Curve Fitting feature (described in Chapter 7) to plot two variables against each other, and entering the resulting equation into the Correlation Curves Screen.

  For example, you can set up the system to correlate ohms/sq units to implant dose (ions/cm^2) after you have performed curve fitting for a double-implant procedure. (Ask a Tencor representative for the technical brief titled, "Sheet Resistance Monitoring of Low Dose Implants Using the Double-Implant Technique.")

Viewing the List of Correlation Curves

To view the list of correlation curves

1. From the Main Engineering Menu, use the page up, page down, or arrow keys to highlight TEST DEVELOPMENT and CORRELATION CURVES.
2. Press F1 (SELECT) to access the Correlation Curves Screen (Figure 5-4).
   - The general correlation curve formula with variables *X* (ohms/sq) and *Y* (new units), and coefficients *S1, S2, A, B, C,* and *D* is displayed at the top of the screen.
   - The CORRELATION table lists the currently available correlations.
   - The VALUES table contains the corresponding set of values for the variables in the correlation curve formula. (New cartridges come with no preset correlations.)

   The first field in the CORRELATION Table (NONE) is reserved for ohms/sq, the standard unit of resistivity measurement. For example, if you use the default values for *S1, S2, A, B, C,* and *D* in the general correlation curve

   $Y = \frac{S_1}{S_2} \cdot (A + BX + CX^2 + DX^3)$, you get:

   $$Y = \frac{1}{1} \cdot (0 + 1X + 0X^2 + 0X^3)$$

   $$Y = (1) \cdot (X)$$

   $$Y = X \text{ (ohms/sq)}$$

   For a listing of values for converting ohms/sq to other measurement units, refer to the next section, "Creating a New Correlation Curve."

To use a correlation curve

1. Make sure that the correlation curve is set up in the Correlation Curves Screen (as described in "Creating a New Correlation Curve").
2. Reference the correlation from the Test Type Index Card. Refer to "Entering Parameters in the Test Type Index Card" in Chapter 4.

Proceed to the following sections for additional information:

- "Creating a New Correlation Curve"
- "Deleting a Correlation from the List of Correlation Curves"

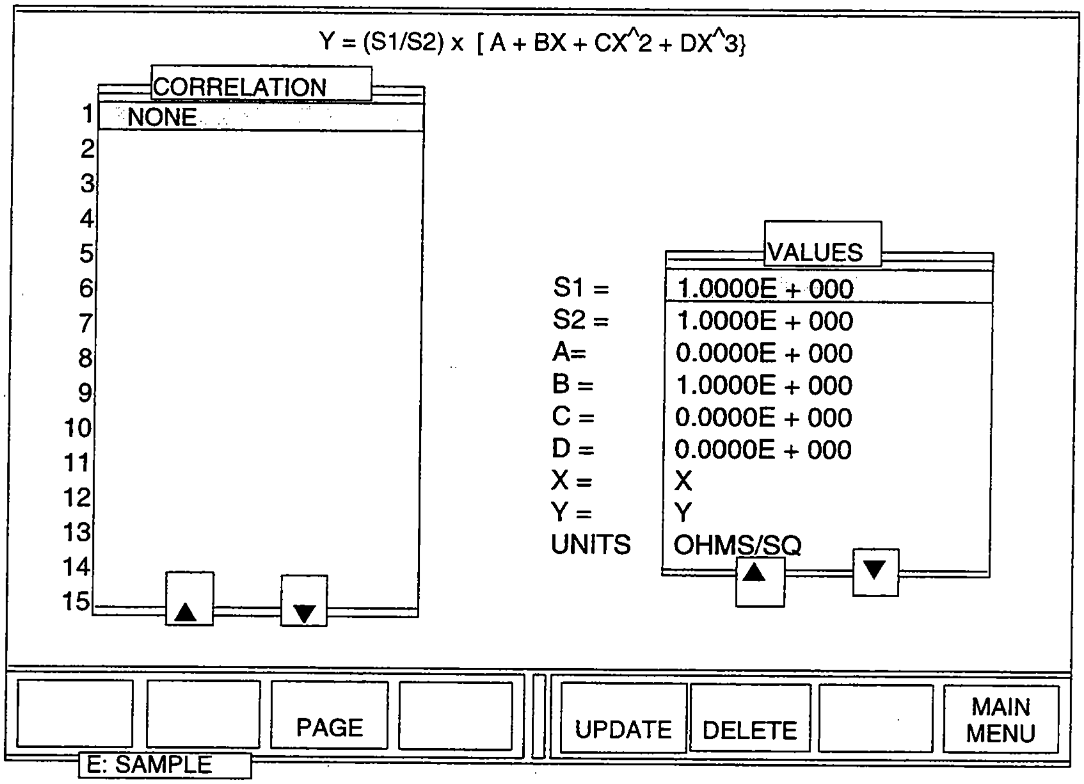

Figure 5-4: Correlation Curves Screen

Creating a New Correlation Curve

This procedure assumes the Correlation Curves Screen is currently displayed on the monitor. If it is not, refer to the previous section, "Viewing the List of Correlation Curves." Table 5-1 gives some correlation examples.

To create a new correlation curve

1. Highlight a blank field in the CORRELATION table, type in a name for the correlation, and press Enter. (You can enter any name that identifies your correlation.)
2. Press the right-arrow key to move to the VALUES table, and type in values for the constants, pressing Enter after each entry. (The default value for S1, S2, and B is 1. Entering a value of *0* for one of these will give a result of *0*.)
3. Highlight the UNITS field, and type in the appropriate units (for example, kilohms/sq, or ohm-cm), and press Enter.
4. Repeat steps 1-3 to set up additional correlations.
5. Press F5 (UPDATE) to store the information.

Note *You can also substitute for both x and y in the correlation formula to create more types of relationships. Select X= or Y= in the VALUES table, and press F4 (TOGGLE ACTIVE). The following options are available: 1/X, LOG10X, LOG10 1/X, 10^X, and 1/Y, LOG10Y, LOG10 1/Y, 10^Y.*

You can now apply the correlation to your measurements by selecting it in the Measure Type Index Card.

***Table 5-1:** Correlation Examples*

Conversion	**Coefficients**							**Units**
	S1	**S2**	**A**	**B**	**C**	**D**	**X**	
Convert from Ω/sq to kΩ/sq:	1	10^3	0	1	0	0		kΩ/sq
Convert from Ω/sq to mΩ/sq:	10^3	1	0	1	0	0		mΩ/sq
Adjust Ω/sq values by +2%	1.02	1	0	1	0	0		Ω/sq
Adjust Ω/sq values by -2%:	0.98	1	0	1	0	0		Ω/sq
Calculate bulk resistivity (Ω-cm) for a 25-micron film	25	10^4	0	1	0	0		Ω-cm
Convert sheet resistance to thickness in Å*	10^8	1	0	resistivity (μ-ohm-cm)	0	0	1/X	angstroms

* For additional information on measuring film thickness with the OmniMap systems, ask your Tencor representative for OmniMap Application Note RS-14, "Determining Metal Thickness Using a Four-Point Probe."

Deleting a Correlation from the List of Correlation Curves

This procedure assumes the Correlation Curves Screen is currently displayed on the monitor. If it is not, refer to the earlier section "Viewing the List of Correlation Curves."

To delete a correlation from the list of correlation curves

1. Highlight the entry, and press F7 (DELETE).

   The monitor displays a message warning you that the data will be lost:

   - Press F1 (YES) if you want to delete the entry.
   - Press F8 (NO) to cancel the deletion.

Temperature Coefficient of Resistance Curves

Temperature is one of the variables that influence sheet resistance measurements. You can adjust for temperature variations by applying a material's temperature coefficient of resistance (TCR) to the measurements. The StatTrax ***temperature compensation*** feature enables you to generate a temperature coefficient of resistance curve for a non-standard material (one that is unique to a particular process).

The system determines a material's TCR by taking sheet resistance vs. temperature readings as it incrementally raises the temperature at the wafer's center from the ambient to a selected upper temperature (≤ 35 °C).The OmniMap system can then be set to use the TCR of the material to ***automatically*** correct subsequent sheet resistance measurements.

The following sections provide instructions on

- Determining the TCR value
- Entering the TCR value into the list of TCR curve files
- Setting up a test that references a TCR curve file

Determining the TCR Value

Before beginning this procedure, perform a Probe Qual Test, to ensure that the resistivity measurement is sufficiently repeatable. Make sure that the standard deviation of R_S for each group of five measurements is < 0.2%. This helps ensure a good, noise-free TCR curve.

To determine the TCR value

1. Perform a Probe Qual, and condition the probe if necessary.
2. From the Introduction Screen, press F1 (FOLDER SELECT).

   The Folder Select Screen appears.
3. Press F6 (UTIL).

   The Utilities Menu Screen appears.
4. Press F1 (TEMP CURVES).

   The Temperature Curve Directory Screen appears (Figure 5-5).
5. Press F2 (NEW FILE).

   The New File Screen for Temperature Compensation appears (Figure 5-6).
6. Edit the File Descriptors fields to describe the new file you are creating. Be sure to enter a CURVE ID that describes the material you are testing (for example, 20 ohm-cm).

   The X AXIS and Y AXIS labels will appear on the Temperature Compensation Screen (Figure 5-8) as labels for the *x*- and *y*-axis respectively. Note that

   - The units for the *x*-axis are always degrees Celsius.
   - The units for the *y*-axis are always sheet resistance (ohms/sq).
7. Press Enter, then F6 (SAVE) to store the file descriptors.
8. Press F1 (COLLECT DATA).

The tester stage rises, and the screen instructs you to load a wafer.

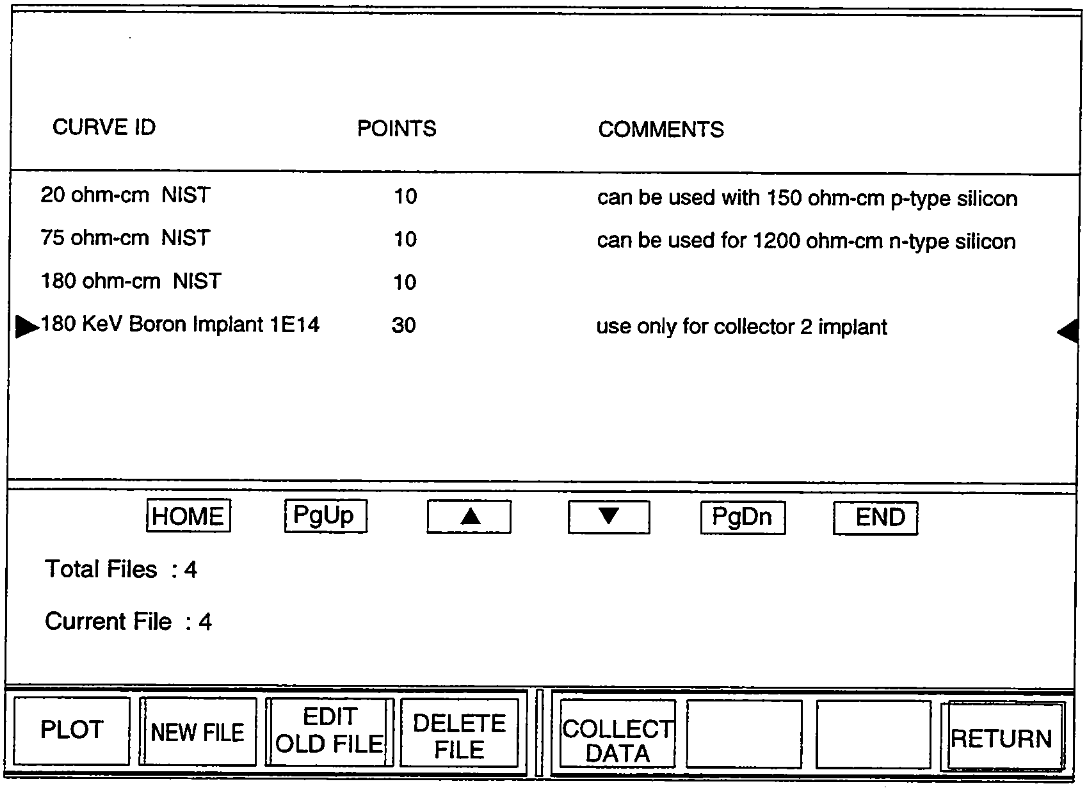

Figure 5-5: Temperature Curve Directory Screen

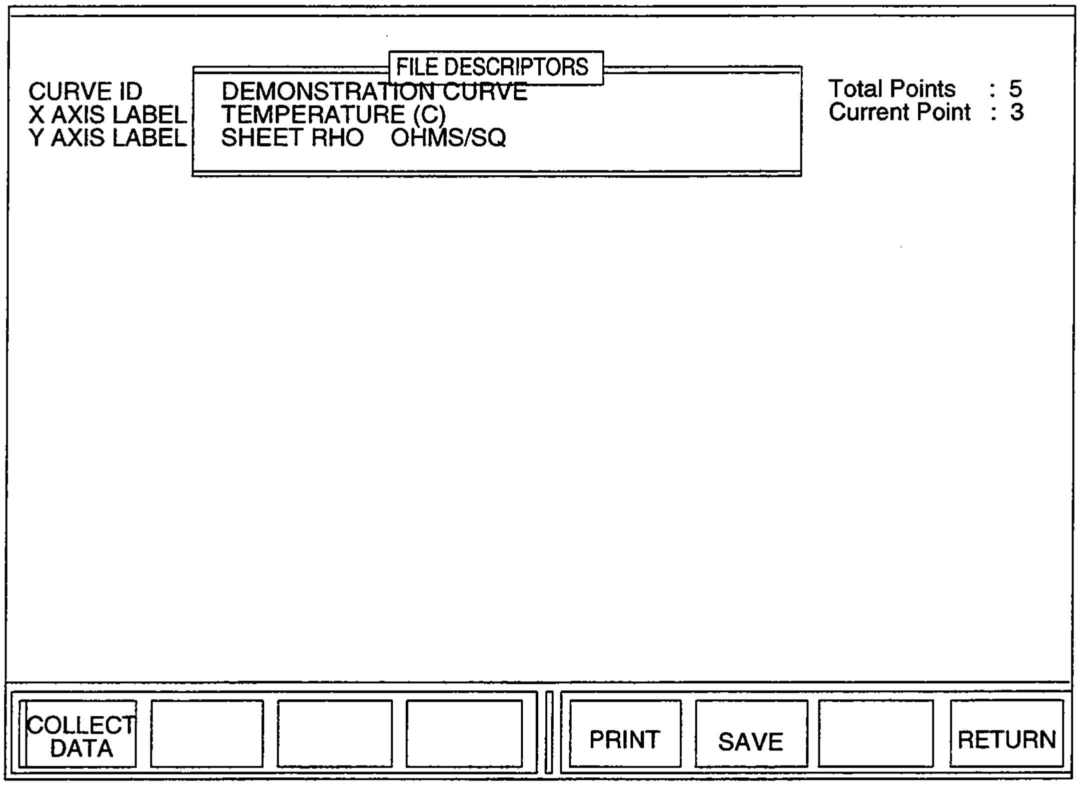

Figure 5-6: New File Screen for Temperature Compensation

9. Place the wafer on the stage, and press F1 (CONTINUE).

   The Measure Type Index Card appears.

10. Edit the Measure Type Index Card, if necessary, to set an appropriate test current, then press F1 (COLLECT DATA).

    The tester stage lowers, and an initial reading is taken at the center of the stage. The Initializing Temperature Screen appears (Figure 5-7).

11. Enter the value desired for each of the temperature compensation parameters described in Table 5-2 or accept the default values.

12. Press F1 (CONTINUE).

    The Temperature Compensation Screen appears (Figure 5-8).

    The system begins a measurement sequence in which the sheet resistance is measured and plotted at a series of temperatures between ambient temperature and the APPROX MAX TEMP. The elapsed time and current temperature at the stage are displayed in the lower left corner of the screen while the testing proceeds. The system takes about fifteen seconds to ramp up to each temperature and find the sheet resistance.

    If the system cannot generate data for the TCR curve, the system displays an error message and suggests a method of correcting the error. Most likely, the error is caused by an APPROX MAX TEMP value that is too low, or a NUMBER OF POINTS value that is too high. However, if the MAXIMUM TIME value is too small, the system will stop testing before data for all the test points has been collected.

When measurement is completed the system asks if you want to save the data.

13. Press F1 (YES) to save the data set.

    The Temperature Curve Directory Screen reappears.

14. Press F1 (PLOT).

    The system displays the Temperature Compensation graph (sheet resistance versus temperature), fitting the points of the graph along a linear path (Figure 5-9). The Temperature Coefficient (TCR) is displayed as an absolute value and as a percentage. You can press F1 (PLOT) to display data for each point on the graph.

15. Write down the absolute TCR value so that you can later enter it in the Temperature Compensation Curve List.

16. From the Temperature Compensation Screen, press F8 to return to the Temperature Curve Directory Screen.

    This screen offers command boxes that enable you to edit files, delete files, or collect new data to add to a file. If you wish to modify a file, refer to one of the following sections "Editing Data in a Temperature Compensation File," "Deleting a Temperature Compensation File," or "Collecting New Data for a Temperature Compensation File."

17. When you've finished working with the file, press F8 twice to return to the Introduction Screen, and proceed to "Entering the TCR Value in the TCR Curve List" later in this chapter.

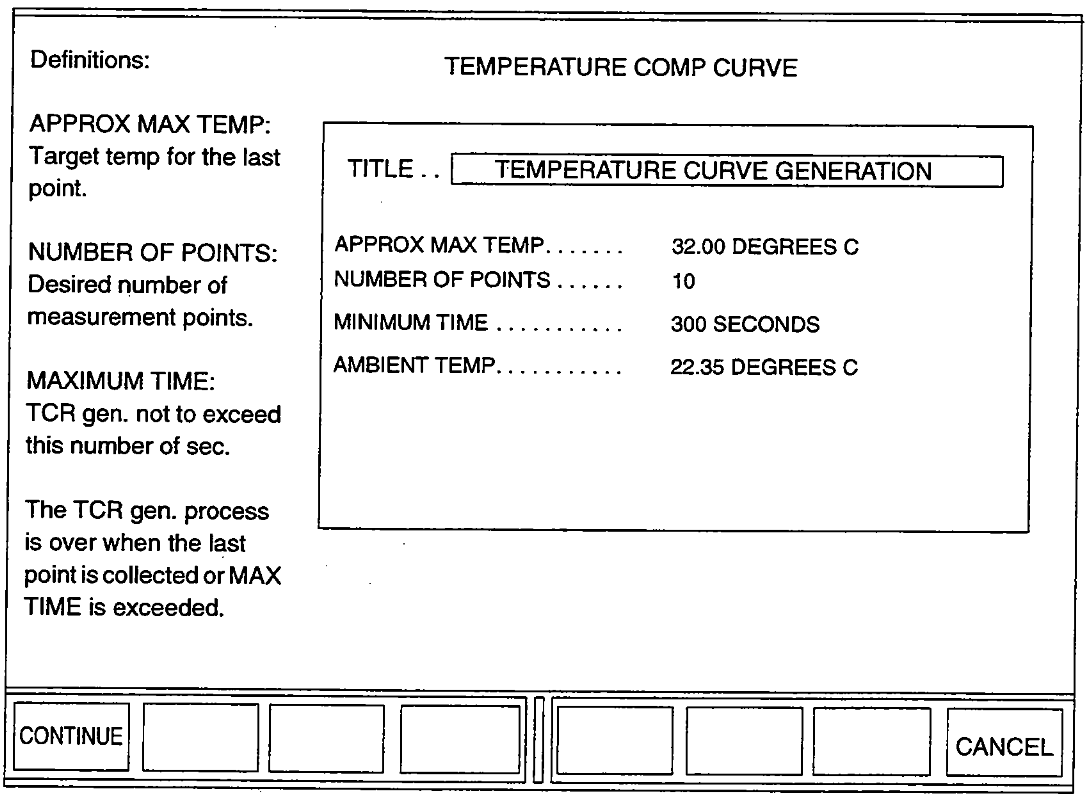

Figure 5-7: Initializing Temperature Screen

Table 5-2: Initializing Temperature Screen

Field Name	Description
APPROX MAX TEMP	The approximate temperature that the last point in the TCR curve will have. This is an editable parameter. The entered temperature must be greater than the ambient temperature displayed. It must also be between 20° and 40 °C.
NUMBER OF POINTS	The number of temperature points at which you want to measure. This is an editable parameter. The entered number must be between 2 and 25.
MAXIMUM TIME	The length of time the system can take to generate a TCR curve. The entered time must be between 15 and 6000 seconds. Although this is an editable parameter, it is recommended that you do not exceed the default time of 180 seconds. Otherwise temperature gradients will occur in the stage and will take considerable time to dissipate.
AMBIENT TEMP	The current temperature measured by the sensor at the wafer stage. This is not an editable field.

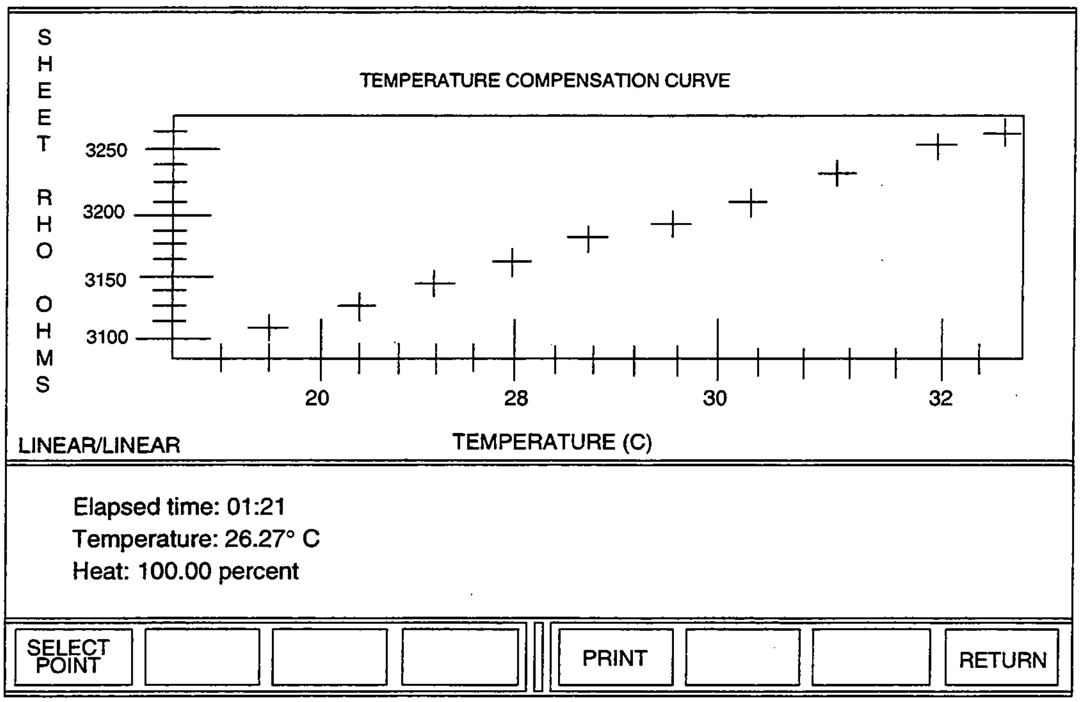

Figure 5-8: Temperature Compensation Screen, After Measurements

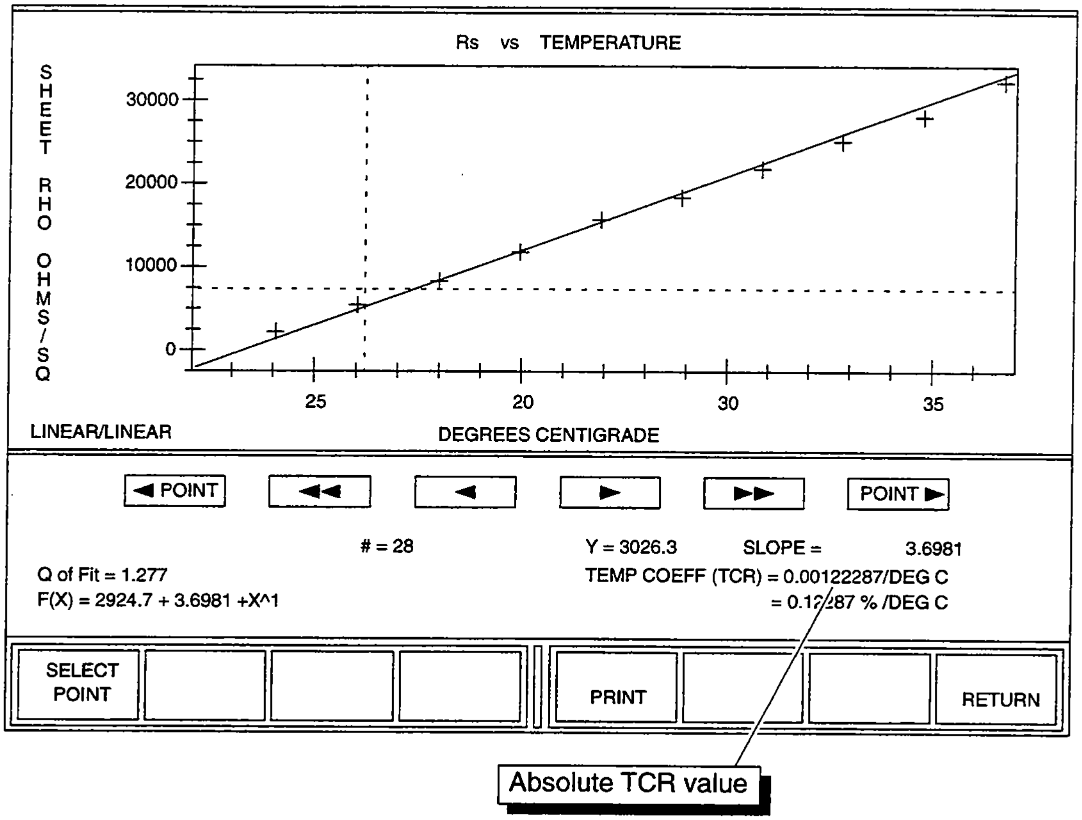

Figure 5-9: Temperature Compensation Screen, After Plotting

Editing Data in a Temperature Compensation File

To edit data in a temperature compensation file

1. From the Temperature Curve Directory Screen (Figure 5-5), select the file you want to edit.
2. Press F3 (EDIT OLD FILE).

   The Editing Screen for Temperature Compensation (Figure 5-10) appears.
3. Select the data you want to edit, and select the appropriate command
   - To delete individual temperatures or sheet resistance data values, press F3 (DELETE DATA).
   - To add to individual temperature or sheet resistance data values, press F4 (ADD TO DATA).
   - To print the data listing, press F5 (PRINT).
   - To save your edits, press F6 (SAVE).
   - To sort data, press F7 (SORT DATA).
     (Sorting data arranges data from lowest to highest according to the value in the y-axis column.)
4. Press F8 (RETURN) to go back to the Temperature Curve Directory Screen.

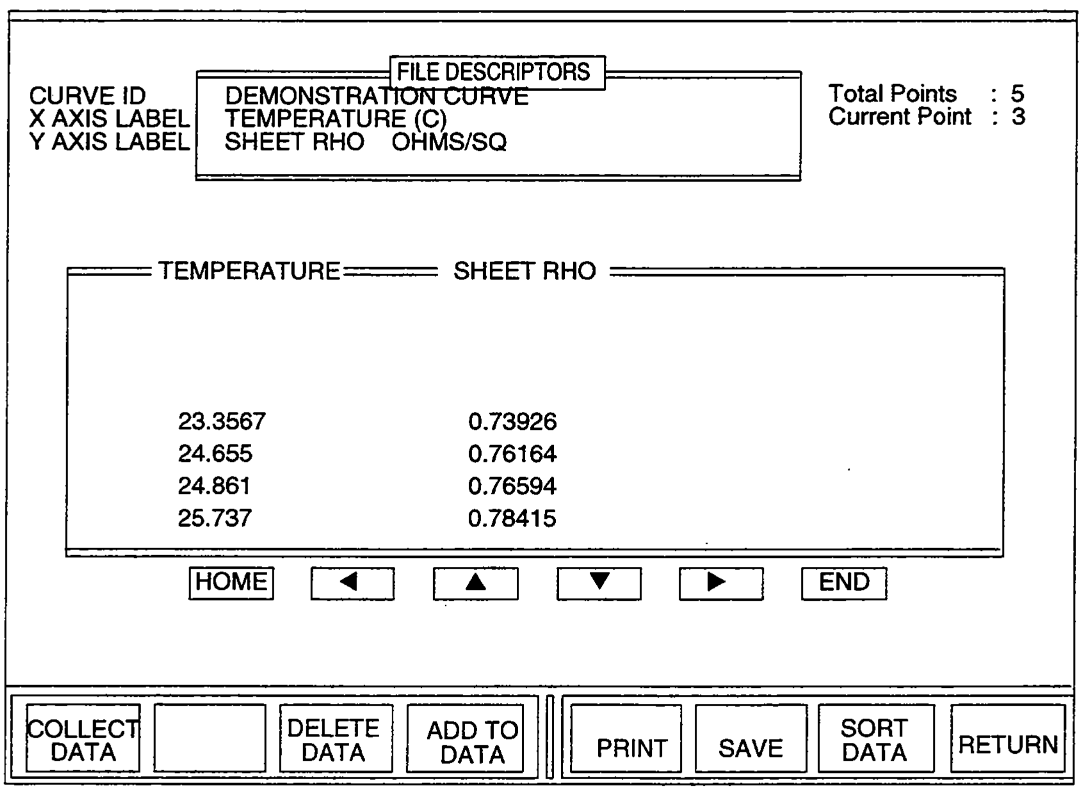

Figure 5-10: Editing Screen for Temperature Compensation

Deleting a Temperature Compensation File

To delete a temperature compensation file

1. From the Temperature Curve Directory Screen, select the file you want to delete.
2. Press F4 (DELETE FILE).

   The system deletes the file.

Collecting Additional Data to a Temperature Compensation File

To collect additional data to a temperature compensation file

1. From the Temperature Curve Directory Screen, select the file you want to add the data to.
2. Press F5 (COLLECT DATA).
3. Proceed as described in "Determining the TCR Value" starting with step 9.

Entering the TCR Value in the TCR Curve List

In order to correct measurements for temperature variations, you must enter the material's TCR into the curve list so that it is accessible from the Measure Type Index Card. Use these instructions to enter the TCR value for the curve (if the TCR value is unknown, refer to the earlier section "Determining the TCR Value"). If you have more than one *tc* system in your fab, and you measure the TCR value of a material on one system, you can manually enter this TCR value into all systems. This ensures that no temperature-related measurement inaccuracies will occur across systems.

To enter the TCR value in the TCR curve list

1. From the Introduction Screen, select F8 (SETUP).
2. From the Main Engineering Menu, select TEST DEVELOPMENT from the MENU box and TEMP.COMP. CURVES from the ITEM box.
3. Press F1 (SELECT).

   The Temperature Compensation Curve Screen appears (Figure 5-11).
4. Select a field in the TEMP. COMP. box (the NONE field cannot be edited), enter the name for the temperature compensation curve you created in Operations Mode, and press Enter.

   We suggest you enter the same name you used when determining the TCR value.
5. Press the right-arrow key to select the VALUES box.
6. Type the TCR value (a decimal value) into the box, and press Enter.
7. When you are finished, press F5 (UPDATE).
8. Press F8 (MAIN MENU).

   The Main Engineering Menu reappears.

Now that you have edited the data values associated with the TCR curve, your next step is to set up a test that will reference the TCR value. Refer to the next section, "Setting Up a Test That References the TCR Value."

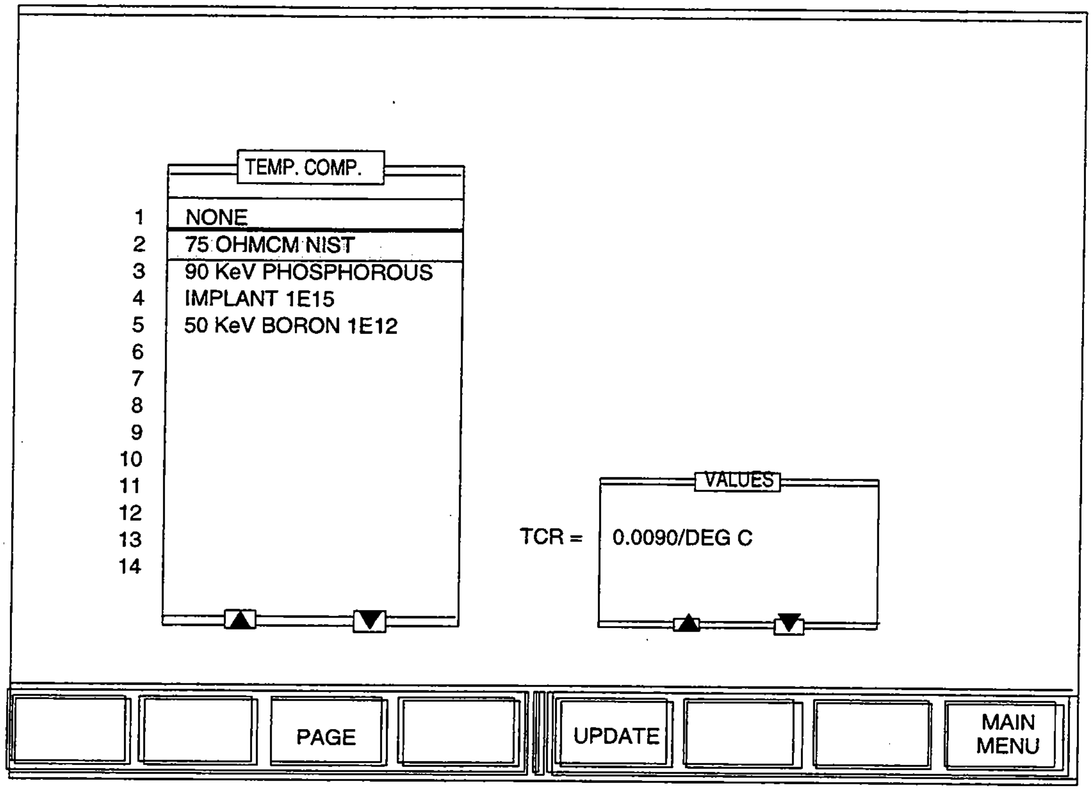

Figure 5-11: Temperature Compensation Curve Screen

Setting Up a Test That References the TCR Value

From the Engineering Mode of your system's software, you can set up and save tests that will reference the TCR value(s) you have generated. After you have generated the TCR values for the materials you are measuring, you need only to refer to this section to set up a test to reference a particular TCR value. The following instructions explain how to set up and save a test.

1. From the Main Engineering menu, select TEST DEVELOPMENT from the MENU box.

   TEST SETUP is highlighted in the ITEM box.

2. Press F1 (SELECT).

   The Folder Select Screen appears.

3. Select the cabinet, drawer, and folder in which you want to store the test configuration, then press F1 (SELECT).

   The Wafer Facts Index Card appears.

4. Edit the fields for the Wafer Facts, Memos & Notes, and Wafer Handler Index Cards where appropriate.
5. Select TEST SETUP from the Card Index, and edit the Test Type Index Card where appropriate.
6. Select the Measure Type Index Card.
7. Enter the appropriate VOLTAGE TARGET and AMPERAGE settings for the film you are measuring.

Note *For implants, epitaxy layers and other films above 1 ohm/sq, Tencor recommends that you select AUTO RANGE (SAMPLE TYPE), 7.5 mV (VOLTAGE TARGET), and an AMPERAGE of 0.01mA. For metal films with low sheet resistivity, select MANUAL (SAMPLE TYPE) and an AMPERAGE between 100-200 mA (depending on the thickness of the metal).*

---

8. Select the TEMP. COMP. CURVE field.
9. Press F4 (TOGGLE ACTIVE) or F3 (EDIT ACTIVE) to select the temperature compensation curve file.

   The CORRECT TO TEMP field changes to reflect the target temperature you entered for that file. (The default for this field is 23 °C.)

10. If needed, press F1 (OPTION) to color-code any fields in the Index Card.

    The color represents how often operators must enter information into that field, or if they can modify the field at all (refer to "Using Color-Coding to Set Text-Entry Requirements for the Operator" in Chapter 1).

11. Press F6 (UPDATE) to save the test set up.
12. Press F8 (FOLDER SELECT).
13. Press F8 (MAIN MENU).

You are now ready to run a test using temperature compensation. (Refer to Chapter 6 for instructions on running tests.)

Custom Contour Maps

Standard test patterns can sometimes produce inaccurate results when used to map a substrate that is not a perfect disk, such as

- A wafer with one or more flats or notches
- A magnetic or optical disk with a central hole

Inaccuracies occur when the system creates a map using data collected at nonexistent sites (the section of the wafer removed to create the flat, notch, or hole), or when a standard pattern is used to map a wafer that has been scribed along its flat.

The Custom Contour Map feature enables you to skip these nonexistent or damaged sites by excluding them from copies of existing Contour Map test patterns. The system then uses a straight-line fit to estimate the excluded values (for mapping only). If two or more adjacent points are excluded, the map displays a break in the contour line.

Viewing the List of Contour Maps

To view the list of Contour Maps

1. From the Main Engineering Menu, select TEST DEVELOPMENT and CONT MAPPING PATTERNS.
2. Press F1 (SELECT) to access the Contour Mapping Patterns Select Screen (Figure 5-12).

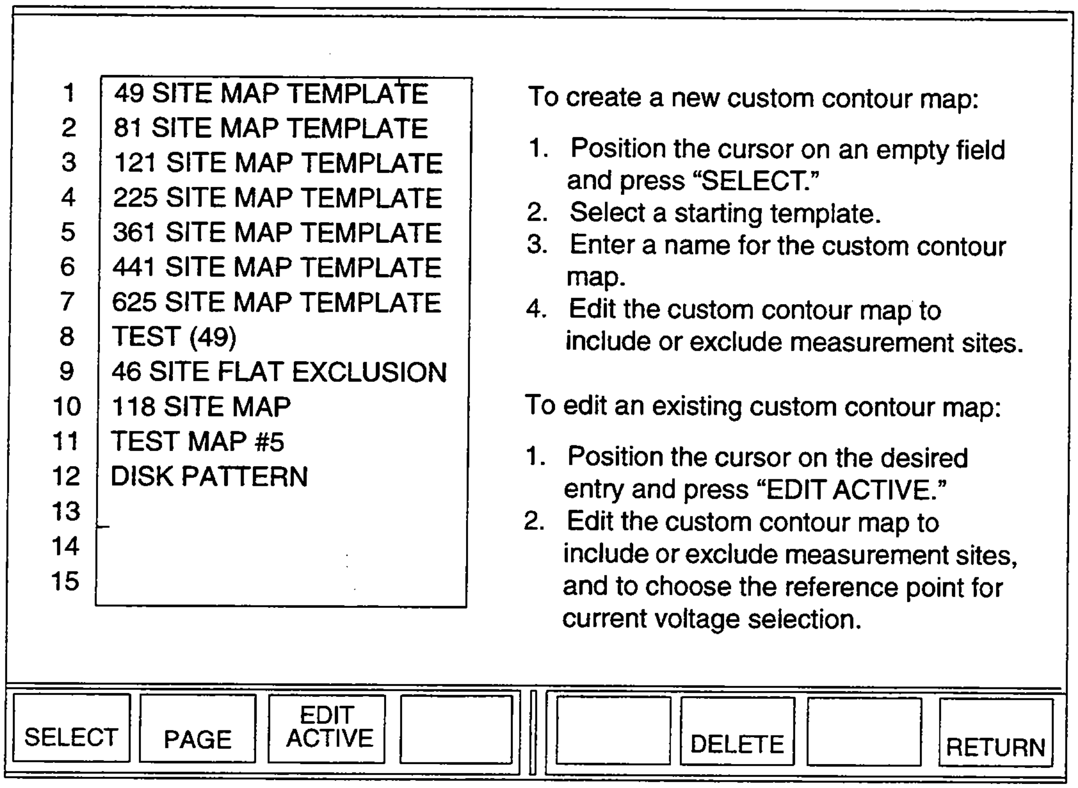

Figure 5-12: Contour Mapping Pattern Select Screen

Creating a New Custom Contour Map

This procedure assumes the Contour Mapping Patterns Select Screen is displayed on the monitor. If it is not, refer to the earlier section "Viewing the List of Contour Maps."

To create a new custom contour map

1. Highlight a blank field in the Contour Mapping Pattern Select Screen, and press F1 (SELECT).
2. Highlight the template that you want to base the new map upon, and press F1 (SELECT).
3. Type in a name for the new map, and press Enter.
4. Press F3 (EDIT ACTIVE) to display the Graphic Location Map (Figure 5-13). Standard test sites are represented by the symbol +.
5. Use the arrow keys to move the cursor from one site to another on the map.
   - The right arrow moves the cursor in a counterclockwise direction (CCW).
   - The left arrow moves the cursor in a clockwise direction (CW).
   - The up arrow moves the cursor towards the center of the map (IN).
   - The down arrow moves the cursor towards the perimeter of the map (OUT).

Note *When the cursor is at the center of the wafer map, the down-arrow key is the only functioning arrow key:*

- ❑ *Moving the cursor clockwise or counterclockwise would only rotate the cursor on its axis, therefore using the left- or right-arrow keys produces no movement.*
- ❑ *The cursor is already at the center of the map, therefore using the up-arrow produces no movement.*

   You can also

   - Move from one site to another by pressing the Page Up (Pg Up) or Page Down (Pg Dn) key to highlight the site's coordinates in the list on the right-hand side of the screen.
   - Move to the first site in the list by pressing the Home (HM) key.
   - Move to the last site in the list by pressing the End (END) key.
   - Move up the list to the previous 15 sites by holding down the control key (Cl) and pressing the Page Up key.
   - Move down the list to the next 15 sites by holding down the control key (Cl) and pressing the Page Down key.

6. Press F3 (SET REFRNC) to select a reference site.

   The probe will be placed at this spot to set the current and voltmeter.

7. Select INCLUDE/EXCLUDE (F4) (or press the Return key) to include or exclude measurement sites.

   - Included points are represented by a + on the map.
   - Excluded points are represented by a solid square (■).
   - Included sites are identified by the word YES in the INC column next to the coordinates.
   - Excluded sites are identified by the word NO in the INC column.

   The SITES = field tells you how many of the original map pattern's sites are currently selected. In Figure 5-13, for example, SITES = 46/49 tells you that your custom map includes 46 of the original map's 49 sites.

8. Finally, press F7 (UPDATE) to save your Custom Contour Map.

   Your Custom Contour Map file stores a description of the original map and the custom map site selections.

   - To print a copy of the test site location map, press F5 (PRINT PATTERNS).
   - To print a list of the sites and their coordinates, press F6 (PRINT SITES).

9. Press F8 (RETURN) to return to the Contour Mapping Pattern Select Screen.

To set up a test using a Custom Contour Map, highlight the MAP PATTERN field in the Test Type Index Card, and use the TOGGLE ACTIVE command to select the map.

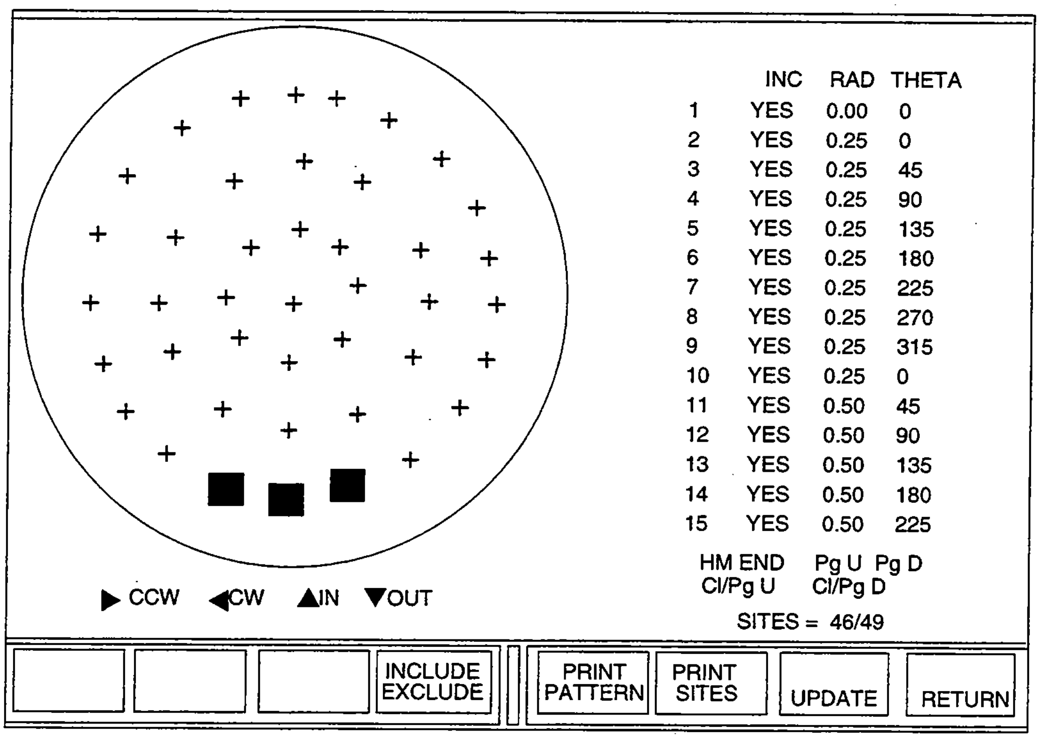

Figure 5-13: Graphic Location Map

Renaming a Contour Map

To rename an existing Contour Map

1. Highlight the current name, and press F1 (SELECT).
2. Type in the new name, and press Enter.

Modifying a Custom Contour Map

To modify an existing Custom Contour Map

1. Highlight the Custom Map you want to modify.
2. Beginning with step 4, follow the instructions in the earlier section, "Creating a New Custom Contour Map."

Note *SITE MAP TEMPLATES (1-7) cannot be edited. These standard test patterns can only be modified after you have copied them to a Custom Contour Map field (8-30). You can create as many as 23 Custom Contour Maps.*

Deleting a Map from the List of Contour Maps

This procedure assumes the Contour Mapping Patterns Select Screen is displayed on the screen. If it is not, refer to the earlier section "Viewing the List of Contour Maps."

To delete a map from the list

1. Highlight the entry, and press F7 (DELETE).

   The monitor displays a message warning you that the data will be lost.

   - Select YES (F1) if you wish to delete the entry.
   - Select NO (F8) if you decide to retain the entry.

Batch Recipes

The Batch Recipe feature enables you to run multiple test recipes as a single operation. Once the Batch Recipe is set up, the test can be initiated with only a few keystrokes. As with other test results, Batch Recipe test results are saved to the individual test recipe's folder. Although the Batch Recipe feature allows you to combine several tests in one operation, in its simplest form you can use the feature to provide easy access to your most frequently used tests: if you create a Batch Recipe that contains only a single test recipe, the test will be available in the Batch Recipe Screen and can be run with only a few keystrokes. The operator need not select the recipe from the folders in the Folder Select Screen.

Note *Batch Recipes cannot be exported, imported, run, or saved using SECS-II communication.*

Test recipes must meet the following criteria to be included in a Batch Recipe:

- The Cassette Slot Editor must be selected on the Wafer Handler Index Card for each test recipe.
- The Wafer Diameter must be the same for all test recipes assigned to the same cassette.
- The Cassette Offset (Pitch) must be the same for all test recipes assigned to the same cassette (except when setting up a Batch Recipe to test 8-inch wafers in a 26-wafer cassette).
- The Auto Slot option SEARCH WHOLE CASSETTE must not be selected.
- Manual operations (manual testing, referencing, alignment, stepping) must not be selected.
- The recipe must not contain any forced-entry (red) text fields.
- The Auto Save option must be enabled.

Setting Up a Batch Recipe

You set up a Batch Recipe in Engineering Mode by assigning pre-defined recipes (setups) to the selected slots in the wafer cassettes. Recipe assignments define how the wafers in the slots will be tested. The individual test recipes must exist in the folders of the active User Account.

- You must know the three-digit Folder ID (cabinet, drawer, folder location) for each test recipe you wish to include in the Batch Recipe because recipes are assigned to the cassette slots by keying in the recipes' Folder ID.
- You can assign a different recipe to each cassette slot in a Batch Recipe, or assign a single recipe to multiple slots in a Batch Recipe, using either or both cassettes, but ***you can only assign one recipe to each slot.*** (You can assign a test recipe to a slot in the Batch Recipe even if that slot is not selected and that cassette is not enabled in the test recipe.)
- You can set up a Batch Recipe using two different cassette sizes, provided you assign test recipes with a cassette size appropriate to the cassette in the Batch

Recipe (i.e., you can set up a Batch Recipe to test wafers in one 8-inch cassette and one 6-inch cassette, but you can only assign 8-inch test recipes to the 8-inch cassette and 6-inch test recipes to the 6-inch cassette in the Batch Recipe).

- You can process tests in all slots of a 26-wafer cassette (8-inch wafers), without having to ***initiate*** two separate tests.

  For example, to run the same test on all 26 wafers, you could

  1. Select EXTENDED - 26 WAFERS as the Wafer Cassette Type in the General System Data Screen.
  2. Create one test recipe for wafers 1–25 (with the Csst. Offset set to 1.00).
  3. Copy this recipe to another folder.
  4. Edit the second recipe (the copy) to test slot 26 (with the Csst. Offset set to 1.25).
  5. From Batch Recipe Setup, assign the first test to slots 1–25 in the Batch Recipe, and assign the second test recipe to slot 26 in the Batch Recipe. (Remember that for any single Batch Recipe, you cannot assign the same test recipe [Folder ID] to all 26 slots in a single cassette, nor can you assign more than one test recipe to a single slot.)

  This test can now be run from the Batch Recipe Screen as described in the section "Running a Batch Recipe" in Chapter 6.

Note *By creating a Batch Recipe that contains only a single test recipe, you provide easy access to the recipe because it is now available in the Batch Recipe Screen and can be run with only a few keystrokes. The operator need not select the recipe from the folders in the Folder Select Screen.*

To set up or edit a batch recipe in Engineering Mode

1. From the StatTrax Introduction Screen, press F8 (SET UP).

   The Main Engineering Menu appears.

2. Highlight Test Development in the Menu box on the left and Batch Recipe Setup in the Item box on the right.

3. Press F1 (SELECT)to display the Batch Recipe Setup Screen (Figure 5-14).

   The Batch Recipe Setup Screen displays the list of Batch Recipes for the active account. Each account can contain up to 20 Batch Recipes (labeled A through T).

   - The DESCRIPTION column displays the Batch Recipes' description (name), as defined in the Batch Recipe Editor Screen (Figure 5-15).
   - The FOLDER ID column displays the Folder ID of the test recipe. For Batch Recipes that contain more than one test recipe, the FOLDER ID column displays the word MULTIPLE. Fields in the Batch Recipe Setup Screen are for display only and cannot be edited.

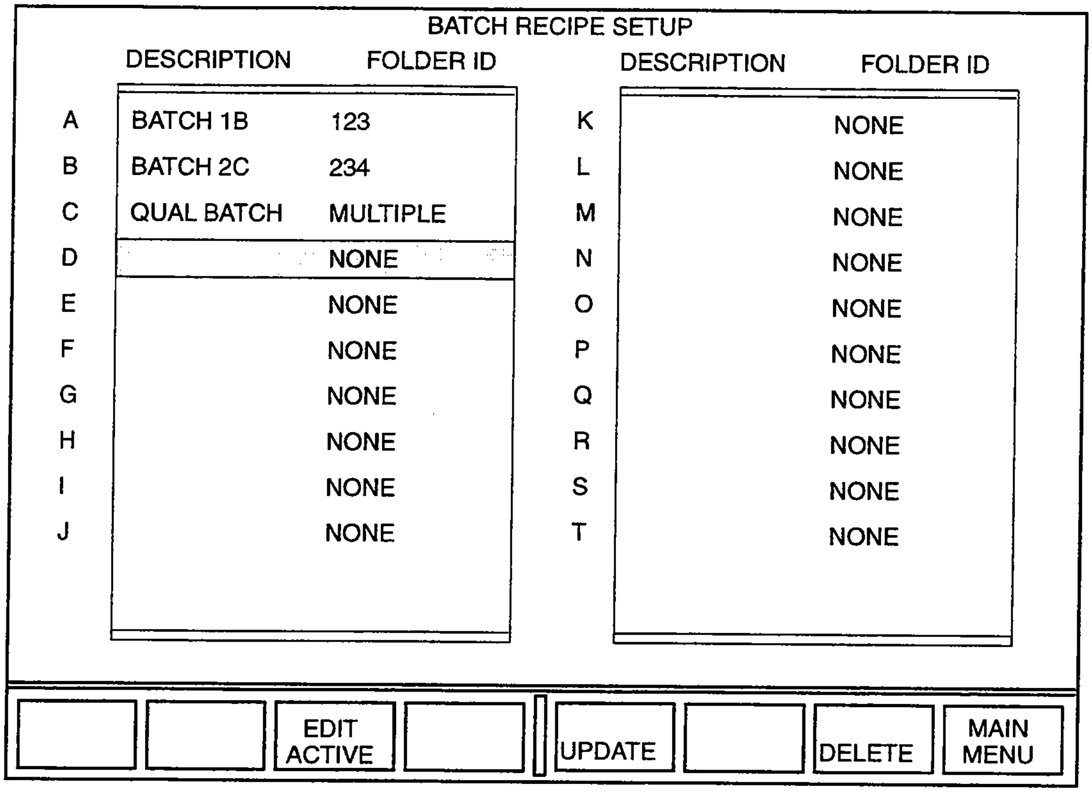

Figure 5-14: Batch Recipe Setup Screen

4. Select an empty field or a field containing a recipe you wish to edit, by pressing the letter corresponding to the field (A through T) or by using the up or down arrow key to highlight it.

5. Press F3 (EDIT ACTIVE). The Batch Recipe Editor Screen appears (Figure 5-15).

   Use the Batch Recipe Editor Screen to define or edit a Batch Recipe. The BATCH TEST field identifies the selected Batch Recipe by its location (A through T) in the Batch Recipe Setup Screen(Figure 5-14). This field cannot be edited. You describe (name) the recipe in the BATCH DESCR. field. The BATCH DESCR. field is automatically selected when you enter the Batch Editor Screen.

6. With BATCH DESCR. selected, type in a descriptive name for the recipe (up to 20 ASCII characters), and press Enter.

7. Press the Tab key to move to the next field, REF. FOLDER ID.

   You can use this field to select a specific Test Folder as a template. When you type in a folder's ID, the recipe in the folder is automatically assigned to the selected Batch Recipe, including the wafer ID and slot assignments from the Cassette Slot Editor of the recipe's Wafer Handler Index Card.

   - The folder ID appears in the FID column on the Batch Recipe Editor Screen for all wafer slots selected on the Cassette Slot Editor (in the test recipe).

   - All wafer IDs assigned to a slot on the Cassette Slot Editor appear in the WAFER ID column for the assigned slot.

BATCH RECIPE SETUP

BATCH TEST D REF.FOLDER ID: 112

BATCH DESCR.: BATCH 3C SEL. FOLDER NAME: PRESCAN

SLOT	WAFER ID	FID	SLOT	WAFER ID	FID
10		0	10	07319310	112
9	07309301	234	9	07319309	112
8	07319318	112	8	07319308	112
7	07319317	112	7	07319307	112
6	07319316	112	6	07319306	112
5	07319315	112	5	07319305	112
4	07319314	112	4	07319304	112
3	07319313	112	3	07319303	112
2	07319312	112	2	07319302	112
1	07319311	112	1	07319301	112

ACCEPT | | | OPTION | | | | RETURN

Figure 5-15: *Batch Recipe Editor Screen*

Note *Batch Recipes must not require operator input during testing. If the recipe in a selected folder requires input, the system will issue an error message when you select ACCEPT in step 13.*

8. To select a Reference Folder, key in the folder's 3-digit Folder ID (Cabinet, Drawer, and Folder number), and press Enter. Otherwise, go to step 9.

   If you are overwriting an existing entry, the system responds

   ```
   You have made modifications on this screen. Do you really
                        want to re-initialize?
   ```

   Press F1 (YES) to confirm your entry.

   The SEL. FOLDER NAME field automatically displays the name of the selected Reference Folder.

Note *You can edit individual slots to change the wafer IDs or slot selections in the reference folder. Follow steps 9 through 12 to do so. Otherwise, go to step 13.*

9. Press the Tab key to move to the Left Cassette Slot Editor.

   The Cassette Slot Editors are similar to the Cassette Slot Editors accessed through the Wafer Handler Index Card.

   - The fields in the SLOT columns represent the corresponding slots in the cassette (26 slots are displayed if EXTENDED - 26 WAFERS is the cassette type selected on the General System Data Screen).

- The fields in the WAFER ID column display the current Wafer ID selection for the slot. You can enter a different Wafer ID directly into this column.
- The fields in the FID (Folder ID) column display the current Folder ID selection for the slot. You can select a different test recipe for a slot by entering the recipe's Folder ID directly into this column.

10. Use the keyboard's up- or down-arrow key to select a slot you wish to edit. The Cassette Slot Editor displays ten slots at a time.
    - To access slots not currently displayed, use the Home, Page Up, Page Down, End, or up- and down-arrow keys.
    - To move between the WAFER ID and FOLDER ID columns, use the left- or right-arrow key. The heading of the active column will be highlighted.
    - To move from the Left Cassette Slot Editor to the Right Cassette Slot Editor, press the Tab key.
    - To move from the Right Cassette Slot Editor back to the Left Cassette Slot Editor, hold down the Shift key as you press the Tab key.
11. Type in a Wafer ID and Folder ID for each slot you wish to include in the batch recipe, and press Enter.
12. If you wish, lock the selections by choosing F4 (OPTION) to color-code the fields black. This prevents deselection of the slot from within Operations Mode.
13. When you have completed your entries, choose F1 (ACCEPT). (If you want to exit the Batch Recipe Editor Screen without retaining your entries, press F8 [RETURN].)

    The system runs an intra-recipe validation to verify that tests do not require operator intervention. Then, the system runs an inter-recipe validation to verify that all folders assigned to the same cassette are compatible. (This validation can take from a few seconds to a few minutes, depending on the complexity of the Batch recipe Setup.) If the system discovers an incompatibility, it reports the incompatibility and identifies the folders involved. If the system does not discover any incompatibilities, the display returns to the Batch Recipe Setup Screen.
14. To save the Batch Recipe to the account, press F5 (UPDATE).
15. To return to the Main Engineering Menu, press F8 (MAIN MENU).

Chapter 6
Collecting Data

Read This First

This chapter is intended for the process engineer or operator. It describes how to use Operations Mode to run tests and collect data. Before you begin the procedures described in this chapter

- Read the Introduction to this manual.
- Read the chapter titled "System Overview."
- Perform the tutorial.

In this chapter you will learn about

- Selecting a test folder
- Editing color-coded text fields
- Loading wafers and running tests
- Running A Batch Recipe
- Viewing collected data and file summaries

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Preparing the System to Collect Data

Make sure that the system is *not* in DEMO MODE. (The words DEMO MODE *should not* be displayed at the top left of the screen.) If DEMO MODE is displayed, go to the Introduction Screen, and press F4 (TURN ON SYSTEM).

Important *Never use DEMO MODE to collect actual data.*

Before you start collecting data, log on to the account that contains the test folder you intend to work with. The name of the currently logged-on (active) account is displayed on the bottom left side of the screen. If you need to change accounts, go to the Introduction Screen, and press F3 (ACCOUNT SELECT) to log on to the correct account. If you are changing the probe head, you must also edit the probe data as described below.

Editing Probe Data in Operations Mode

Each time you change the four-point probe, you must enter the appropriate probe ID and tip space into the Probe Data Editing Screen. The following section describes how to edit probe data in Operations Modes. For information on checking probe head calibration, choosing the right probe head, and changing probe heads, refer to Appendix D.

To edit probe data

1. From the Introduction Screen, press F1 (FOLDER SELECT).
2. Press F3 (CHANGE PROBE).

   The Probe Data Editing Screen appears. The cursor is positioned at the first field, PROBE ID.
3. The probe ID is typically the serial number that appears on the probe itself. Type in the probe ID, then press Enter. You can enter up to 20 characters in the PROBE ID field.
4. Select the TIP SPACE field. Standard tip spaces include
   - 0.025 inches (0.635 mm) . . . . . types F, G, and H
   - 0.040 inches (1.016 mm) . . . . . types A, B, C, and D
   - 0.0625 inches (1.587mm) . . . . . type E

   These values are indicated on the probe under the label PITCH.
5. Type in the correct tip space, and press Enter.
6. Press F5 (UPDATE) to store the new probe information, and press F8 (MAIN MENU) to access the Folder Select Screen.

Selecting a Test Folder

You select the folder containing your test setup from the Operations Mode Folder Select Screen (except for Batch Recipes which are accessed directly from the Introduction Screen).

To select a test folder

1. From the Introduction Screen, press F1 (FOLDER SELECT).

   The Folder Select Screen appears (Figure 6-1).
2. Use the trackball or keyboard arrow keys to highlight the cabinet, drawer, and folder containing the test folder you will be working with.

Remember *The Folder ID displayed at the top of the Folder Select Screen identifies the location of the folder, the type of test set up in the folder, and the number of data files currently stored within the folder (see the section "Conventions for Naming Test Folders" in Chapter 1).*

---

3. With the folder still highlighted, press F1 (COLLECT DATA).
4. Determine if the test is set up for manual or automatic wafer loading.
   - If the Wafer Facts Index Card (Figure 6-2) appears, the test is set up for *manual loading* of wafers.
   - If the Wafer Handler Index Card (Figure 6-3) appears, the test is set up for *automatic loading* of wafers (the wafer handler loads the wafers onto the platen).

Before loading wafers, you will probably have to enter information into some of the index cards' text fields. Refer to the next section, "Editing Color-Coded Text Fields" to determine which fields require entries and to learn how to enter the required information.

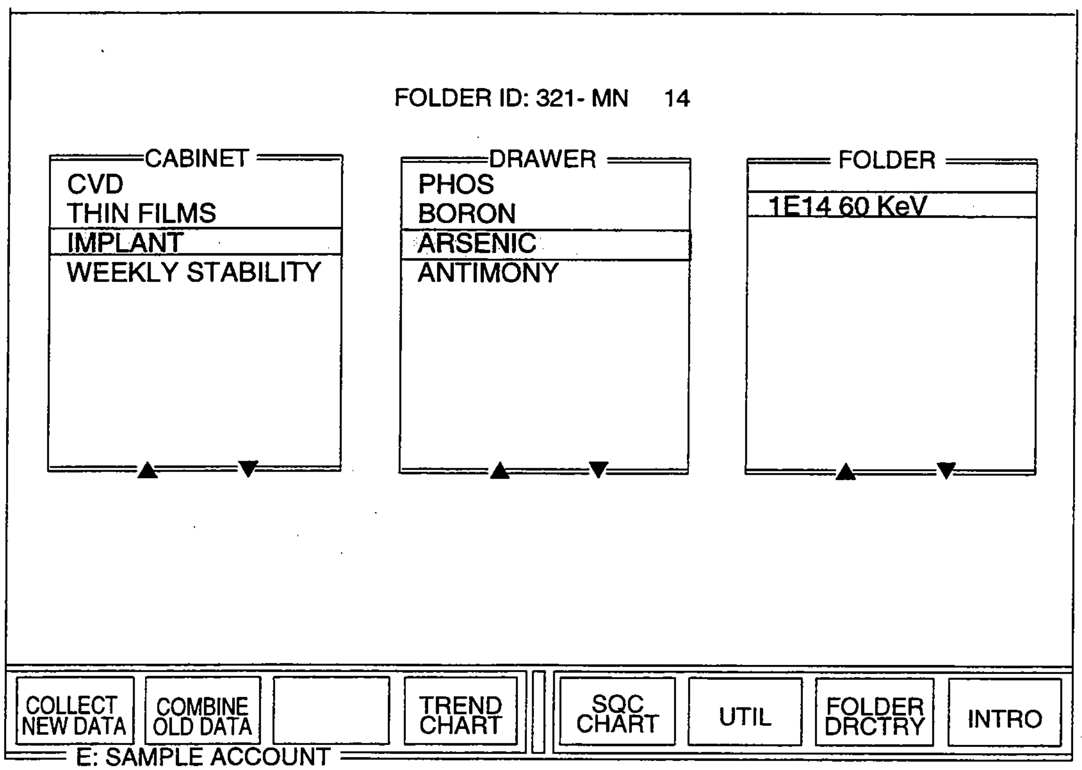

Figure 6-1: *Folder Select Screen, Operations Mode*

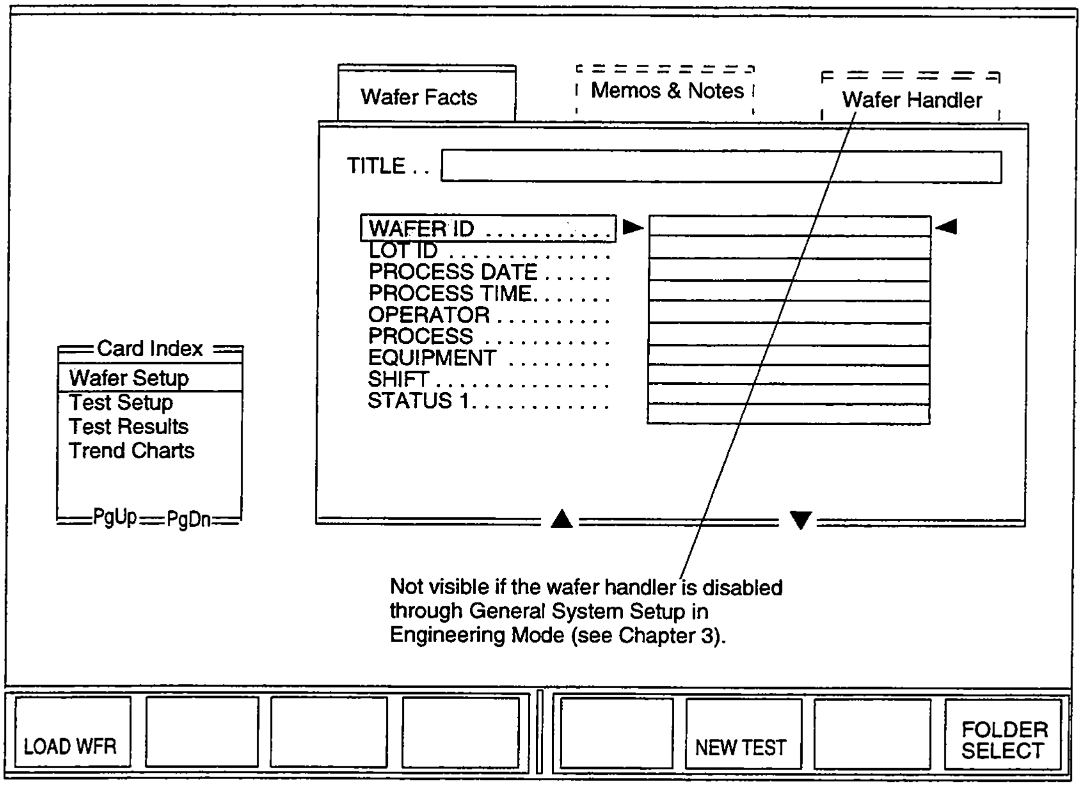

Figure 6-2: Wafer Facts Index Card, Operations Mode

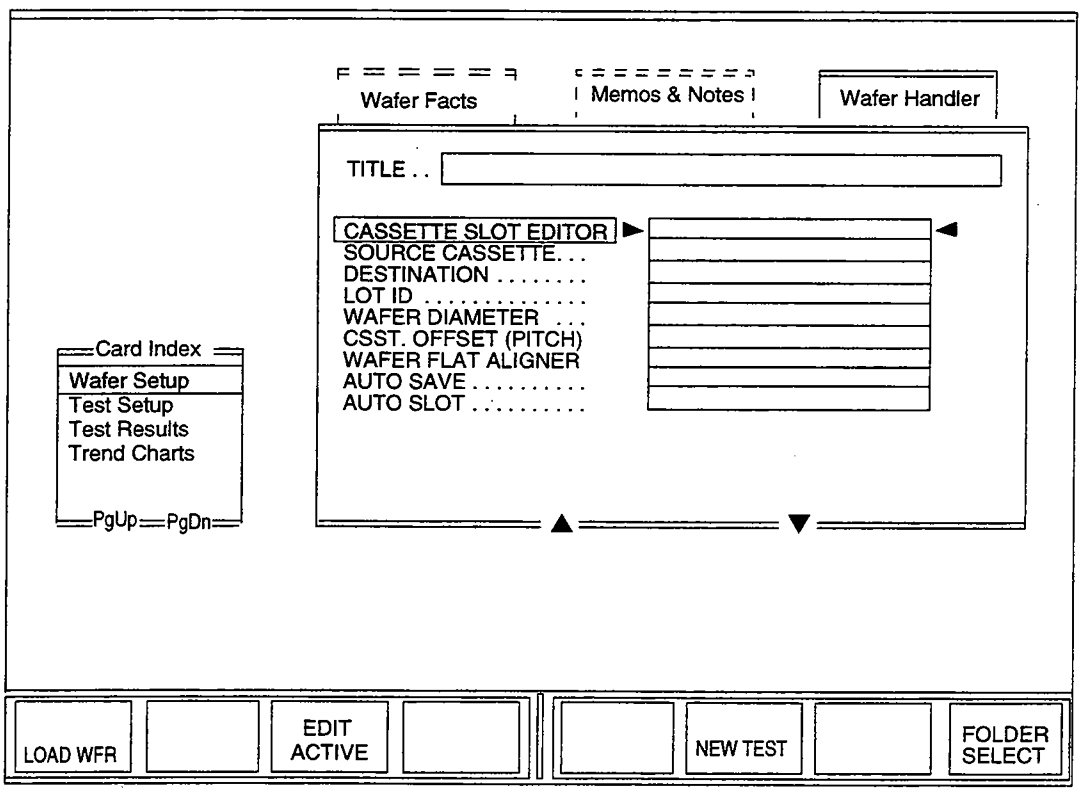

Figure 6-3: Wafer Handler Index Card, Operations Mode

Editing Color-Coded Text Fields

During Test Setup, the process engineer color-coded the text fields that require input. Text fields can be color-coded orange, red, blue, or black (see "Using Color-Coding to Set Text-Entry Requirements for the Operator," in Chapter 1). Table 6-1 defines the color-codes.

Table 6-1: *Text Field Color Codes*

Field Color	Meaning
Orange	You *must* enter information into the text field *each time you open the folder* to collect data.
Red	You *must* enter information into the text field *each time a wafer is loaded.*
Blue	You can—but *do not need to*—enter information to begin the test.
Black	You *cannot* make entries in the text field.

This procedure assumes you have selected the test folder you intend to work with. If you have not, refer to the earlier section "Selecting a Test Folder."

To enter information into an index card's text fields

1. Highlight the color-coded field, type in the information, and press Enter.

   The field changes from orange or red to blue.

2. Repeat step 1 for each field that requires an entry.

   In the Wafer Setup Card Index

   - Tests that require manual loading of wafers use the parameters entered in two of the index cards: Wafer Facts and Memos & Notes.
   - Tests that use the wafer handler use the parameters entered in all three index cards: Wafer Facts, Memos & Notes, and Wafer Handler.
     - If the WAFER ID field in the Wafer Handler Index Card is color-coded red, enter the ID for the first wafer to be tested. The system will later prompt you to enter a wafer ID after each subsequent wafer is loaded. (When entering numeric IDs, precede a single-digit ID with a zero for correct file sorting; that is, enter a *5* as **05**.)
     - If you do not have a response to a message in the Memos & Notes Index Card, you can simply acknowledge the message by highlighting the field and pressing Enter twice.

Note *If you press F1 (LOAD WFR) before editing all orange or red text fields, the system displays this message at the bottom of the screen:*

```
FORCED ENTRY FIELDS MUST BE EDITED BEFORE TESTING!
```

The system then takes you back to the index card that needs to be edited.

Loading Wafers Manually

If the Wafer Facts Index Card appears after you selected the test folder and pressed F1 (COLLECT DATA), the test is set up for manual *wafer loading as* described below. If, in addition, the Sample Type in the Meas. Type Index Card is set to Manual–Auto Run, Manual–Pause, or Auto Range–Pause, the test is also set up for *manual testing*, and you should refer to the next section "Loading and Testing Wafers Manually."

To load wafers manually

1. From the Wafer Facts Index Card, press F1 (LOAD WFR).

   The system prompts you to place the wafer on the platen.

2. Make sure that the alignment pins are in the correct location on the platen, and then place the wafer on the platen (refer to the section "Alignment Holes of the Wafer Platen" in Chapter 1).

3. Press F1 (CONTINUE) to proceed with the test.

   After the tester finishes measuring the wafer it will reprobe any ***bad*** sites (sites that indicate a value outside the sorting sigma, typically set to the default of 3.0). When measurements are complete

   - Text fields in the index cards in the Wafer and Test Setup Card Indexes change from blue to black indicating that they cannot be edited. The displayed values are for the completed test and will be saved as part of the test data. To edit the fields for a subsequent test, you must first press F6 (NEW TEST).
   - The Card Index expands to include Test Results, Trend Charts, and SQC Charts Card Indexes. These cards summarize the results of your wafer tests, display test results in map form, and enable you to track the overall performance of your processes.
   - The Data Summary Index Card appears.
   - If the AUTO PRINT parameter in the General System Data Screen is set to AUTO PRINTING ON, the system automatically prints the test results.
   - If one of the AUTO SAVE selections is enabled, the system automatically saves the test data to the account.
   - If one of the AUTO SAVE parameter's AUTO UPLOAD options is selected, the system automatically uploads test data to the host computer.

4. If AUTO SAVE is not enabled, press F7 (SAVE) if you want to save the data.
5. Remove the tested wafer from the platen, and proceed with steps 6 through 8 for any additional wafers.
6. Place the next wafer on the platen.
7. Press F6 (NEW TEST).
8. Press F1 (LOAD WFR), and repeat this procedure from step 3.

Loading and Testing Wafers Manually

A *manual test* is a test that requires operator input. Manual testing options include the following Sample Types (selected in the Meas. Type Index Card):

- MANUAL–AUTO RUN
- MANUAL–PAUSE
- AUTO RANGE–PAUSE

When running a manual test, you can program the system to *automatically* load the wafers onto the platen, or you can *manually* load the wafers onto the platen. When manually loading wafers, be sure to use the alignment pins provided with the system to correctly position the wafers on the platen.

To manually load the wafers, you must first disable the wafer handler from either the General System Data Screen (refer to the section "Setting General System Parameters" in Chapter 3) or the Wafer Handler Index Card as described below.

This section describes how to manually load wafers and run a MANUAL–AUTO RUN, MANUAL–PAUSE, or AUTO RANGE–PAUSE test. These tests require you to enter information in the index cards during operation.

To manually load a wafer and run a Manual–Auto Run, Manual–Pause, or Auto Range–Pause test

1. Go to the Folder Select Screen, and press F1 (COLLECT NEW DATA).
   - If the wafer handler has not been disabled in the General System Data Screen, the Wafer Handler Index Card appears. To disable the wafer handler, highlight the SOURCE CASSETTE field, and press F4 (TOGGLE ACTIVE) to select NOT ENABLED.
   - If the wafer handler has been disabled in the General System Data Screen, the Wafer Facts Index Card appears (refer to Figure 6-2).
2. Enter information into any required-entry text field (WAFER ID, LOT ID, OPERATOR, and so on) as described in "Editing Color-Coded Text Fields."

   Remember, when entering numeric IDs, precede a single-digit ID with a zero for correct file sorting; that is, enter a 5 as `05`.
3. Select Test Setup in the Card Index.
4. Verify the parameters in the Test Type and Measure Type Index Cards.

   (Refer to the sections "Entering Parameters in the Measure Type Index Card" and "Entering Parameters in the Test Type Index Card," in Chapter 4.)
5. Press F1 (LOAD WFR).

   A message appears telling you to put the wafer on the platen.
6. Make sure that the alignment pins are securely placed in the correct holes in the platen (refer to the section "Alignment Holes of the Wafer Platen" in Chapter 1).
7. Place the wafer on the platen, and press F1(CONTINUE)
   - If MANUAL–AUTO RUN or MANUAL–PAUSE is selected, the probe

head contacts the wafer. The tester sets the measurement current to the value entered in the AMPERAGE field. The resulting voltage displayed in the VOLTAGE field is the consequence of using the selected current.

- If AUTO RANGE–PAUSE is selected, the probe head contacts the wafer and (beginning with the current in the AMPERAGE field) searches the full current range until it finds a current that results in a voltage drop equal to the target voltage entered in the VOLTAGE field.

8. When this process is completed, the Measure Type Index Card appears.

   - If MANUAL–AUTO RUN or MANUAL–PAUSE was selected, the index card displays the resulting voltage.
   - If AUTO RANGE–PAUSE was selected, the system replaces the value in the AMPERAGE field with the current that produced the voltage drop entered in the VOLTAGE field.

   With MANUAL–AUTO RUN, the system then begins the measurement sequence without pausing. Proceed to step 13.

   With MANUAL–PAUSE or AUTO RANGE–PAUSE, the system pauses to allow you to enter a different amperage in the AMPERAGE field. You might wish to enter a different amperage before initiating wafer measurement when you are testing a new application, and where a consistent sheet resistance and a low standard deviation indicate the optimum current.

9. For MANUAL–PAUSE or AUTO RANGE–PAUSE, type the new value into the AMPERAGE field, and press Enter (or go to step 12 if you wish to use the currently displayed amperage).
10. Press F6 (SAMPLE) to measure the sheet resistance based on your entry.
11. Repeat this procedure until the system reaches the voltage drop and sheet resistance you want.
12. Press F1 (TEST WFR).

    When testing is complete, the Data Summary Index Card appears.

After the tester finishes measuring the first wafer

13. Press F7 (SAVE) to save the collected data (if AUTO SAVE is not selected).
14. Remove the wafer from the platen.
15. Place the next wafer on the platen.
16. Press F6 (NEW TEST).
17. Press F1 (LOAD WFR), and repeat this procedure from step 7.

Loading and Testing Wafers Automatically

If the Wafer Handler Index Card appears after you select the test folder and press F1 (COLLECT DATA), the test is set up for automatic wafer loading. *Automatic wafer loading* means using the wafer handler to load wafers onto the tester's platen. Therefore, before beginning the test, you must make sure that the wafer handler is online and properly prepared for loading wafers. (The words HANDLER ON LINE should appear at the top, right-hand side of the screen.) You must also make sure that the system's software is properly set up to load wafers automatically. Check the parameters in the Wafer Handler Index Card as noted below.

Automatic testing means that operator input is not required during testing. Check the parameters in the index cards to make sure that the parameters match your testing requirements and wafer characteristics. Note that if the Sample Type field in the Measure Type Index Card is set to Manual–Pause or Auto Range and Pause, the system will pause after the first wafer is measured and require operator intervention to continue measuring wafers.

Note *If you change a parameter in an index card in Operations Mode, the parameter changes only as long as you remain in the current test folder. When you exit the test folder (via the Folder Select Screen), the parameter returns to the one specified in Engineering Mode.*

To check the wafer handler parameters for automatic wafer loading

1. Go to the Folder Select Screen, and press F1 (COLLECT NEW DATA).

   The Wafer Handler Index Card appears.
2. Check the following:
   - Make sure that the source cassette matches the location indicated in the SOURCE CASSETTE field. The Source Cassette is the cassette from which the wafers will be taken. If the setting is incorrect, press F4 (TOGGLE ACTIVE) to toggle the source cassette to the appropriate location. You can select Right or Both.
   - Make sure that the destination cassette matches the location indicated in the DESTINATION field. The Destination Cassette is the cassette where the wafers will be placed after testing. If the setting is incorrect, press F4 (TOGGLE ACTIVE) to toggle the destination cassette to the appropriate location.
3. If the AUTO SLOT MODE is not set to ON: SRCH WHOLE CSSTE, use the CASSETTE SLOT EDITOR field to select the wafers in the SOURCE Cassette that you want to measure (refer to the section "Selecting Individual Wafers Using the Cassette Slot Editor" in Chapter 4).
4. Make sure that entries in the WAFER DIAMETER and CASSETTE SIZE OFFSET fields are correct. ***Wafers can be damaged if these settings are not correct.***

Note *To enable **automatic testing**, make sure that PAUSE is not selected in the SAMPLE TYPE field of the Measure Type Index Card. If PAUSE is selected, the system will display an error message and require you to select AUTO RANGE–AUTO RUN or MANUAL –AUTO RUN before proceeding.*

After verifying entries in the remaining index cards, you are ready to begin loading wafers automatically. Remember that black text fields (blue printing on a black background) can only be modified in Engineering Mode. If you think that an entry in a black field is incorrect, and you do not have access to Engineering Mode, contact your supervisor. (For a detailed description of the text fields in the index cards, refer to Chapter 4.)

To load wafers automatically

1. Press F1 (LOAD WAFER).

   The wafer platen rotates to the load/unload position, and the screen displays the message

   ```
   Press STOP key to pause handler operations
   ```

   as the handler performs the following tasks in order:

   - The vacuum finger retrieves a wafer from the first selected slot in the source cassette.
   - If the flat aligner is enabled, the flat or notch location is identified.
   - If the Wafer ID field is a forced-entry field, the system moves the platen forward and pauses as it displays the message

     ```
     PLEASE ENTER WAFER ID:
     ```

2. Type in the Wafer ID (if prompted), and press Enter. When entering numeric IDs, precede a single-digit ID with a zero for correct file sorting i.e., enter a *5* as **05**.

   The system places the wafer on the stage. After the system finishes measuring the wafer, the wafer platen again moves to the load/unload position, and the handler returns the first wafer to the slot designated by the test setup.

Note *If the handler halts while finding or loading a wafer, refer to the section "Bringing the Wafer Handler Online and Recovering from Handler Errors" in Chapter 3.*

Running a Batch Recipe

The Batch Recipe feature enables you to run multiple test recipes in a single operation. Batch Recipes are automated tests defined in Engineering Mode by linking the folder IDs of predefined tests to individual wafers in the cassettes. A Batch Recipe must reside in the same *account* as the folders assigned to it and can only be run from the account in which it resides. See the section "Batch Recipes," in Chapter 5, for details.

After the Batch Recipe is set up in Engineering Mode, testing can begin with only a few keystrokes. Batch Recipe tests are initiated from the Batch Recipe Screen.

To collect data using a batch recipe

1. From the StatTrax Introduction Screen, press F5 (BATCH RECIPE).

   The Batch Recipe screen appears (Figure 6-4).

2. From the Batch Recipe Screen, select the Batch Recipe you want to run by pressing the letter key that corresponds to the batch recipe.

3. With the wafer cassette(s) correctly positioned on the wafer handler, press F1 (COLLECT) to begin the batch test.

   Before beginning the batch test, the system verifies that none of the selected tests require operator intervention (such as entering data in a forced field or editing the voltage in a manual test). Then it checks that all folders linked to the test cassette are compatible, e.g., call for wafers of the same diameter. (This process can take from a few seconds to a few minutes, depending on the complexity of the Batch Recipe Setup.) If the system discovers an incompatibility, it reports the problem and identifies the folders involved. Otherwise, testing proceeds:

   - As the system loads the wafer, the monitor displays the Wafer Handler Index Card for the active folder.
   - As testing proceeds, the monitor displays the Data Summary Index Card for the active folder. (For Patterned Tests, the system displays the Die Map.)
   - As each test is completed, data is saved to the active folder. A legend at the top of the screen identifies the active folder.

4. To interrupt testing and return to the Batch Recipe Screen, press F8 (CANCEL).

5. When all testing is completed, the Batch Recipe Screen reappears. Return to the Introduction Screen by pressing F8 (INTRO).

Note *Fields in the Batch Recipe Screen are for display only and cannot be edited. However, cassette slot selections for the individual Batch Recipes can be edited in the Batch Recipe Slot Editor in Operations Mode. See the next section, "Reviewing or Editing a Batch Recipe in Operations Mode."*

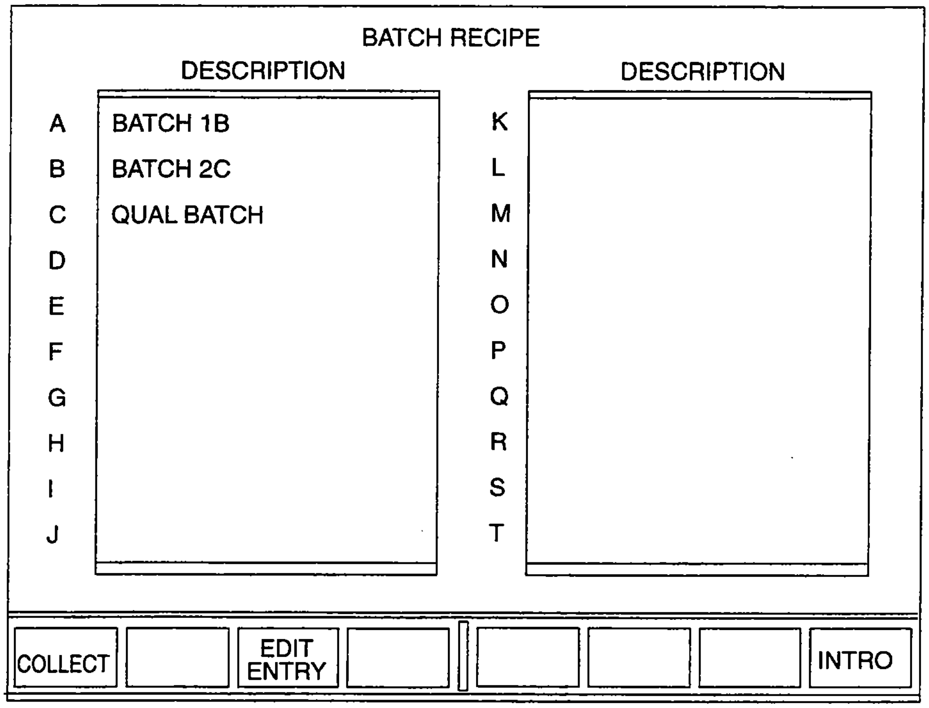

Figure 6-4: Batch Recipe Screen, Operations Mode

Reviewing or Editing a Batch Recipe in Operations Mode

Use the Batch Recipe Slot Editor to review the Batch Recipe's setup or to skip testing of some of the wafers in the cassette.

Note *You cannot add or change slot assignments in Operations Mode. Any edits made in Operations Mode are temporary. Permanent edits can only be made in Engineering Mode.*

The BATCH TEST field identifies the selected Batch Recipe by its location (A through T) on the Batch Recipe Screen (Figure 6-4). The BATCH DESCRIPTION field displays the recipe's name as it appears in the Batch Recipe Screen.

To review or edit a batch recipe in Operations mode

1. From the Batch Recipe Screen, select the recipe you want to review or edit by pressing the letter key that corresponds to the recipe.
2. Choose F3 (EDIT ENTRY). The system displays the Batch Recipe Slot Editor screen for the selected batch recipe (Figure 6-5).
   - The numbers in the SLOT column represent the corresponding wafer slots in the cassette.
   - The WAFER ID column displays the ID number of the wafer assigned to each slot.
   - The SELECTED column displays the Folder ID assigned to the wafer slot.
3. To skip a wafer test, highlight the row containing the slot number and test folder ID, and press F1 (SELECT). The SELECTED Folder ID is blacked out, indicating that the test will not be run.
   - To scroll through the cassette slot entries, use the up- or down-arrow keys.
   - To access cassette slots not currently displayed, use Home, Page Up, Page Down, or End keys.
   - To move from one cassette to the other, use the left- or right-arrow key.

Note *The F1 command box only enables you to skip wafer tests that were not locked in Engineering Mode. Folder ID assignments locked in Engineering Mode appear in inverse video on a black field.*

4. To restore a wafer test to the batch recipe, highlight its cassette slot number, and choose F1 (SELECT) again. The SELECTED column will redisplay the originally selected Folder ID.

When you finish editing the batch recipe, you can begin testing immediately without returning to the Batch Recipe screen. Press F1 (COLLECT) to initiate data collection for the batch test.

Note *Batch Recipe test results are saved to the selected test's folder. Using the left cassette in Figure 6-5 as an example, results for the wafer in slot 10 will be stored in Folder 123, results for the wafer in slot 9 will be stored in Folder 234, and results for the wafers in slot 1 through 8 will be stored in Folder 112.*

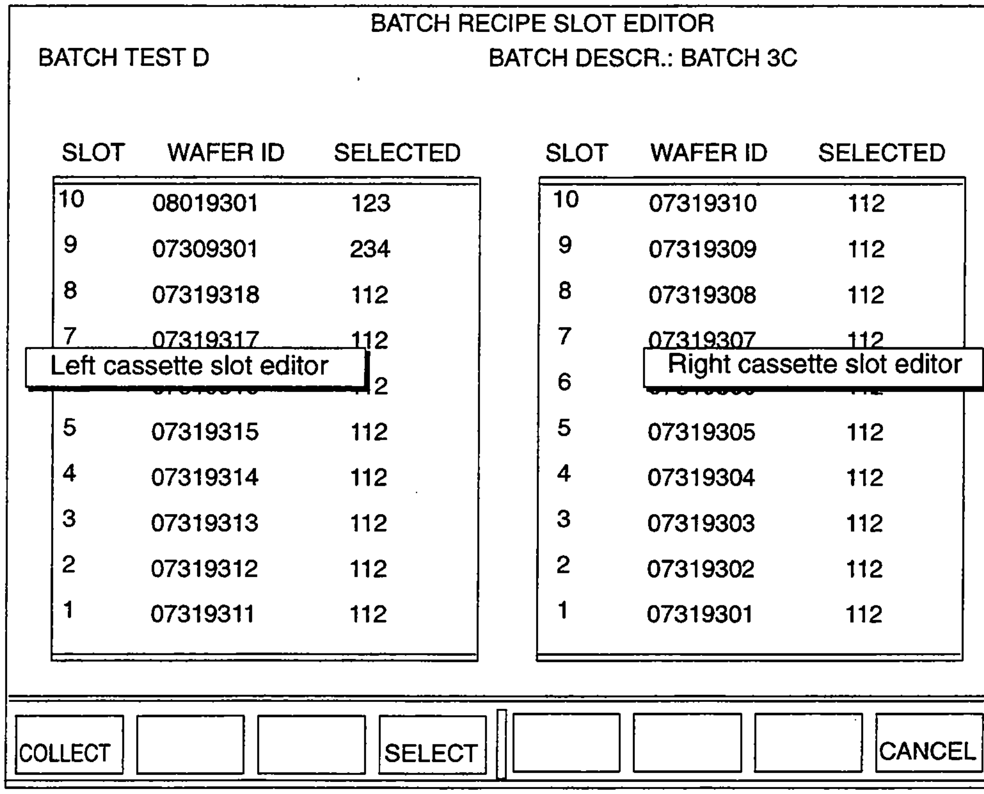

Figure 6-5: Batch Recipe Slot Editor Screen, Operations Mode

Looking at Data and File Summaries of Collected Data

After the system completes the measurement sequence, the screen displays the Wafer Handler Index Card (if you used the wafer handler), or the Data Summary Index Card (if you did not use the wafer handler). Depending on your test type, you can display Contour Maps, 3D Maps, Diameter Scans, or Die Maps using the command boxes available in these index cards. You can also display and print data values (refer to Chapter 7 for details).

The File Summary Index Card (Figure 6-6) displays file information such as the current file number, the test type, the number of test sites, the film type measured, and associated statistical data. To access the File Summary Index Card from the Wafer Handler Index Card, press the keyboard's Page Down key to move to the Test Results Card Index.

The Data Summary Index Card (Figure 6-7) presents a statistical summary of the data. To access the Data Summary Index Card from the File Summary Index Card, press the keyboard's right-arrow key.

Now that you have tested wafers, go to Chapter 7 to learn how to display, analyze, and transfer the test results.

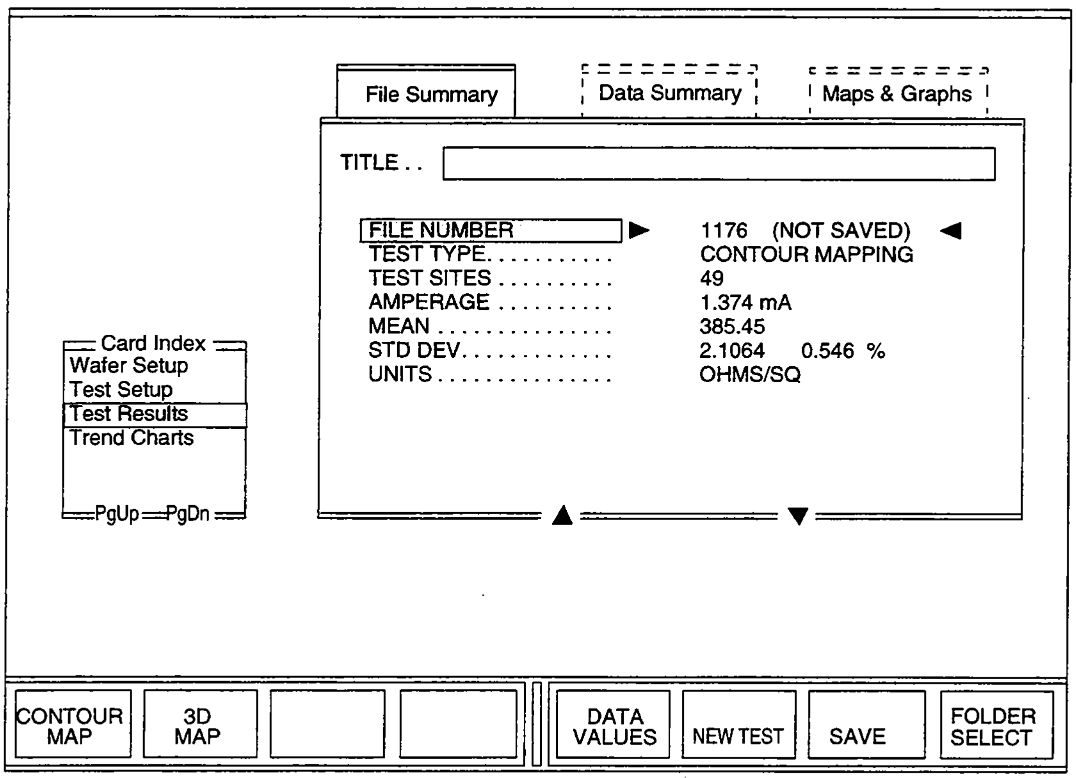

Figure 6-6: File Summary Index Card, Operations Mode

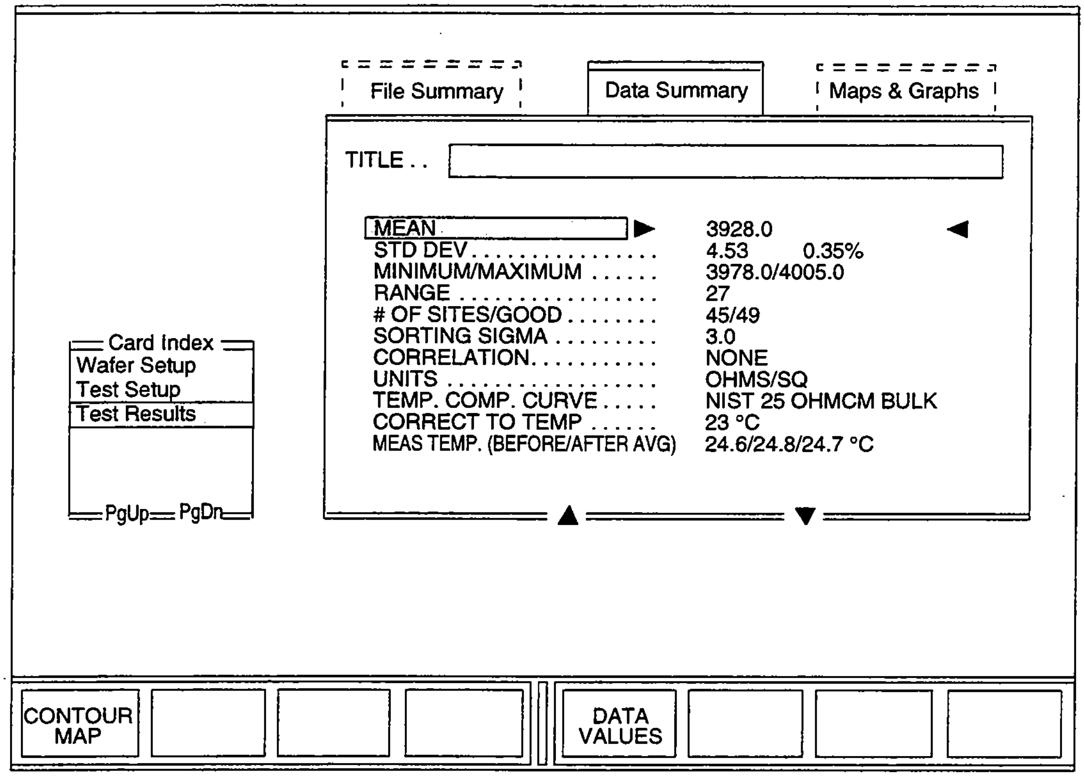

Figure 6-7: Data Summary Index Card, Operations Mode

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OmniMap® RS55/tc

Sheet Resistance Mapping Systems with StatTrax® Software version 6.3

User's Guide

Volume 2 of 2

June 1996
04-0263 A

This manual supports:

- *Auto* RS55/tc Resistivity Mapping Systems
- RS55/tc Resistivity Mapping Systems

PRINTED ON CLEANROOM PAPER

This manual contains chapters 7 through Appendix F.

Tencor®
Film Measurement Division

A Quick Guide to This Manual

Do you want to know about...

- Learning to use your system
  See Chapter 2.
- Overview of system hardware and software
  See Chapter 1.
- Setting general system parameters
  See page 3-14.
- Precautions for handling cartridges
  See page 1-5.
- File naming conventions used in StatTrax software
  See page 1-18.
- Test measurement patterns
  See Appendix B.
- About Temperature Coefficient of Resistance (TCR) curves
  See page 5-10.
- Loading wafers automatically
  See page 6-9.
- About P/N Typing
  See page 4-34.
- Basic maintenance procedures for your system
  See Appendix C.

Note *If the subject you want to look up is not listed above, please refer to the Table of Contents or the Index.*

NOTICE

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7 VIEWING AND ANALYZING DATA

Chapter 7
Viewing and Analyzing Data

Read This First

Chapter 6 describes how to collect data. This chapter, intended for both the process operator and the process engineer, describes the different ways to display, analyze, and interpret test results. This chapter includes topics as simple as displaying maps of wafer data, and as complex as statistically combining data or creating a fitted curve to plotted data points for purposes of extrapolation.

In this chapter, you will learn about

- Viewing test results immediately after data collection
  - Displaying maps and raw data lists
  - Displaying and interpreting Trend and SQC Charts
- Converting data to different types of units
  - Using the Data Values Screen to convert data to different units
  - Creating curve files of wafer measurement and process data
- Combining data to modify or compare test results

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Test Results

StatTrax software lets you collect and view resistivity data in a number of ways. The parameters that determine how the data is displayed were set up in the Test Type Index Card, where the process engineer chose from the following tests:

- Contour Map (and 3D Map), which provides a topographic map of resistivity across a wafer's surface
- Diameter Scan, which gives a linear profile across the diameter of the wafer
- Quick Test, which measures a small number of sites on monitor wafers using standard or customized measurement patterns (you cannot display a wafer map of Quick Test results)
- Pattern Testing, which displays the test sites on patterned wafers in die map form
- Qual Procedure, which enables you to monitor short- and long-term variation of the system's measurement repeatability

StatTrax Trend Charts enable you to track a process over time by displaying the means and standard deviations of several wafers in a specified chronological sequence. SQC Charts take your data analysis a step further by chronologically plotting *collections* of wafers by mean, range, or standard deviation using system-calculated control limits.

Displaying Maps and Raw Data Lists

After the system collects data on a wafer (or a set of wafers during automatic testing), it gives you access to several index cards in Operations Mode. You can display your test results in map form or as a raw-data listing:

- You can view your data in the form of a Diameter Scan if the process engineer selected DIAMETER SCAN in the Test Type Index Card in Engineering Mode.
- You can view your data in the form of a Contour Map or a 3D Map if one of the following conditions is met:
  - The process engineer selected CONTOUR MAP in the Test Type Index Card in Engineering Mode.
  - The process engineer selected PATTERN TESTING and you have sufficient test-site density selected in the Die Map Screen. (The minimum test-site density is a checkerboard pattern.) Refer to the later section "Patterned Wafer Die Maps."

  StatTrax uses identical information to generate Contour Maps and 3D Maps. Each presents the same information in a different way (refer to the later sections, "Contour Maps" and "3D Maps").

The following sections describe the various display options and how you can view them immediately after testing.

Contour Maps

A Contour Map provides a picture of wafer uniformity in the form of a two-dimensional topographic map (Figure 7-1). Contour lines enclosing plus signs (+) and minus signs (-) on the wafer map indicate gradients from the mean value. The mean value is indicated by a bold contour line. An asterisk (*) on the map indicates a data point that falls outside the limit set in the Sorting Sigma field in the Test Type Index Card. A square block means no measurement could be obtained at the measurement site.

The process engineer sets the Contour Map display parameters in the Maps & Graphs Index Card. The entry in the Contour Interval field changes the number, and therefore the density, of the contour lines. (Refer to the section "Entering Parameters in the Maps & Graphs Index Card" in Chapter 4.)

StatTrax software color-codes the Contour Map as described in Table 7-1. The color is determined by the MEAN–TARGET, MEAN–WARNING, and MEAN–SPEC limits set in the Trend Scaling Index Card.

Viewing Contour Maps

To view test results as a Contour Map immediately after testing

1. Press F1 (CONTOUR MAP).

   The system draws a Contour Map of your data (Figure 7-1). To print the map and a summary of the test data, press F5 (PRINT).
2. Press F8 (EXIT) to return to the index card.

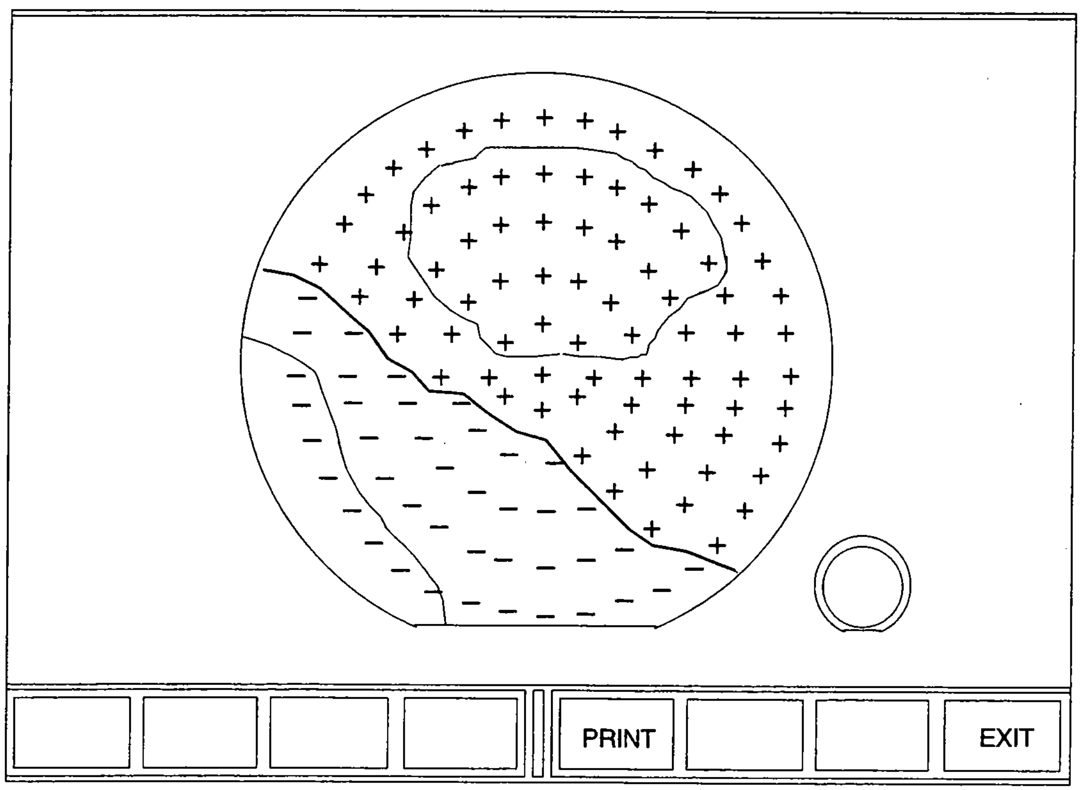


Figure 7-1: Contour Map, Polar Coordinates

Table 7-1: Color Coding on Contour Maps

Color	Meaning
Green	Measurement is within spec
Yellow	Measurement exceeds warning limits
Red	Measurement exceed control limits

3D Maps

The 3D Map presents the same information as a Contour Map but in a three-dimensional form (Figure 7-2). In the Maps & Graphs Index Card, you can select the display type, plot limits, and the rotational and tilt viewing angles. Refer to the section "Entering Parameters in the Maps & Graphs Index Card" in Chapter 4.

As with the Contour Map, StatTrax software colors different areas of a 3D Map: green, yellow, or red according to the values the process engineer enters for the MEAN–TARGET, MEAN–WARNING and MEAN–SPEC limits in the Trend Scaling Index Card in Engineering Mode.

Viewing 3D Maps

To view test results as a 3D Map immediately after testing

1. Press F2 (3D MAP).

   The system draws a 3D map of your data.
2. Press F5 (PRINT) to print the map and a summary of the test data.
3. Press F8 (EXIT) to return to the index card.

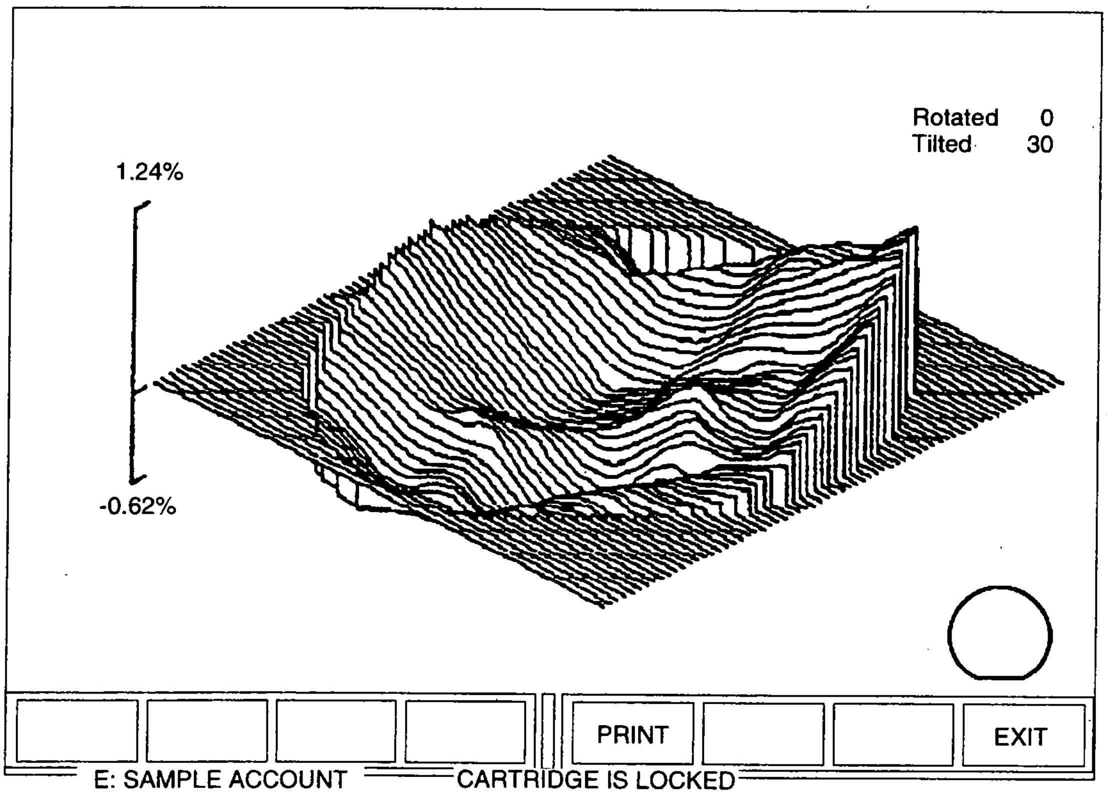


Figure 7-2: 3D Map

Diameter Scans

The Diameter Scan gives a profile of wafer uniformity along a single diameter line through the center of the wafer, selected as a radial angle between 0° and 360°. As with Contour Maps and 3D Maps, Diameter Scans can represent up to 625 test sites. Figure 7-3 shows an example of a 49-site test scanned from the top to the bottom of the wafer (toward the major flat or notch).

Viewing a Diameter Scan

To view the results of a Diameter Scan immediately after testing

1. Press F1 (DIAMETER SCAN) or F2 (3D MAP).

   The system plots the Diameter Scan results.
2. Press F5 (PRINT) to print the map and a summary of the test data.
3. Press F8 (EXIT) to return to the index card.

Refer to "Entering Parameters in the Maps & Graphs Index Card" in Chapter 4 for information on setting up Diameter Scans, or Appendix B for additional information about Diameter Scans.

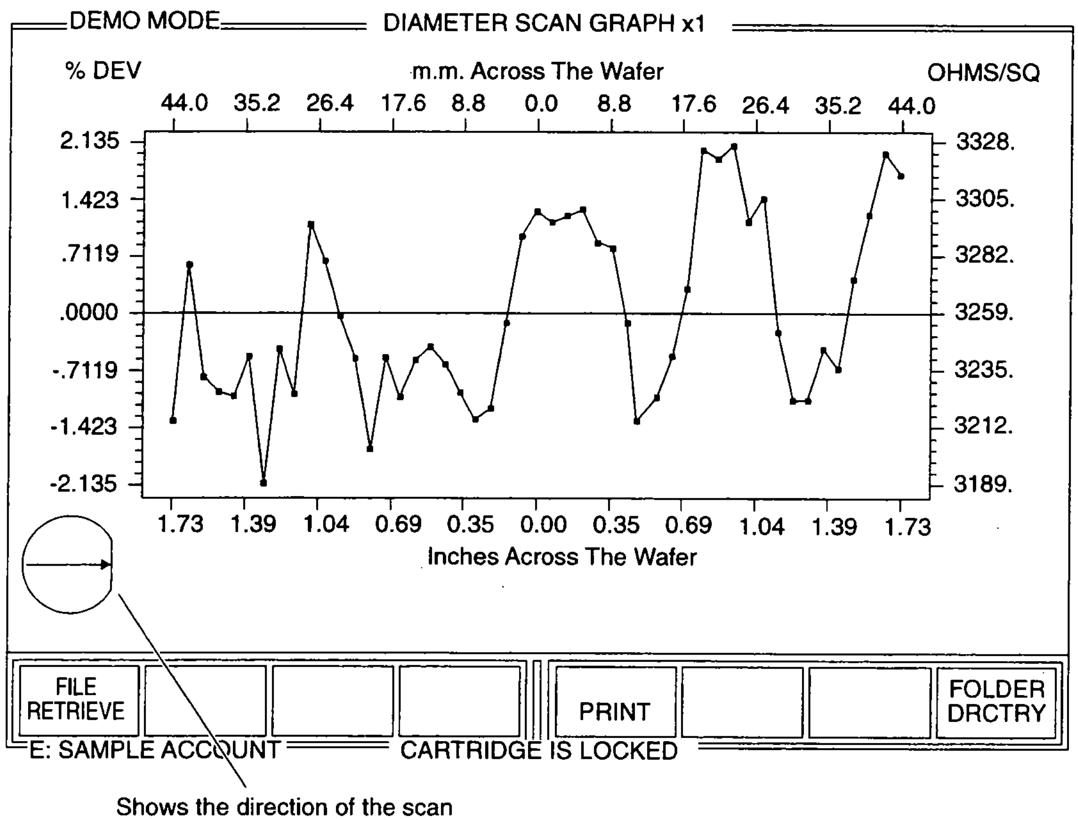


Figure 7-3: 49-Site Diameter Scan

Expanding a Diameter Scan

StatTrax gives you the option of expanding the Diameter Scan and printing it over the length of two or three 8.5-inch x 11-inch pages.

1. After collecting wafer data, press F1 (DIAMETER SCAN) from any index card in Operations Mode.
2. Press F3 (TOGGLE LENGTH) to select the scan print size. Refer to Table 7-2.

   As you toggle the length of the scan, the horizontal scale changes accordingly to display the different segments of the scan. Use the Page Up and Page Down keys to view these segments.
3. Press F5 (PRINT ALL) to print the scan and corresponding file summary information.
4. Press F8 (EXIT) to return to the previous screen.

Table 7-2: *Diameter Scan Print Sizes*

Size Options	Style	Dimensions
x 1	Portrait style	6.75 inches wide (standard size)
x 2	Landscape style	15 inches long
x 3	Landscape style	21 inches long

Quick Tests

The process engineer can set up two types of Quick Tests:

- Standard or customized tests on unpatterned wafers (polar or Cartesian coordinate)
- Customized die map tests on patterned wafers (Cartesian coordinates). (Refer to the next section, "Patterned Wafer Die Maps.")

The Quick Test is a quick wafer measurement using 1, 3, 4, 5, 6, 8, 9, or 10 test sites in standard patterns, or up to 30 sites for customized patterns. Measurement results from a Quick Test are presented only as a raw data listing. Figure 7-4 shows a raw data listing for a five-site Quick Test. Refer to "Quick Test Patterns (Polar Coordinates)," in Appendix B, for pattern displays and additional information.

Viewing the Results of a Quick Test

To view the results of a Quick Test or Qual Procedure, from any index card in Operations Mode

1. Press F5 (DATA VALUES).

   The system displays the data values. Lines highlighted in red indicate values that fall outside the sorting sigma, typically set to 3.0.
2. Press F5 (PRINT) to print a copy of the die map and the test data.
3. Press F8 (RETURN) to return to the index card.

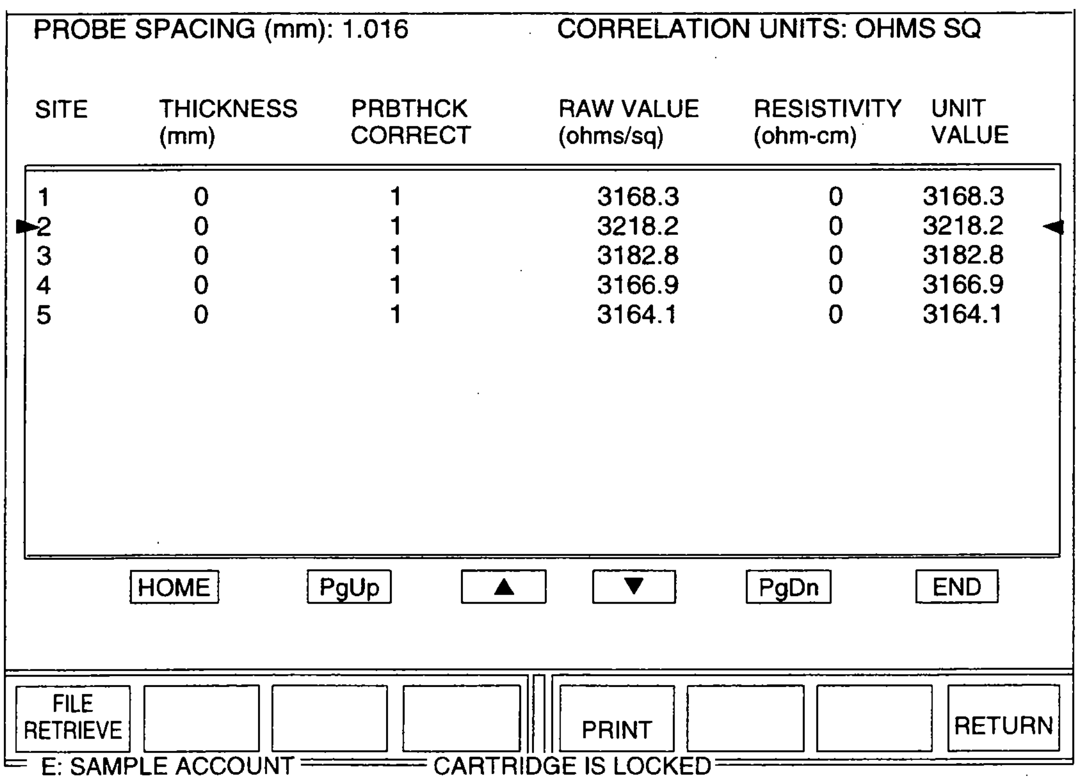


Figure 7-4: Data Listing of Five-Site Quick Test

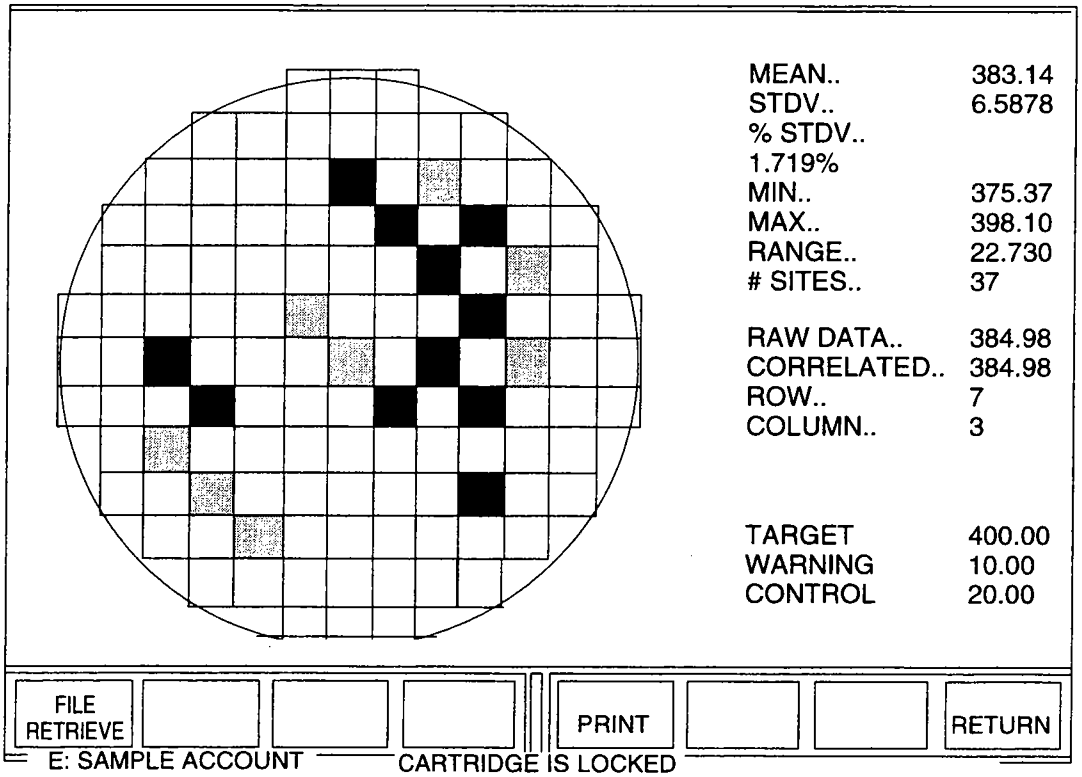
Patterned Wafer Die Maps

In the example shown in Figure 7-5, a process engineer created a 37-site pattern. The step size was set to x=y=10 mm. The values displayed on the right side of the screen represent the site indicated by the crosshairs on the die map.

Viewing the Results of a Patterned Wafer Test

To view the results of a test on patterned wafers, from any index card in Operations Mode

1. Press F5 (DISPLAY PATTERNS) to view the test results as a die map (Figure 7-5).
   - From the map display, press F5 (DATA VALUES) to see a site-by-site listing of the data. (Lines highlighted in red indicate values that fall outside the sorting sigma.)
   - Press F8 (RETURN) to return to the die map display.
2. Press F5 (PRINT) to print the map and a summary of the test data.
3. Press F8 (RETURN) to return to the index card.



Red die indicate values that exceed control limits.

Yellow die indicate values that exceed warning limits

Green die indicate values that are within spec.

White die were not measured.

Figure 7-5: Die Map Screen

Trend Charts

You access a folder's Trend Chart from the Operations Mode Folder Select Screen. The parameters that define this display was established during test setup in Engineering Mode.

A Trend Chart enables you to examine the variability in your process over time by showing you the means and standard deviations of several wafers arranged in a specified chronological sequence. Each Trend Chart displays data from a single test folder, and each point in the chart represents a single file (wafer) (see Figure 7-6).

You can view a list or a map of the data of any individual point on the Trend Chart by first selecting the point on the screen (using the right- or left-arrow key) and then pressing F1 (DATA DISPLAY).

The information in the directory at the top of the screen changes as you select different points. The bars above and below each point represent the standard deviation of the data points that produced the average value. In Figure 7-6, the vertical cursor bar at position 12 (blue on screen) is centered on the average resistivity value from the last wafer test. Table 7-3 provides a short description of each command box on the Trend Chart Screen.

Refer to "Entering Parameters in the Trend Setup Index Card" and "Entering Parameters in the Trend Scaling Index Card," in Chapter 4, for setup information.

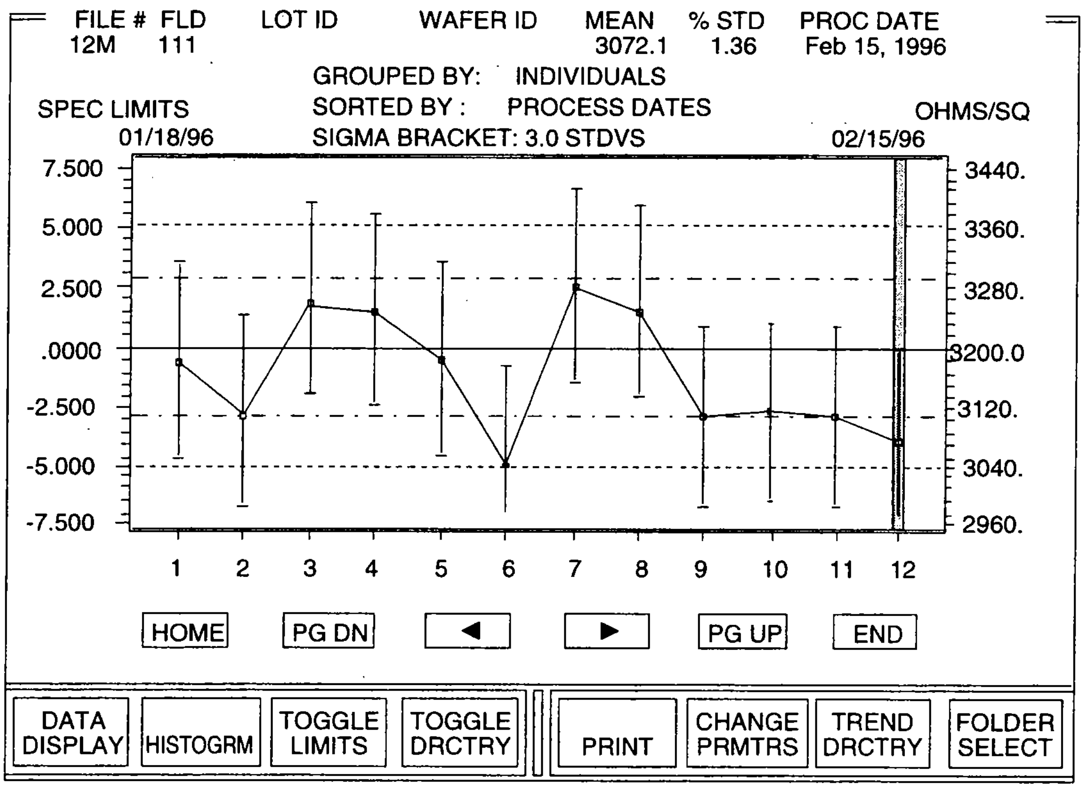


Figure 7-6: Trend Chart

Table 7-3: Command Box Functions in the Trend Chart

Command Box	Function
F1 (DATA DISPLAY)	Displays the wafer test data for the selected file on the Trend Chart. The selected point represents a single wafer test file. If the file is a Diameter Scan file (S), selecting DATA DISPLAY presents the Diameter Scan. To return to the Trend Chart from the data display, press F8 (TREND CHART).
F2 (HISTOGRM)	Displays in *histogram* form all files of collected wafer data currently in the Trend Chart. Refer to the next section "Trend Histograms."
F3 (TOGGLE LIMITS)	Toggles the *trend display limits* between FULL SCALE, SPECIFICATION LIMITS, and USER-DEFINED LIMITS.
F4 (TOGGLE DRCTRY)	Toggles the *directory line* information displayed at the top of the screen. In addition to the standard individual wafer file and test information, you can also display the mean of means and the standard deviation of all *n* files in the Trend Chart.
F5 (PRINT)	Prints a copy of the Trend Chart.
F6 (CHANGE PRMTRS)	Displays the Trend Setup Index Card to enable you to modify the chart by entering *parameter* changes.
F7 (TREND DRCTRY)	Displays the files shown on the Trend Chart as a *directory* listing, with each file occupying a single line. Each line of the Trend Directory displays the file number and summary information on each wafer file.
F8 (FOLDER SELECT)	Return to the Folder Select Screen.

Trend Histograms

The Trend histogram shows the distribution of trended data and the corresponding standard deviations. Its primary use is for monitoring process variability over time. You access the Trend histogram from the Trend Chart Screen by pressing F2 (HISTOGRM).

The MEANS histogram on the left in Figure 7-7 shows the distribution of the means in measurement units. The SIGMA VALUES histogram on the right shows the distribution of wafer uniformity expressed as a percentage of the mean. The horizontal scales represent the sample quantity. Red bars indicate sample means outside 3 σ.

The sigma multiple displayed in the histogram on the right is taken from the SIGMA BRACKET field in the Trend Setup Index Card. The SIGMA BRACKET would be set to 1 for this histogram to represent 1σ wafer-level uniformity, expressed as a percentage of the mean.

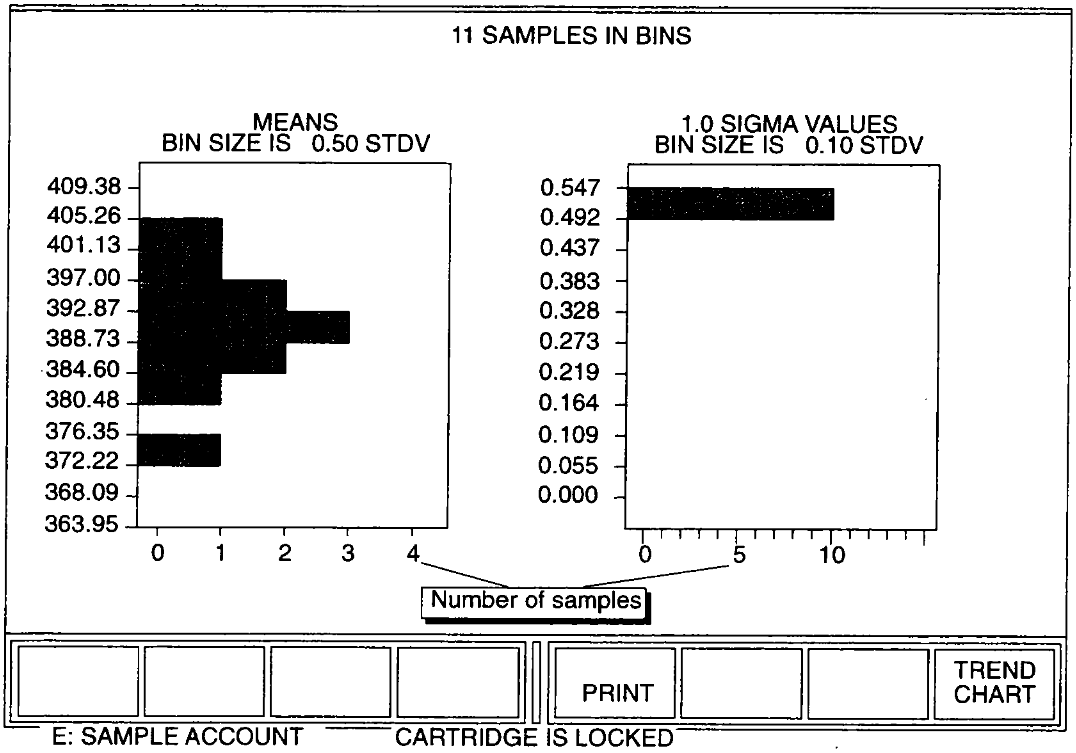


Figure 7-7: Trend Histogram

SQC Charts

You access a folder's SQC Chart from the Operations Mode Folder Select Screen. The parameters that define this display was established during test setup in Engineering Mode.

The SQC Chart, or X-BAR and R chart, chronologically plots the average (X-BAR) and ranges (R) of groups of wafers by their mean, range, or standard deviation. Its usefulness lies in its ability to group data into patterns which, when tested statistically, can lead to valuable information about a process. (AT&T Technologies 1958, 4)

StatTrax software uses the AT&T Rule Set as criteria to identify control limit violations that might indicate drift or other process troubles (refer to the later section "The AT&T Rule Set").

Points or groups of points that violate these rules are marked with a red *x* and considered out of control. Figure 7-8 shows an example of an SQC Chart. Refer to "Entering Parameters in the SQC Setup Index Card" and "Entering Parameters in the SQC Scaling Index Card" in Chapter 4 for information on setting up the SQC Index Cards in Engineering Mode. Table 7-4 describes the command box functions in the SQC Chart.

Refer to the following texts for additional information on SQC Charts and process control theory:

- AT&T Technologies. 1958. *Statistical Quality Control Handbook.* Charlotte, North Carolina: Delmar Printing Co.
- Grant, Eugene L., and Richard S. Leavenworth. 1980. *Statistical Quality Control.* New York: McGraw-Hill, Inc.
- Juran, J. M., and Frank M. Gryna, Jr., eds. 1988. *Juran's Quality Control Handbook.* New Jersey: McGraw-Hill Book Co.
- Monahan, Kevin M., ed. 1994. *Handbook of Critical Dimension Metrology and Process Control.* Washington: The Society of Photo-Optical Instrumentation Engineers.

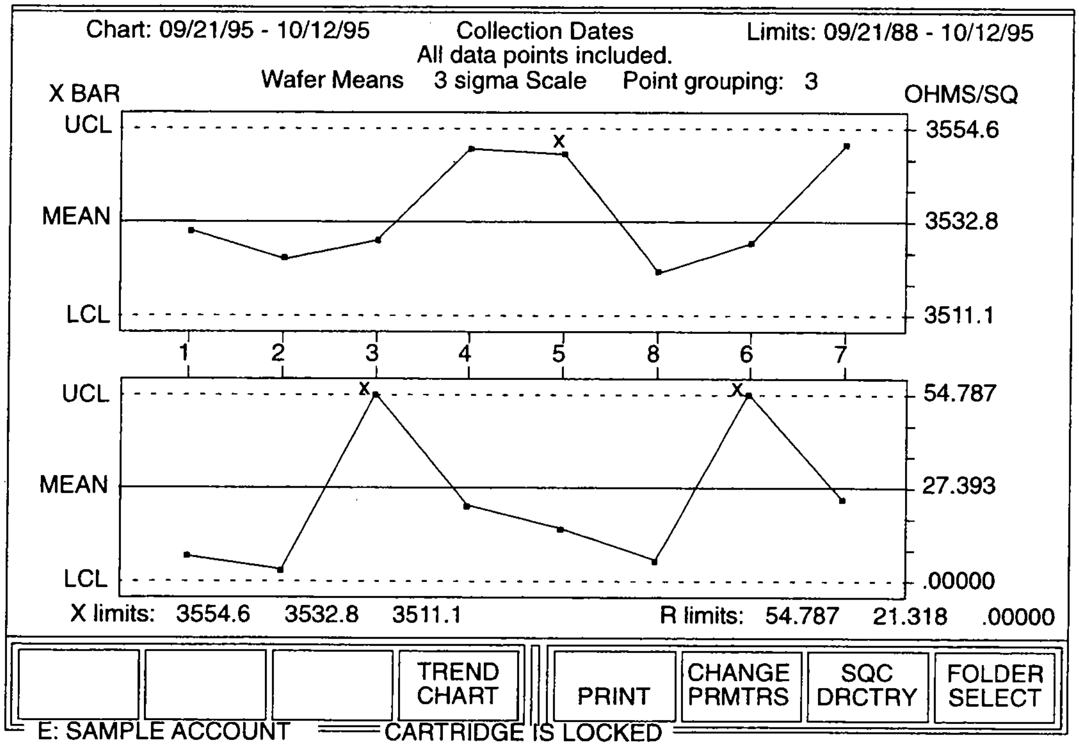


Figure 7-8: *SQC Chart*

Table 7-4: *Command Box Functions in the SQC Chart*

Command Box	**Function**
F4 (TREND CHART)	Shows the Trend Chart of the displayed test data.
F5 (PRINT)	Prints the SQC Chart with a summary of the data, the number of point groups, the group size and any control limit violations. (See the following section, "The AT&T Rule Set.")
F6 (CHANGE PRMTRS)	Displays the SQC Setup Index Card enabling you to modify the chart by entering *parameter* changes.
F7 (SQC DRCTRY)	Displays the files shown on the SQC Chart as a *directory* listing, with each file occupying a single line. Each line of the Trend Directory displays the file number and summary information on each wafer file.
F8 (FOLDER SELECT)	Return to the Operations Folder Select Screen.

The AT&T Rule Set

The AT&T Rule Set is applied by separating the control chart into zones, each approximately one standard deviation wide, above and below the center line (CL). Figure 7-9 displays the control chart zones.

UCL[1] - - - - - - - - - -		3S
	Zone A	
- - - - - - - - - -		2S
	Zone B	
- - - - - - - - - -		1S
	Zone C	
MEAN______________		(CL)
	Zone C′	
- - - - - - - - - -		1S
	Zone B′	
- - - - - - - - - -		2S
	Zone A′	
LCL[2] - - - - - - - - - -		3S

1 = Upper Control Limit

2 = Lower Control Limit

Figure 7-9: Control Chart Zones

StatTrax identifies violations of the rules below the CL as follows:

#1 At least one point lies below Zone A′.

#2 2 out of 3 successive points in Zone A′ or below.

#3 4 out of 5 successive points in Zone B′ or below.

#4 8 successive points in Zone C′ or below.

StatTrax identifies the rules above the CL as follows:

#5 8 successive points in Zone C or above.

#6 4 out of 5 successive points in Zone B or above.

#7 2 out of 3 successive points in Zone A or above.

#8 At least one point lies above Zone A.

For example, the x that marks the points in the mean SQC Chart in Figure 7-8 indicates a number 7 rule violation. And, the two points marked with x's in the range (R) SQC Chart indicate a number 8 rule violation. All x's appear red both on the screen and in color printouts.

Single- and Multiple-Wafer SQC

StatTrax enables you to introduce Statistical Quality Control to your process using single wafers or wafers in groups of 2–10. The statistics are not the same in each case, as indicated in Table 7-5.

Table 7-5: *Single Versus Multiple Wafer SQC Statistics*

	Single-Wafer SQC	Multiple-Wafer SQC (groups of 2–10)
X-bar	The mean of the collective resistivity values from the measured wafer.	Each wafer mean is treated as an individual. Therefore, the X-bar in the chart becomes the *mean of the means.*
R	The range of values across a wafer that fall within the Sorting Sigma, calculated as the maximum value minus the minimum value.	The difference between the maximum mean and the minimum mean of the wafers that make up the group.

How StatTrax Calculates Control Limits

StatTrax automatically calculates the upper control limit (UCL) and lower control limit (LCL) for each SQC Chart, based on the sample set defined by the LIMITS ARE field and the sample size selected in the IN GROUPS OF field in the SQC Setup Index Card.

For single-wafer SQC (IN GROUPS OF = WAFER POINT GROUP), the limits are based on a normal (Gaussian) distribution. For multiple-wafer SQC (IN GROUPS OF = 2-10), StatTrax employs numerical factors taken from the AT&T *Statistical Quality Control Handbook,* which approximate the 1-, 2-, and 3-sigma zone limits based on the average range. Refer to the following section "Choosing the Correct Sample Set."

Choosing the Correct Sample Set

The sample set on which you base the control limits must be selected from a normal distribution of points. That is, you should choose a consecutive sequence of data points that were influenced only by normal, random process variations (when the process was *in control*). As an aid, use the following criteria when choosing the sample set:

- Most points are near the center (mean) line.
- A few points spread out and approach the control limits.
- None of the points (or only an occasional point) actually exceed the control limits. (AT&T Technologies 1958, 24)

If you are using single-wafer SQC, you can check for normal distribution by graphing the sample set as a histogram. Display the Trend Chart Screen, and press F2 (HISTOGRM).

Data Conversion

You can convert units using one of the following methods:

- Using the Data Values Screen, you can manually enter the units to which you want the system to convert measured data, and observe the conversion results on the screen. This screen enables you to convert data to several different types of units, but you cannot save the conversions.
- Using the Correlation Curves feature, you can pre-select the units to which the system will automatically convert the data during testing. The system will convert the measured data to the specified units until you select otherwise.

The Data Values Screen

This section describes using the Data Values Screen to convert measured data to different units. You can convert sheet resistance measurements to thickness using known bulk resistivity values, or convert sheet resistance measurements to bulk resistivity using known thickness values.

The relationship between bulk resistivity (R_b), layer thickness (t), and sheet resistance (R_s) can be expressed by the equation

$$R_b = t \times R_s \times Cf(t/s)$$

where Cf(t/s) represents probe tip spacing-to-layer thickness correction factor (t = layer thickness, s = spacing).

The Data Values Screen enables you to

- Calculate and apply a thickness correction for measuring bulk silicon.
- Enter a resistivity value and calculate thickness or vice versa *on a site-by-site basis* (for Quick Tests).
- Calculate the average thickness or average resistivity *of all your measurements* (for tests other than Quick Tests).

Table 7-6 shows the instances in which the spacing-to-thickness, temperature, and correlation correction factors are applied to the units.

Table 7-6: *Applying Correction Factors to Units*

Correction factor	**Units**			
	Raw Value	Raw Corrected	Resistivity	Unit Value
Thickness Cf	N/A	If toggled on	If toggled on	If toggled on
Temperature Cf	N/A	If toggled on	If toggled on	If toggled on
Correlation Cf	N/A	N/A	If toggled on	If toggled on

The methods used to calculate the data values are as follows (*Cf* represents *Correction factor*):

- Raw Value = actual measured sheet resistance value
- Raw Corrected (Crct) = Raw Value x Thickness Cf x Temperature Cf
- Unit Value = Raw Value x Thickness Cf
- Resistivity = Unit Value x Layer Thickness in centimeters

Note however, that the resistivity value would not be applicable if the correlation modification changes the actual units, such as ions/cm^2. If you want to change both the fundamental units from ohms/sq and calculate resistivity, you must do each separately.

Displaying the Data Values Screen

There are two versions of the Data Values Screen: one for Quick Tests, the other for maps and scans.

- Figure 7-10 depicts the Data Values Screen for Quick Tests. You can use this screen to enter a resistivity value and calculate thickness or vice versa on a *site-by site basis.*
- Figure 7-11 depicts the Data Values Screen for tests other than Quick Tests. You can use this screen to calculate the average thickness or average resistivity of *all measurements.*

Table 7-7 describes the command box options for these screens.

To display the Data Values Screen in Engineering Mode

1. From the Main Engineering Menu, select DIRECTORY OPS in the MENU box.
2. Select FOLDER DIRECTORY in the ITEM box.
3. Press F1 (SELECT).

   The Folder Select Screen appears.
4. Select the cabinet, drawer, and folder containing the data you wish to convert.
5. Press (F1) FOLDER DRCTRY.

   The Folder Directory Screen appears.
6. Select your file, and press F1 (DATA DISPLAY).
   - If you select a Quick Test, the screen displays a list of data values.
   - If you select a Diameter Scan, Contour Map, or 3D Map, the corresponding type of map appears.
7. Press F1 (FILE RETRIEVE).

   The File Summary Index Card appears.
8. Press F5 (DATA VALUES) box.

   The Data Values Screen appears.

To display the Data Values Screen in Operations Mode

1. From the Introduction Screen, press F1 (FOLDER SELECT).

   The Folder Select Screen appears.
2. Select the cabinet, drawer, and folder containing the data you wish to convert, and press F7 (FOLDER DRCTRY).

   The Folder Directory Screen appears.
3. Select the file containing the data you wish to convert, and press F1 (FILE RETRIEVE).

   The File Summary Index Card appears.
4. Press F5 (DATA VALUES).

   The Data Values Screen appears.

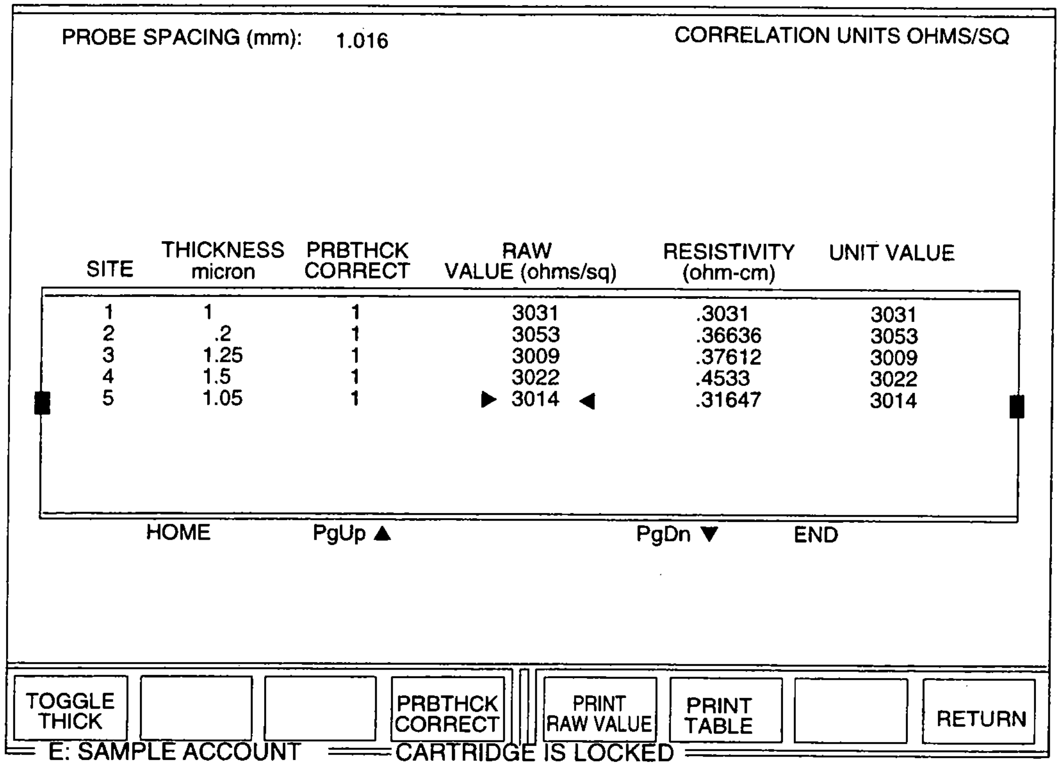


Figure 7-10: *Data Values Screen for Quick Tests*

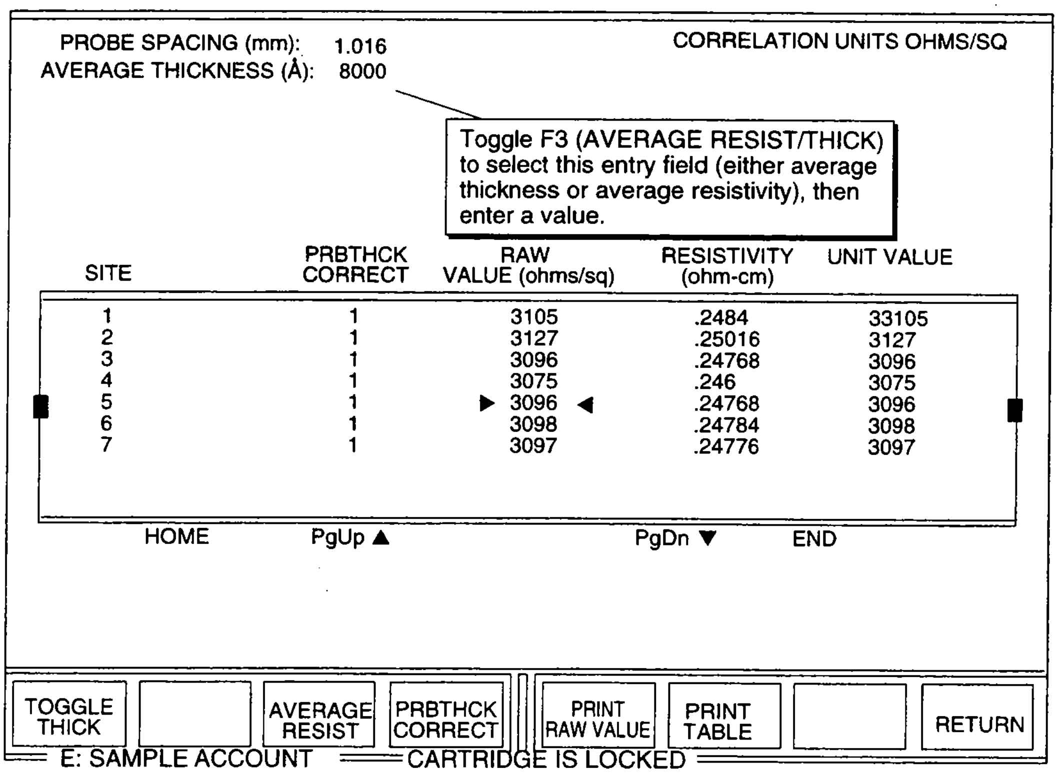


Figure 7-11: *Data Values Screen for Tests Other Than Quick Tests*

Table 7-7: Command Boxes in the Data Values Screen

Command Box	Description
F1 (TOGGLE THICK)	Toggles the thickness units: • In the Data Values Screen for tests other than Quick Tests, use F1 (TOGGLE THICK) to toggle the thickness units in the AVERAGE THICKNESS field. • In the Data Values Screen for Quick Tests, use F1 (TOGGLE THICK) to toggle the thickness units in the thickness column. You can choose angstroms, microns, millimeters or mils.
F3 (AVERAGE RESIST/THICK)	Toggle between the average thickness and the average resistivity. This command box is found only in the Data Values Screen for tests other than Quick Tests.
F4 (PRBTHCK CORRECT/IGNORE CORRECT)	The algorithm assumes that the probe-to-probe spacing is much larger than the thickness of the layer to be measured. If the film or substrate (for bulk silicon) thickness approaches one-half the separation of the probe tips, the probe thickness correction factor should be used to prevent errors in readings. Press F4 (PRBTHCK CORRECT) to multiply the raw data value by the PRBTHCK CORRECT value (thickness correct) to compensate for the difference between average thickness and probe spacing. If IGNORE CORRECT appears in the F4 position, pressing F4 will remove the display of corrected values.
F5 (PRINT RAW VALUES)	Print a site-by-site listing of the test data, including the percent standard deviation of each site, and file/test summary information. This is the standard data printout.
F6 (PRINT TABLE)	Print a site-by-site listing of the test data, including thickness/resistivity and thickness-correction factors.
F8 (RETURN)	Return to the previous screen.

Using the Data Values Screen to Convert Units

You use the Data Values Screen to manually convert measured data to different units. You can toggle a command box to convert data to several different types of units, but you cannot save the conversions. This section includes instructions for using the Data Values Screen to

- Convert Sheet Resistance to Film Thickness
- Convert Film Thickness to Resistivity
- Convert Resistivity to Film Thickness

The instructions in this section assume that the Data Values Screen is displayed. If it is not, refer to the previous section, "Displaying the Data Values Screen."

Converting Sheet Resistance to Film Thickness

To convert sheet resistance to film thickness for ***Quick Test data***

1. In the Data Values Screen, enter the bulk resistivity of the film (in ohm-cm) in each row of the RESISTIVITY column.

   The film thickness for each site appears in the corresponding row in the THICKNESS column.

2. Toggle F1 (TOGGLE THICK) to convert units in the THICKNESS column to angstroms, microns, millimeters, or mils.

To convert sheet resistance to film thickness for tests ***other than Quick Tests***

1. In the Data Values Screen, toggle F3 (AVERAGE RESIST/THICK) to select the AVERAGE RESISTIVITY field at the top of the screen under PROBE SPACING.

   The fourth column from the left displays the label THICKNESS, and the value for all sites is given as *0*.

2. Enter the bulk resistivity of the film in ohm-cm in the AVERAGE RESISTIVITY field.

   The film thickness for each site appears in the corresponding row in the THICKNESS column.

3. Toggle F1 (TOGGLE THICK) to convert units in the THICKNESS column to angstroms, microns, millimeters, or mils.

Converting Film Thickness to Resistivity

To convert film thickness to resistivity for ***Quick Test data***

1. In the Data Values Screen, toggle F1 (TOGGLE THICK) to convert units in the THICKNESS column to angstroms, microns, millimeters, or mils.

2. Enter the film thickness for each site in the corresponding row in the THICKNESS column.

   The resistivity at each site (in ohm-cm) appears in the corresponding row in the RESISTIVITY column.

3. Note the number in the PRB–THICK CORRECT column. If it is less than 1, press F4 (PRB-THCK CORRECT) to apply a thickness correction to the data. The resultant corrected sheet resistance values appear in the RAW CRCT'D column to the right of the RAW VALUE column.

   The corrected resistivity for each site (in ohm-cm) appears in the corresponding field in the RESISTIVITY column.

To convert film thickness to resistivity for tests ***other than Quick Tests***

1. In the Data Values Screen, toggle F3 (AVERAGE RESIST/THICK) to select the AVERAGE THICKNESS field at the top of the screen under PROBE SPACING.

   The fourth column from the left displays the label RESISTIVITY, and the value for all sites is given as *0*.

2. Toggle F1 (TOGGLE THICK) to convert units in the AVERAGE THICKNESS field to angstroms, microns, millimeters, or mils.

3. Enter the average thickness of the film in the AVERAGE THICKNESS field.

   The resistivity at each site (in ohm-cm appears) in the corresponding row in the RESISTIVITY column.

4. Note the number in the PRB–THICK CORRECT column. If it is less than 1, press F4 (PRB-THCK CORRECT) to apply a thickness correction to the data. The resultant corrected sheet resistance values appear in the RAW CRCT'D column to the right of the RAW VALUE column.

   The corrected resistivity for each site (in ohm-cm) appears in the corresponding field in the RESISTIVITY column.

Converting Resistivity to Thickness

To convert resistivity to thickness for ***Quick Test data***

1. In the Data Values Screen, toggle F1 (TOGGLE THICK) to convert units in the THICKNESS column to angstroms, microns, millimeters, or mils.
2. Enter the resistivity for each site in the corresponding row in the RESISTIVITY column.

   The thickness at each site appears in the corresponding row in the THICKNESS column.

To convert resistivity to thickness for tests ***other than Quick Tests***

1. In the Data Values Screen, toggle F3 (AVERAGE RESIST/THICK) to select the AVERAGE RESISTIVITY field at the top of the screen under PROBE SPACING.

   The fourth column from the left displays the label THICKNESS, and the value for all sites is given as *0*.
2. Toggle F1 (TOGGLE THICK) to convert units in the AVERAGE THICKNESS field to angstroms, microns, millimeters, or mils.
3. Enter the resistivity of the film in the AVERAGE RESISTIVITY field.

   The thickness at each site appears in the corresponding row in the THICKNESS column.

The Curve Fitting Utility

Curve Fitting enables you to

- Create curve files of wafer measurement and process data (such as sheet resistance and implant dose) as described in the later section "Creating a New Curve File."
- Define and plot the curve that best fits the data as described in the later section "Plotting Data in a Curve File."

You can then

- Enter the resulting equation into the Correlation Curve Screen (see "Creating a New Correlation Curve" in Chapter 5).
- Apply the correlation to your measurements by selecting it in the Test Type Index Card (see "Entering Parameters in the Test Type Index Card" in Chapter 4).

Accessing the Curve Fitting Utility

To access the Curve Fitting Utility

1. From the Introduction Screen, press F1 (FOLDER SELECT).

   The Folder Select Screen appears (refer to Figure 7-12).

2. Press F6 (UTIL) to display the UTILITIES MENU (Figure 7-13).

   Although you access the Utilities Menu from the Folder Select Screen, the utilities do not act within the currently highlighted folder.

3. Press F2 (CURVE FITTING).

   The Curve File Selection Screen appears (Figure 7-14). Table 7-8 describes the command boxes in the Curve File Selection Screen.

Next, refer to the following sections "Creating a New Curve File," "Plotting Data in a Curve File," and "Editing an Existing Curve File."

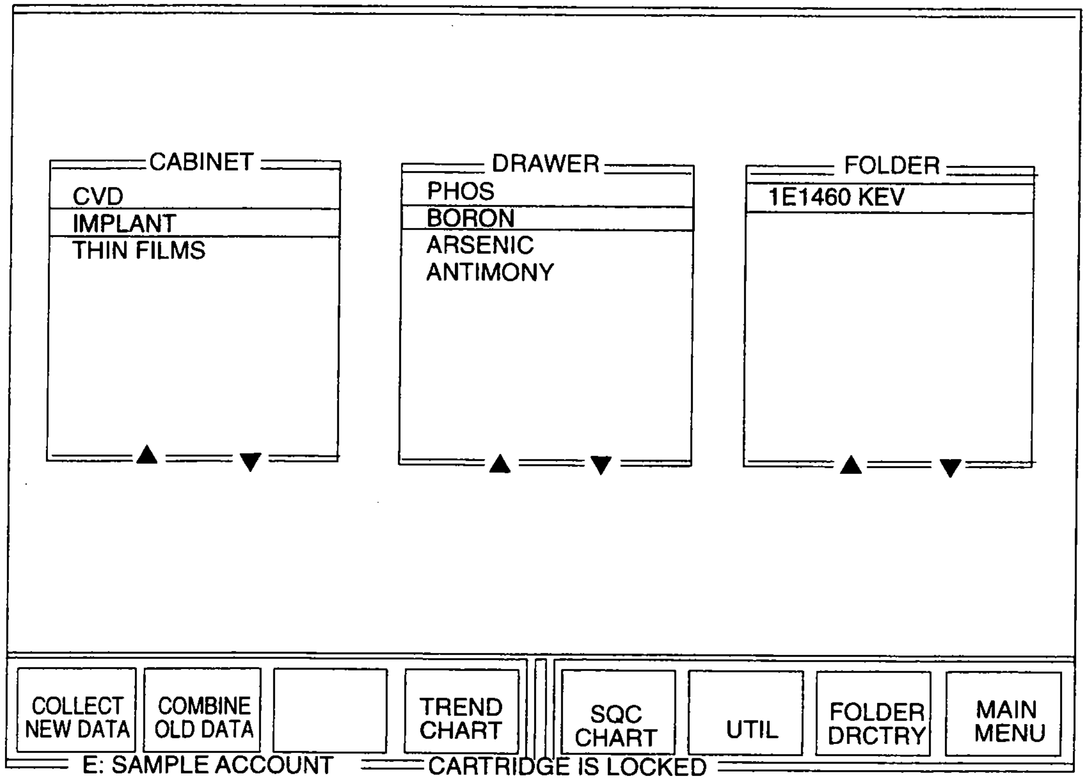


Figure 7-12: Folder Select Screen, Operations Mode

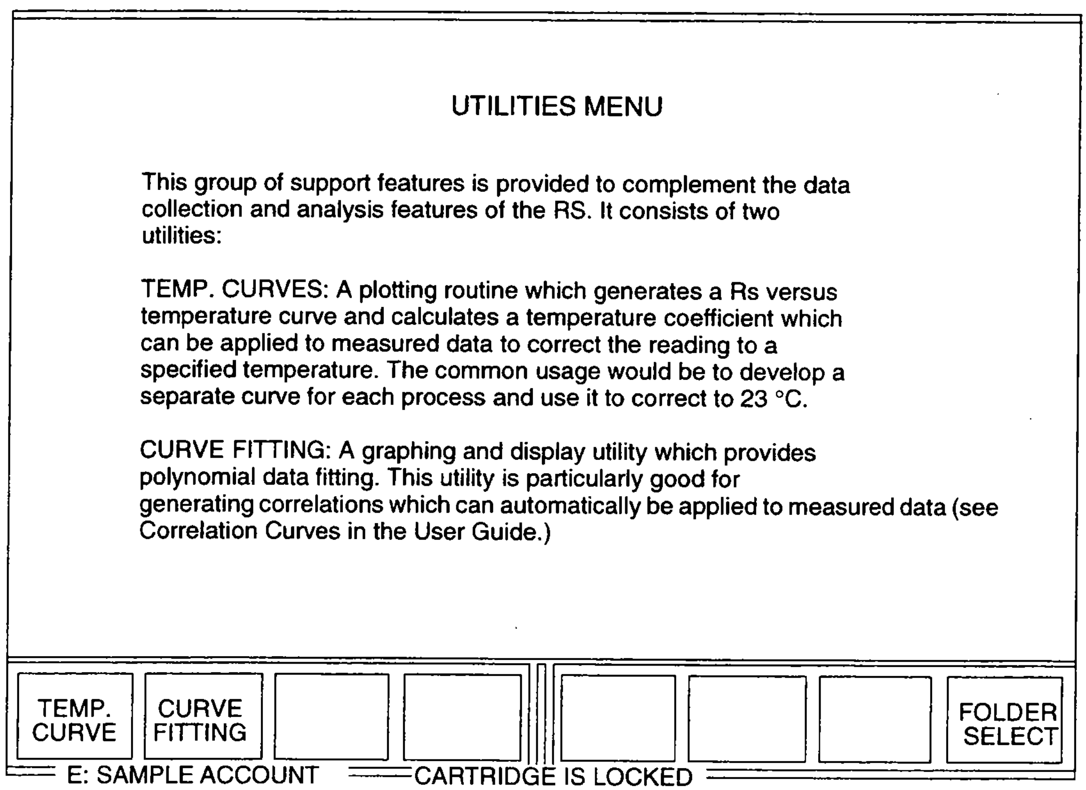


Figure 7-13: Utilities Menu

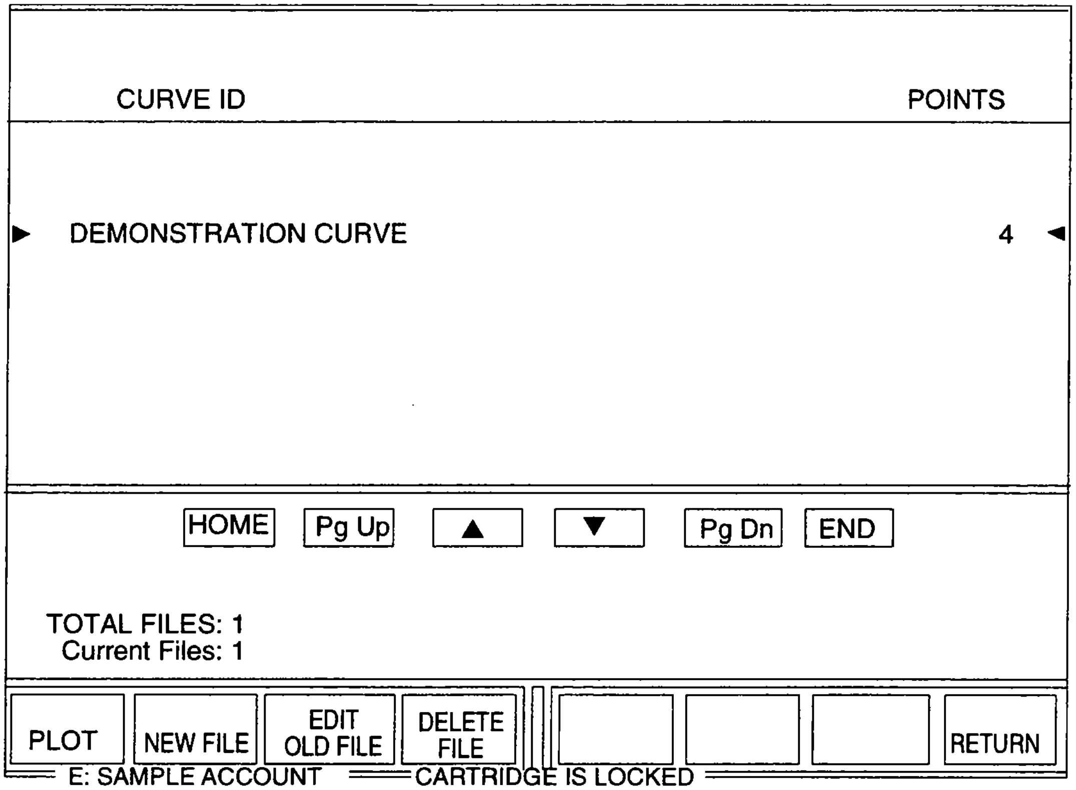


Figure 7-14: *Curve File Selection Screen*

Table 7-8: *Command Boxes in the Curve File Selection Screen*

Command Box	**Description**
F1 (PLOT)	Plots the data from the selected curve file. To plot a curve, you must specify more than one data point for the curve file. StatTrax plots the data according to a first, second or third-order polynomial, depending on whether the data consists of two points, three points, or four or more points respectively. You can have as many as 50 points per curve and as many as 30 curves.
F2 (NEW FILE)	Creates a new curve file. (See the later section "Creating a New Curve File.")
F3 (EDIT OLD FILE)	Lets you edit the data in an existing curve file, or view and print the data. (See the later section "Editing an Existing Curve File.")
F4 (DELETE FILE)	Deletes existing curve files

Creating a New Curve File

This procedure assumes that the Curve File Selection Screen is displayed on the monitor. If it is not, refer to the previous section, "Accessing the Curve Fitting Utility," before continuing.

To create a new curve file

1. Press F2 (NEW FILE) from the Curve File Selection Screen.

   The Data Entry Screen appears (Figure 7-15). Table 7-9 describes the functions of the command boxes at the bottom of the screen.

2. Enter the CURVE ID name in the designated field in the FILE DESCRIPTORS box.

   The CURVE ID will appear as the title on the curve plot.

3. Highlight the first line under FILE #. (You may need to press the left-arrow key to move to the FILE column. The blinking indicators show your position in the field.)

4. Retrieve the average value of a wafer test from the StatTrax database by typing its file number in the FILE # column. (If necessary, use the MAIN DRCTRY command [F1] to locate the appropriate file.)

   The wafer value (in this example, sheet rho) will appear in one of the two *data value* columns to the right of the FILE # column. The first data value column (directly to the right of the FILE # column) corresponds to the *x*-axis, the second to the *y*-axis.

5. Move to the remaining axis value column, enter the known value (in this example, implant dose) that will be plotted against the wafer test value, and press Enter.

6. If you want, press the right-arrow key to move the indicators to the next column, and enter some descriptive information under COMMENT.

7. To enter the next pair of values, press F4 (ADD TO DATA).

   As in steps 4–6, enter the FILE #/data values in the line provided. Repeat this procedure for each point.

8. Go back to the FILE DESCRIPTORS box, and type in descriptive labels for the values displayed in the corresponding *x*- and *y*-data value columns.

9. Press F6 (SAVE) to save the curve file you just created.

10. Press F8 (RETURN) to return to the Curve File Selection Screen.

11. Proceed to the next section, "Plotting Data From a Curve File."

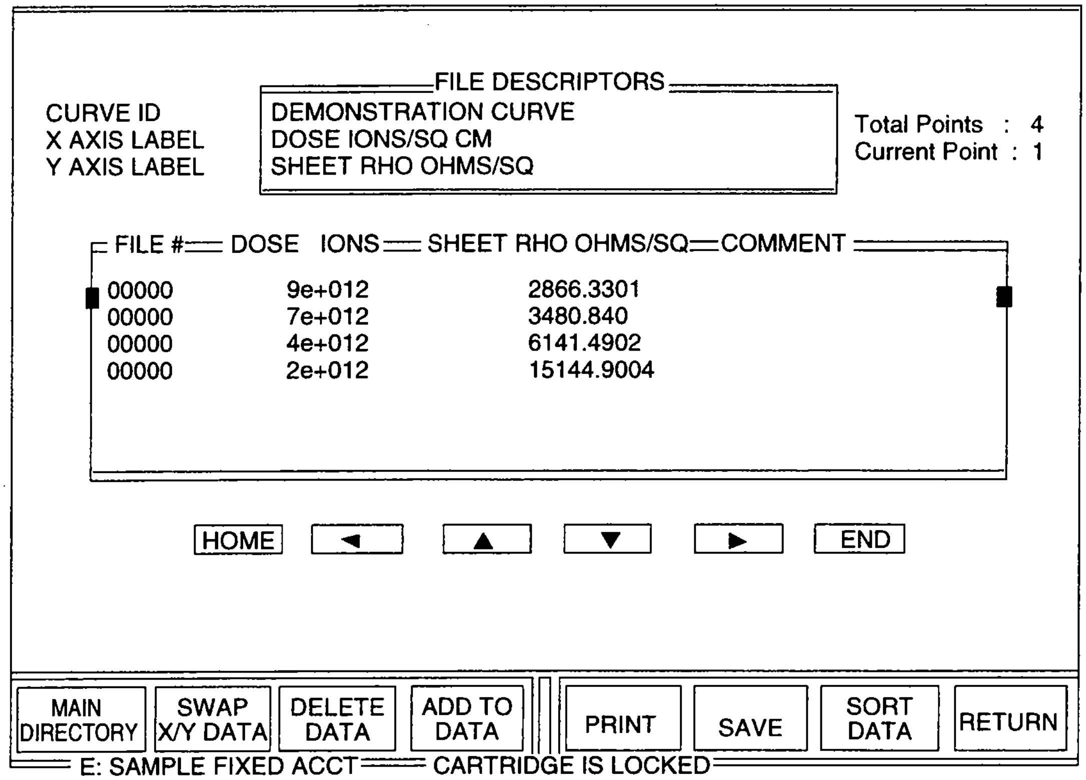


Figure 7-15: Data Entry Screen

Table 7-9: Command Boxes in the Data Entry Screen for Curve Files

Command Box	Function
F1 (MAIN DRCTRY)	Opens the Main Directory to look up a file number
F2 (SWAP X/Y DATA)	Reverses the *x* and *y* plot axes
F3 (DELETE DATA)	Deletes the coordinates for a point from the curve file
F4 (ADD TO DATA)	Adds new point coordinates to the curve file
F5 (PRINT)	Prints the data for all point coordinates in the curve file
F6 (SAVE)	Stores the current point coordinate data for the curve file
F7 (SORT DATA)	Arranges the data in the *y*-axis column from lowest to highest value
F8 (RETURN)	Return to the Curve File Selection Screen

Plotting Data in a Curve File

After creating a curve file, you can plot the points in the file. Plotted curves appear in a logarithmic scale unless the data consists of one or more zero or negative data points. Curve files with negative data points are plotted in a linear scale. You can enter any x-axis value to calculate the corresponding y-axis value on the curve from this screen. In the example shown in Figure 7-16, implant dose (x-axis) is plotted as a function of sheet "rho" (y-axis).

This procedure assumes you have accessed the curve fitting utility, and the Curve File Selection Screen is displayed on the screen. If it is not, refer to the earlier section "Accessing the Curve Fitting Utility" before continuing.

To plot the curve file

1. From the Curve Fitting Screen, press F1 (PLOT).

   The system plots the curve file data (Figure 7-16).

2. You can manually change the scales to log by pressing F3 (TOGGLE X AXIS) or F2 (TOGGLE Y AXIS). When you change a curve file with zero or negative values to log, part of the curve disappears. However, you can still select and work with points that do not appear on the screen.

   Table 7-10 describes the command boxes displayed at the bottom of the Curve Fitting Screen.

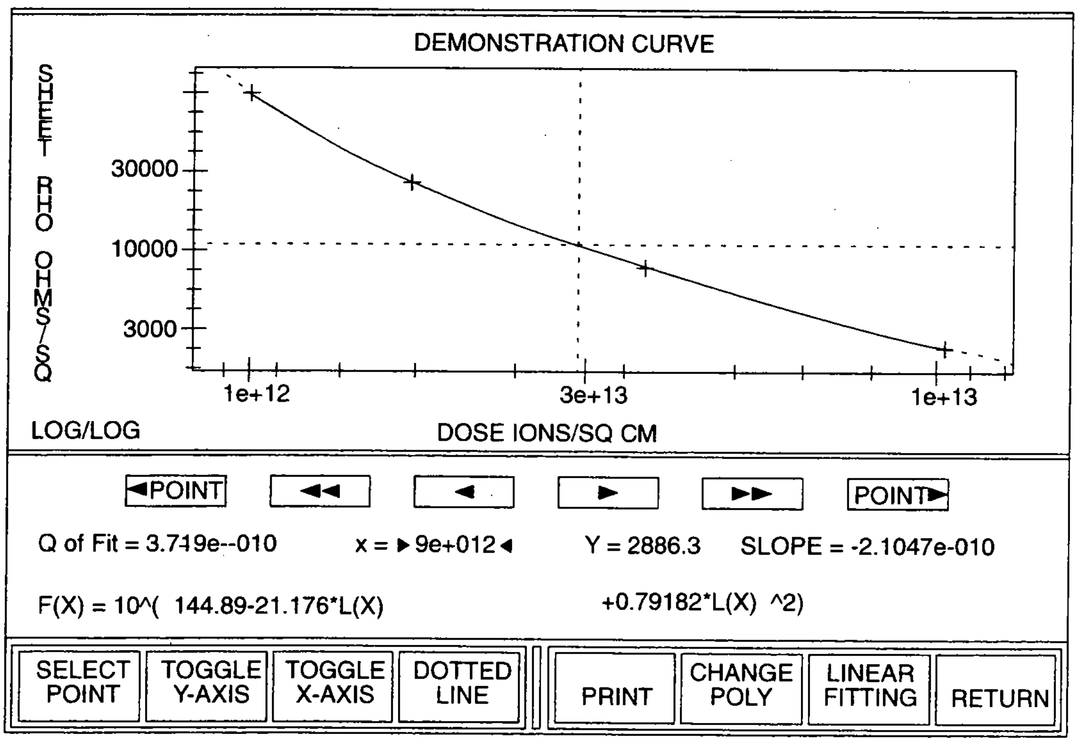


Figure 7-16: Curve Fitting Screen

Table 7-10: Command Boxes in the Curve Fitting Screen

Command Box	Description
F1 (SELECT POINT)	Displays the coordinates of the selected point. To use this option, type a value in the x-coordinate box, press Enter, and press F1 (SELECT POINT). The selected point appears as a small green square on the curve. Selected points are also printed in curve plot printouts. You can also choose a point on the curve by • using the ◀ and ▶ keys to move the cursor along the curve in small increments • using the mouse to select ◀◀ or ▶▶ to move the cursor in large increments • using the mouse to select ◀ Point or ▶ Point (or pressing the Page Up and Page Down keys). These selections let you move from point to point on the curve.
F2 (TOGGLE Y AXIS)	Toggles the y-axis between a log10 scale and a linear scale
F3 (TOGGLE X AXIS)	Toggles the x-axis between a log10 scale and a linear scale
F4 (SOLID/DOTTED LINE)	Changes the plot curve from a solid line to a dotted line or vice versa
F5 (PRINT)	Prints the curve plot and associated data. This includes the equation, the coordinates of any selected points along with the slope and sensitivity values, the curve's maximum and minimum x and y values, and the Q-value of the fit. (Q is an indicator of the goodness-of-fit; the smaller the value, the better the fit.)
F6 (CHANGE POLY)	Changes the order of the fit polynomial from third, to second, to first, and then back, depending on the number of points in the curve file: 4 or more points: First-, second-, or third-order polynomial 3 points: First- or second-order polynomial 2 points: First-order polynomial You cannot change the order of the fit polynomial to one less than the number of data points. If you press F6 (CHANGE POLY) enough times, you cycle to the original-order polynomial.
F7 (LOG/LINEAR FITTING)	Toggles the polynomial between a log10 fit and a linear fit. The general forms are Log: $f(x) = 10(a + b(\log x) + c(\log x)^2 + d(\log x)^3)$ Linear: $f(x) = a + bx + cx^2 + dx^3$

Editing an Existing Curve File

You can edit existing curve files to add or delete data, reverse the plot axes, or rearrange data. This procedure assumes that the Curve File Selection Screen is displayed on the monitor. If it is not, refer to the earlier section, "Accessing the Curve Fitting Utility," before continuing.

To edit an existing curve file

1. Highlight the curve file you wish to modify.
2. Press F3 (EDIT OLD FILE).

   The monitor displays the Data Entry Screen.
3. At this point you can
   - Enter another StatTrax file number or enter a new resistivity value by selecting F4 (ADD TO DATA).
   - Delete a coordinate by highlighting that coordinate, and selecting F3 (DELETE DATA).
   - Reverse the plot axes by selecting F2 (SWAP X/Y DATA).
   - Arrange the data in the column on the right from lowest to highest within the selected curve file by selecting F7 (SORT DATA).
4. Press F6 (SAVE) to store the changes to the curve file.
5. Press F8 (RETURN) to return to the Curve File Selection Screen.

Data Combination

Data Combining is an advanced data manipulation feature enabled in Engineering Mode and used in Operations Mode. With Data Combining, you can analyze data by applying one of 15 formulae to it. This feature enables you, for example, to compare sheet resistance measurements before and after a tungsten etch process. To do so, you would use Combining Data to subtract wafer #2 data from wafer #1 data, and produce a difference map.

To combine data, files must

- Be of the same type (that is, a die map, Diameter Scan or Contour Map)
- Have the same number of measurement sites
- In the case of die maps, have the same die pattern

A process engineer can prohibit or enable data combining operations in Operations Mode for any folder by pressing the F3 key to display the COMBINE OLD DATA box in the Engineering Folder Select Screen.

Accessing the Combine Data Screen

To access the Combine Data Screen

1. From the Introduction Screen, choose FOLDER SELECT (F1) to display the Folder Select Screen.
2. Select a test folder, and select COMBINE OLD DATA (F2).

   The system displays the Combine Data Screen (Figure 7-17). The Combine Data Screen contains the command boxes described in Table 7-11.

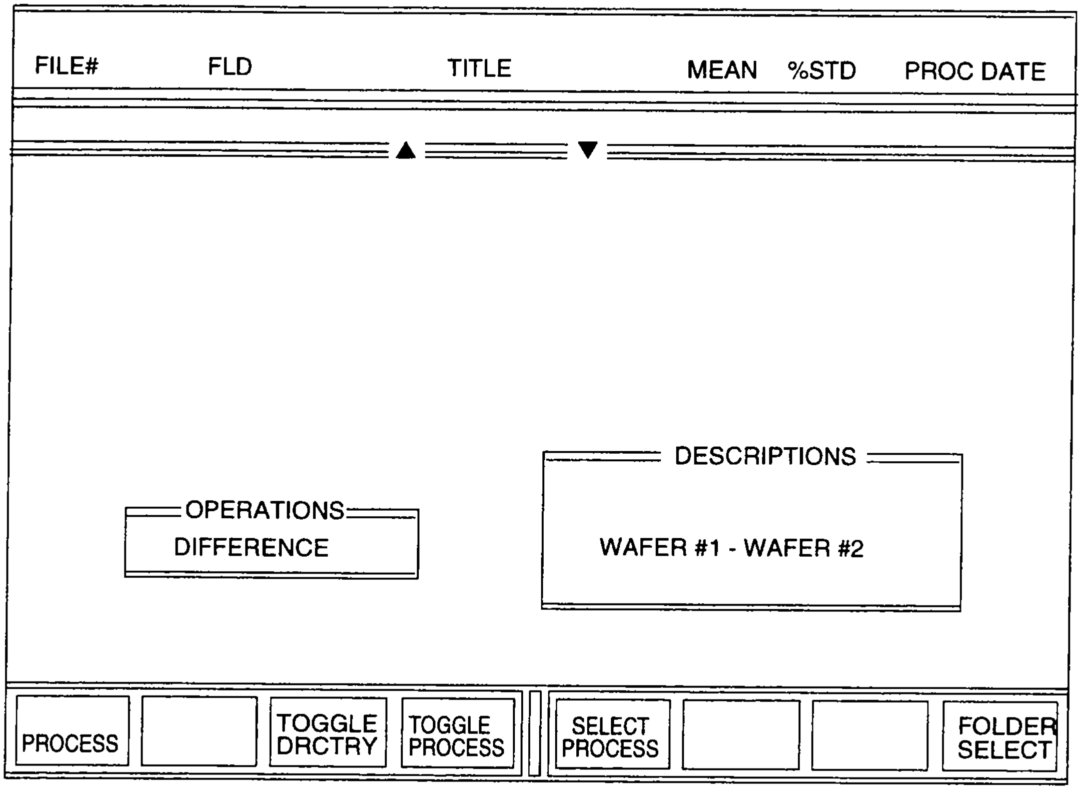


Figure 7-17: *Combine Data Screen*

Table 7-11: *Command Boxes in the Combine Data Screen*

Command Box	Description
F1 (PROCESS)	Initiates the selected data combining operation, then display a map and a summary of the data
F2 (TOGGLE DRCTRY)	Toggles the file directory at the top of the screen according to the file information you want to display You can display either the Title Line, the Lot/Wafer ID Line, or the Statistics Line. You can edit the default directory summary information in the DIRECTORY LINE TYPE field under GENERAL SYSTEM DATA in Engineering Mode.
F4 (TOGGLE PROCESS)	Scrolls through the selections listed in Table 7-12
F5 (SELECT PROCESS)	Enables you to view all of the data combining processes displayed under F4 (TOGGLE PROCESS) and to select from the list more rapidly.
F8 (FOLDER SELECT)	Returns to the Folder Select Screen

Combining Data

To combine data

1. From the Combine Data Screen, press F5 (SELECT PROCESS) (or press F4 to toggle through the list of processes).

   Refer to Table 7-12 for a description of options for combining data.

2. Highlight the process you wish to use.

   If the selected process involves a constant (see Table 7-12), type the constant into the field indicated by the flashing cursor, and press Enter.

3. Press F8 (EXIT) to return to the Combine Data Screen.

4. Enter the appropriate file number(s) (the number of the files that contain the values you wish to process) into the fields at the top of the screen.

5. Press F1 (PROCESS) to instruct the system to process the data.

   The screen displays a map (or data listing) of the results.

6. To print a copy of the map (or data listing), press F5(PRINT).

7. Press F1 (FILE RETRIEVE) to display the File Summary Index Card:

   - To view a Contour Map or a 3D Map of combined Contour Map data, select CONTOUR MAP (F1), or 3D MAP (F2).
   - To view a map of combined Diameter Scan data, select DIAMETER SCAN (F1). Return to the File Summary Index Card by selecting EXIT (F8).
   - To view a Die Map of combined Pattern Test files, select DISPLAY PATTERNS (F8). Return to the File Summary Index Card by selecting RETURN (F8).
   - To view the new (combined) data values, select DATA VALUES (F5). Return to the File Summary Index Card by selecting RETURN (F8).

8. Display the Wafer Facts Index Card. Enter relevant information about the combined data into the TITLE, WAFER ID, PROCESS, or STATUS fields.

9. If you intend to save the file, enter a significant name in the TITLE field.

   The system automatically assigns the *name* of the last file selected to the combined data file. (For example, assume you were averaging three wafers from a diffusion run and have named file #1 *Load*, file #2 *Centers*, and file #3 *Source*. The resulting (average) file will also be named *Source* (the same name as file #3). When you save the file, it is assigned the next available file number in the Main Directory.

10. To save the file, press F7 (SAVE).

11. Press F8 (COMBINE PROCESS) to return to the Combine Data Screen.

Note *While some of the data combining operations in Table 7-12 are of little practical use in semiconductor production, they might have applications in process research and development. For this reason, these operations are made available to the process engineer for use in advanced data analysis.*

Table 7-12: Data Combining Operations

Combine Operation	Description
ADD CONSTANT	Adds a constant to the value at each site
AVERAGE	Averages the corresponding site values of up to 8 wafers
DIFFERENCE	Subtracts the values of wafer #2 from the values of wafer #1, site-by-site. Used in etch applications to observe pre- and post-etch effects Enter two files.
DIVIDE BY CONSTANT	Divides the value at each site by a constant
INVERSE	Calculates the inverse of each site value
LOG10	Calculates the base10 logarithm of each site value
LOG_e	Calculates the base-e (2.71) logarithm of each site value
MULTIPLY	Multiplies the values of wafer #1 by the corresponding values of wafer #2 Enter two files.
MULTIPLY BY CONSTANT	Multiplies the value at each site by a constant
NORMALIZE DIFFERENCE	Normalizes the site-by-site differences of two wafers to the average value of the first. Uses the formula $\left(\frac{WFR1}{AVE1} - \frac{WFR2}{AVE2}\right) \times AVE1 + AVE1$ Enter two files.
PARALLEL ADD	Adds the individual values of two wafers in parallel. Uses the formula $\frac{1}{\frac{1}{(WAFER\ \#1)} + \frac{1}{(WAFER\ \#2)}}$ Enter two files.
PARALLEL SUBTRACT	Subtracts the individual values of two wafers in parallel. Used in etch applications to observe pre- and post-etch effects (using resistances). Uses the formula $\frac{1}{\frac{1}{(WAFER\ \#1)} - \frac{1}{(WAFER\ \#2)}}$ Enter two files.

Table 7-12: Data Combining Operations (Continued)

Combine Operation	Description
RATIO	Divides the values of wafer #1 by the corresponding values of wafer #2. Uses the formula $\frac{\text{WAFER \#1}}{\text{WAFER \#2}}$ Enter two files.
REFERENCE AVERAGE	Subtracts the difference of wafers #1 and #2 from the average value of wafer #1. Reference Averaging is used in etch applications to determine the etch profile on a *perfect* wafer (a normalized wafer #1). Uses the formula AVERAGE WAFER #1 – (WAFER #1 – WAFER #2) Enter two files.
FILE REVIEW	Displays the data in a file.

Chapter 8
Managing Data Files

Read This First

This chapter, intended for the process engineer, describes how to manage data files. You will learn how to

- Access the data stored in test folders
- *Mark out*, edit, sort, transfer, and copy files
- Backup and reorganize files (deleting unwanted files)
- Recover files if a failure occurs during a backup or optimization
- Export and import files on a floppy diskette (for transfer between systems)
- Export files, in ASCII format, to a floppy diskette (for transfer to a spreadsheet)

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The Directory Ops Menu

The features available from the Directory Ops (Operations) Menu (Figure 8-1) enable you to

- Modify access to files
- Edit data
- Sort data
- Copy files

The Directory Ops Menu offers two types of system directories: the Folder Directory and Main Directory. The Folder Directory accesses all files inside the *selected folder.* The Main Directory accesses all files in the *current account*. In addition to accessing files for viewing, analyzing, or copying, the Main and Folder Directories enable you to ***mark out*** files or edit individual data values within the files. Marked-out files

- Will not appear in the Operations Mode directories
- Can be excluded from a backup, copy, or transfer procedure
- Can be removed from the database during Backup/Delete Files and Optimize/Delete Files procedures

The remaining selections in the Directory Ops Menu are Directory Sorting and File Transfer & Copy. The Directory Sorting feature enables you to sort through all of the data files in an account and find the files that meet the selected criteria. The File Transfer & Copy feature enables you to copy files to another folder or to a host computer using RS232 or SECS-II protocol.

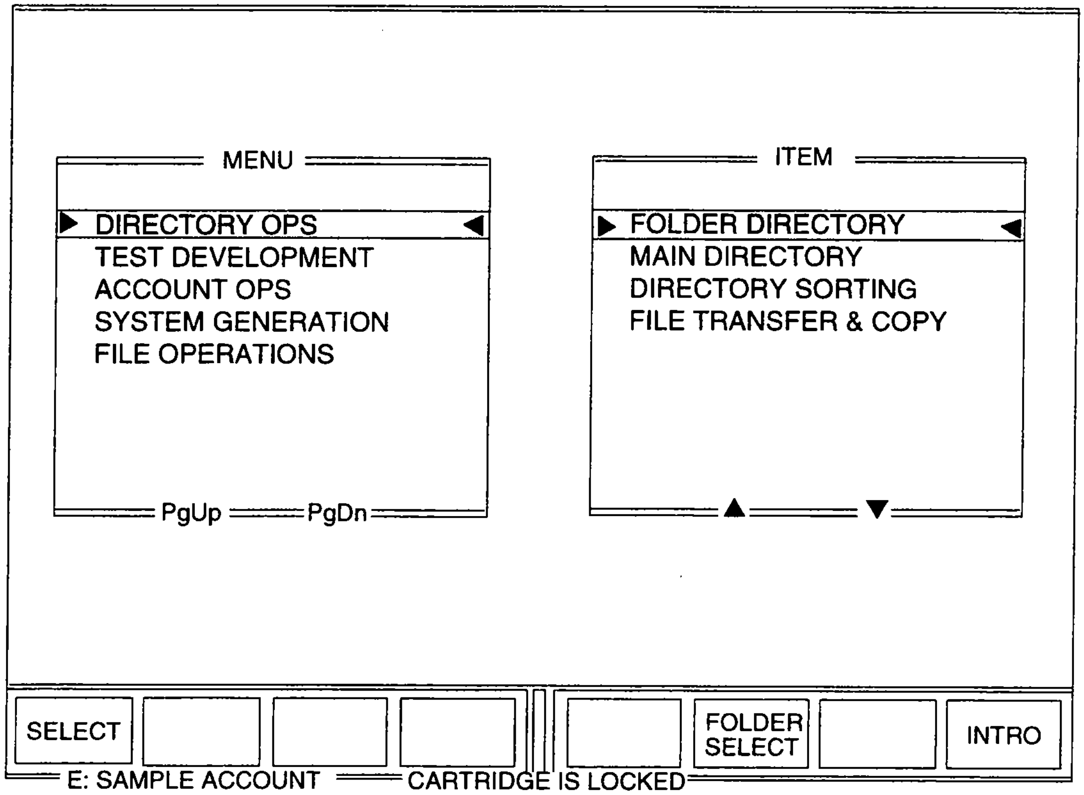

Figure 8-1: Main Engineering Menu, Directory Ops

The Folder and Main Directories

StatTrax provides access to test files through the Folder and Main Directories. The Folder Directory enables you to view all of the data files that have been created in the *selected folder.* The Main Directory enables you to view *all* of the data files that have been created *in the currently active account,* regardless of the folder they are stored in. Typically, a process engineer would access either the Folder or Main Directory, and then select files to either edit or mark out. Marking out files excludes the marked files from being visible in Operations Mode. Editing individual values within selected files enables the process engineer to correct bad data, or to create maps using entered values.

To access files from either the Folder or Main Directory

1. From the Main Engineering Menu, highlight DIRECTORY OPS under MENU.
2. Highlight FOLDER DIRECTORY to access files within a single folder or MAIN DIRECTORY to access files in any folder in the current account.
3. Press F1 (SELECT).
   - For the Folder Directory, the system displays the Folder Select Screen. Go to step 4.
   - For the Main Directory, the system displays the Main Directory Screen, similar to Figure 8-2. Go to step 6.
4. Highlight the test folder you want to work with.

   The number of files in the folder appears at the end of the Folder ID at the top of the screen.
5. Press F1 (FOLDER DRCTRY).

   The system displays the directory for the selected folder (Figure 8-2). The Folder Directory Screen offers the command boxes described in Table 8-1.
6. If you want to go directly to a particular file, type the file number, and press Enter. You can also use the following keys to move through the directory:

Home	Move the cursor to the first file in the directory.
Page Up	Moves the cursor up one full display page (nine files maximum).
▲	Moves the cursor up one line to the previous file.
▼	Moves the cursor down one line to the next file.
Page Down	Moves the cursor down one full display page (nine files maximum).
End	Moves the cursor to the last file in the directory.

At this point, you can mark out files or edit individual data values in either the Folder or Main Directory Screens. Refer to later sections "Marking Out Files in the Folder and Main Directories" or "Editing Raw Data in Contour Maps, Quick Tests, Diameter Scans, and Die Maps" in this chapter.

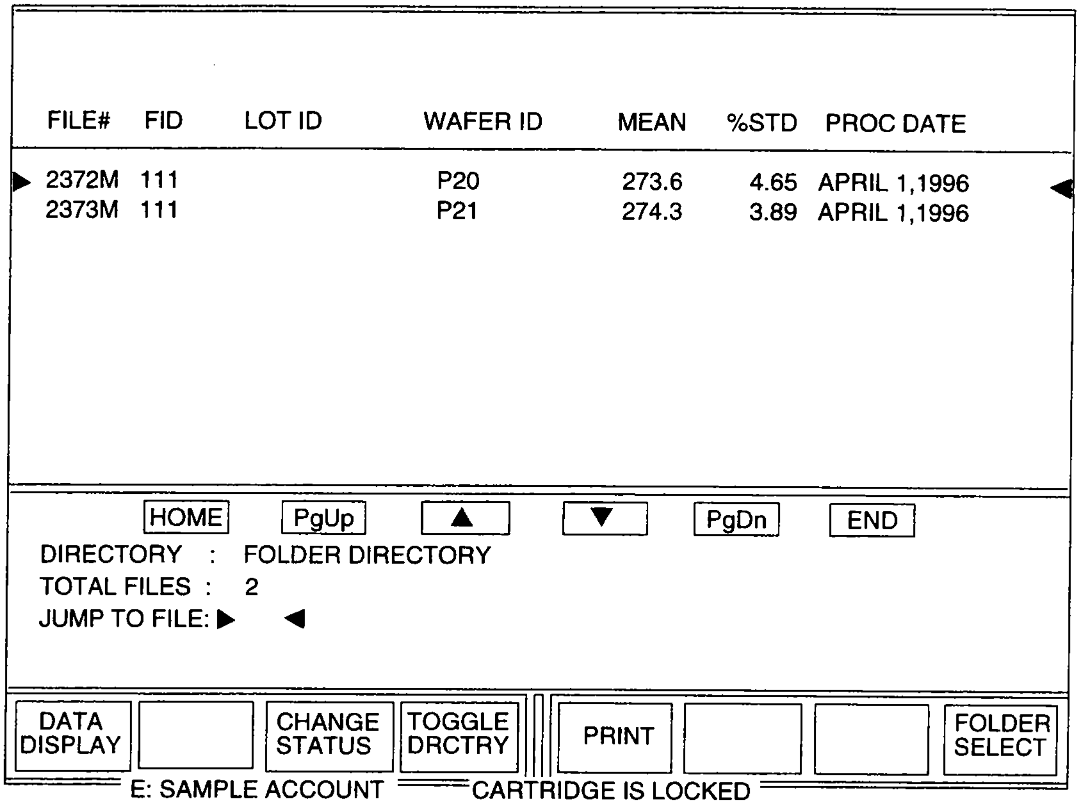

Figure 8-2: Folder Directory Screen

Table 8-1: Command Boxes in Folder Directory Screen

Command Box	Description
F1 (DATA DISPLAY)	Displays the test data for the selected file. Press F1 (FILE RETRIEVE) to access a file's index cards and to edit data values.
F3 (CHANGE STATUS)	Marks out a file. This makes a file invisible in Operations Mode. The file is still there, but it cannot be seen. In Engineering Mode, marked out files appear dark gray in color, and the letter indicating the test type (XY, M, S, Q, P) appears in lowercase on the screen and in directory printouts.
F4 (TOGGLE DRCTRY)	Toggles the directory line information at the top of the screen. (You set the default line header selection in the General System Data Screen.) Press F4 (TOGGLE DRCTRY) to display different lines. You can display either the Title Line, the Lot/Wafer ID Line, or the Statistics Line. See the entries "Directory Line" and "Directory Line Headers" in the reference chapter.
F5 (PRINT)	Prints the Folder Directory Screen from the cursor position down
F8 (FOLDER SELECT/ MAIN MENU)	Return to the previous screen, either the Folder Select Screen or Main Menu

Marking Out Files in the Folder and Main Directories

Marking out files excludes the marked files from being visible in Operations Mode. Marked-out files can be excluded from a backup, copy, or transfer procedure and can be removed from the database during Backup/Delete Files or Optimize/Delete Files procedures. You use the same basic procedures to mark out files, or edit individual data values in either the Folder or Main Directory.

To mark out files in the Folder or Main Directories

1. From the Main Engineering Menu, highlight DIRECTORY OPS under MENU.
2. Highlight FOLDER DIRECTORY to access files within a single folder or MAIN DIRECTORY to access files in any folder in the current account.
3. Press F1 (SELECT).
   - For the Folder Directory, the system displays the Folder Select Screen. Go to step 4.
   - For the Main Directory, the system displays the Main Directory Screen. Go to step 6.
4. Highlight the test folder you want to work with.

   The number of files in that folder appears at the end of the Folder ID at the top of the screen.
5. Press F1 (FOLDER DRCTRY).

   The system displays the directory for the selected folder.
6. If you want to go directly to a particular file, type the file number and press Enter. You can also use the following keys to scroll through the directory.

Home	Move the cursor to the first file in the directory.
Page Up	Moves the cursor up one full display page (nine files maximum).
▲	Moves the cursor up one line to the previous file.
▼	Moves the cursor down one line to the next file.
Page Down	Moves the cursor down one full display page (nine files maximum).
End	Moves the cursor to the last file in the directory.
7. Move the cursor to the file(s) you want to mark out.
8. Select F3 (CHANGE STATUS) to mark out files as desired.
9. Choose F8 (FOLDER SELECT or MAIN MENU) to exit.

Editing Raw Data in Contour Maps, Quick Tests, Diameter Scans, a··· Maps

StatTrax enables you to edit individual values within selected files to correct ba··· ···, or to create your own maps using entered values. The process is virtually the same for the Folder Directory and the Main Directory.

To edit data in Contour Maps, Quick Tests, and Diameter Scans

1. From the Main Engineering Menu, highlight DIRECTORY OPS under MENU.
2. Highlight FOLDER DIRECTORY to access files within a single folder or MAIN DIRECTORY to access files in any folder in the current account.
3. Press (F1) SELECT.
   - For the FOLDER DIRECTORY, the system displays the Folder Select Screen. Go to step 4.
   - For the MAIN DIRECTORY, the system displays the Main Directory Screen. Go to step 6.
4. Highlight the test folder you want to work with.

   The number of files in that folder appears at the end of the Folder ID at the top of the screen.
5. Press (F1) FOLDER DRCTRY.

   The system displays the directory for the selected folder.
6. If you want to go directly to a particular file, type the file number, and press Enter. (You can also use the PgUp, PgDn, Home, End, or up- and down-arrow keys to move through the directory.)
7. From the Folder or Main Directory Screen, move the cursor to the file you want to edit.
8. Press F1 (DATA DISPLAY). The system displays a map of test results.
9. Press F1 (FILE RETRIEVE).

   The system displays the File Summary Index Card.
10. Press F5 (DATA VALUES) to display a listing of the data values by site.
11. Position the cursor at the value you want to edit. Type in the new value, and then press Enter.
12. Press F8 (RETURN) to return to the File Summary Index Card.
13. Save the edits by pressing F7 (UPDATE).
14. To display the edited map, select CONTOUR MAP (F1) or 3D MAP (F2). (For a diameter scan, select DIAMETER SCAN (F1) to display the edited scan.)
    - Press F5 (PRINT) to print a copy of the edited map or scan.
    - Press F8 (EXIT) to return to the File Summary Index Card.
15. Press F8 (FOLDER DRCTRY) to return to the Folder Directory.
16. Press F8 (FOLDER SELECT) or (MAIN MENU) to return to the exit.

To edit raw data from a Die Map

1. From the Main Engineering Menu, highlight DIRECTORY OPS under MENU.
2. Highlight FOLDER DIRECTORY to access files within a single folder or MAIN DIRECTORY to access files in any folder in the current account.
3. Press (F1) SELECT.
   - For the Folder Directory, the system displays the Folder Select Screen. Go to step 4.
   - For the Main Directory, the system displays the Main Directory Screen. Go to step 6.
4. Highlight the test folder you want to work with.

   The number of files in that folder appears at the end of the Folder ID at the top of the screen.
5. Press (F1) FOLDER DRCTRY.

   The system displays the directory for the selected folder.
6. If you want to go directly to a particular file, type the file number, and press Enter. (You can also use the PgUp, PgDn, Home, End, or up- and down-arrow keys to move through the directory.)
7. From the Folder or Main Directory Screen, move the cursor to the file you want to mark out.
8. Press F1 (DATA DISPLAY).

   The system displays a die map of the data in the selected file. In this screen you can move the cursor to any site on the map to see its raw data value and its row and column location.
9. Press F1 (FILE RETRIEVE).

   The system displays the File Summary Index Card.
10. Press F5 (DISPLAY PATTERNS) to display a die map of the data and to begin the editing session.
11. Press F4 (BEGIN EDITING).

    The message EDIT ACTIVE appears above the RAW DATA field.
12. Position the cursor at a value you want to edit. Type in the new value, and press Enter.
    - If the value you enter is outside the warning or control limits set in the Trend Scaling Index Card, the edited die changes to yellow or red.
    - If the value is within the warning limit, the die changes to green. Repeat this step for other values, if desired.
13. Press F4 (END EDITING) to end the editing session.

If you want to print the edited die map and the relevant file/test summary information, press F5 (PRINT). Points that fall outside the sorting sigma will be printed in boldface type.

14. When you have finished editing data, press F8 (RETURN) to return to the File Summary Index Card.
15. Save the raw data edits by pressing F7 (UPDATE).
16. Press F8 (FOLDER DRCTRY) to return to the Folder Directory Screen.
17. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

Directory Sorting

Directory Sorting is an advanced feature of StatTrax that is available in Engineering Mode. It enables you to sort through all of the data files in an account and find the files that meet the criteria you establish in the Directory Sorting Screen.

This feature also enables you to choose the range of files to be included in the sort. For example, you might want StatTrax to find Contour Map files with a standard deviation of 0.0%-1.0%. To do so, you enter these criteria in the TEST TYPE and STDV RANGE fields in the Directory Sorting Screen (Figure 8-3).

The Directory Sorting Screen contains eleven sorting parameters:

- The first six are ranges (you enter the starting value in the START box and the ending value in the FINISH box).
- The last five (beginning with TEST TYPE) are single-value parameters.

After you enter a parameter—either a single value or a range of values—you instruct StatTrax to include or exclude the files with the specified parameters from the sort:

- Pressing F1 (INCLUDE OPS) instructs StatTrax to search for all of the files that conform to the entered parameters. Refer to the section "Sorting Files That Meet Your Sort Criteria (Inclusive Searches)" later in this chapter.
- Pressing F2 (EXCLUDE OPS) instructs StatTrax to search for all files that do *not* meet the criteria you established in the Directory Sorting Screen. Refer to the section "Sorting Files That Do Not Meet Your Sort Criteria (Exclusive Searches)" later in this chapter.

During the search, the Directory Sorting Screen displays the number of FILES TO SEARCH and the number of FILES SEARCHED. It also tells you how many files it has FOUND THUS FAR during the search. After the search, the screen displays the TOTAL # (of files) FOUND.

After StatTrax locates a set of files that meet the criteria you specify, it calls this set of files the ***Hit List***, and displays these files in the FILES IN HIT LIST field. The Hit List changes each time you sort. You can add files from the Hit List to the Subdirectory by selecting F5 (ADD TO SUB DIR). The ADD TO SUB DIR box appears after you select any of the following commands in the main Directory Sorting Screen:

- F1 (INCLUDE OPS)
- F2 (EXCLUDE OPS)
- F3 (DISPLAY OPS)
- F5 (FILE OPS)

After selecting the sorting parameters, you can specify where the search can take place:

- In the Main Directory (all files in the account)
- In the Hit List (a temporary list of located files that met your sort criteria. If you change the criteria and perform another sort, the Hit List changes.)
- In the Subdirectory (a saved directory that you create from Hit List files).

After the sort, StatTrax can display your sorted data as a directory or as data in a trend chart. To begin a sort procedure, refer to the next section, "Displaying the Directory Sorting Screen and Establishing Criteria for Sorting Files."

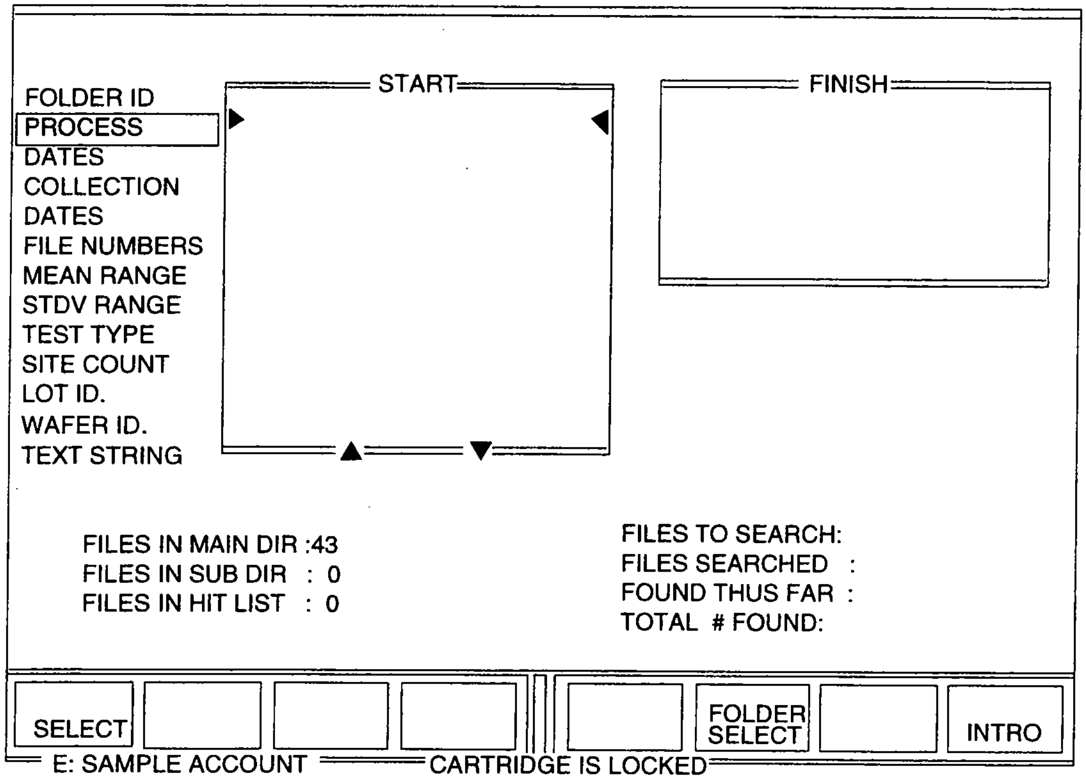

Figure 8-3: Directory Sorting Screen

Displaying the Directory Sorting Screen and Establishing Criteria for Sorting Files

The Directory Sorting Screen contains eleven parameters that the system uses as criteria for file sorting. You can select one or more of these parameters for any sort (refer to Table 8-2).

To display the Directory Sorting Screen

1. From the Main Engineering Menu, select DIRECTORY OPS and DIRECTORY SORTING.
2. Press F1 (SELECT).

   The Directory Sorting Screen appears.

The tables in this section describe the parameters available from the Directory Sorting Screen for establishing criteria. After entering your sorting parameters, proceed to either "Sorting Files That Meet Your Sort Criteria (Inclusive Searches)" or "Sorting Files That Do Not Meet Your Sort Criteria (Exclusive Searches)" which follow.

***Table 8-2:** Parameters in the Directory Sorting Screen*

Parameter	Description
FOLDER ID	These numbers correspond to the Cabinet-Drawer-Folder ID described in Chapter 1. Enter a starting and finishing value between 111 and 999.
PROCESS DATES	Select this field, press F4 (EDIT ACTIVE), then toggle the appropriate boxes for the month, day, and year. Press F1 (ACCEPT) to write the starting and ending dates to the sort fields, and return to the Directory Sorting Screen.
COLLECTION DATES	Select this field, and press F4 (EDIT ACTIVE). When the Collection Date Screen appears, correct the date by selecting the appropriate boxes for the month, day, and year. Press F1 (ACCEPT) to write the starting and ending dates to the sort fields and, return to the Directory Sorting Screen.
FILE NUMBERS	Enter a starting and finishing value between 1 and 99999.
MEAN RANGE	Enter a starting and finishing mean resistivity value in ohms/sq.
STDV RANGE	Enter a starting and finishing standard deviation range in ohms/sq or as a percentage (be sure to include the % sign).
TEST TYPE	Select this field, and press F4 (TOGGLE ACTIVE) to select one of the following test types for sorting: • CONTOUR MAP • DIAMETER SCAN • QUICK TEST • QUALIFICATION TEST • PATTERN TEST

Table 8-2: Parameters in the Directory Sorting Screen (Continued)

Parameter	Description
SITE COUNT	Enter a value between 1 and 999 to have StatTrax sort by the number of test sites.
LOT ID	Type in an alphanumeric string of up to 20 characters.
WAFER ID	Type in an alphanumeric string of up to 20 characters. StatTrax sorts through all of the Wafer ID fields in the Main Directory, the current Subdirectory, or the Hit List.
TEXT STRING	Type in an alphanumeric string of up to 20 characters for which the system will look to match in the Wafer Facts Index Card. This search is somewhat slower than other sort routines. (The system sorts through all of the text fields in the Wafer Facts Index Card for each test file to locate the text string.)

The Directory Sorting Screen has three directory file-count fields (Table 8-3). It also has four file-count fields that display the sort status ***during*** the sort (Table 8-4).

Table 8-3: File-Count Fields in the Directory Sorting Screen

Parameter	Description
FILES IN MAIN DIR	The total number of files on the cartridge
FILES IN SUB DIR	The number of files currently in the Subdirectory
FILES IN HIT LIST	The number of files currently in the Hit List

Table 8-4: File-Count Fields Displayed in the Directory Sorting Screen During the Sort

Parameter	Description
FILES TO SEARCH	The total number of files selected for the sort process. This could refer to files from the Main Directory, the Subdirectory, or the Hit List.
FILES SEARCHED	The number of files sorted through thus far
FOUND THUS FAR	The number of files found thus far that meet the sorting criterion
TOTAL FOUND	The total number of files found that meet the sorting criteria

Sorting Files That Meet Your Sort Criteria (Inclusive Searches)

This section assumes you have established criteria for sorting files. If you have not, refer to the earlier section "Displaying the Directory Sorting Screen and Establishing Criteria for Sorting Files."

After you select the sorting parameters from the Directory Sorting Screen, begin the sorting process by selecting INCLUDE OPS (F1). Include Ops displays the Include Operations Sorting Screen, which enables you to perform inclusive searches for data files. Inclusive searches look for all the data files that meet the criteria you establish, and include those files in a ***Hit List***.

Table 8-5 describes the command boxes available from the Include Operations Sorting Screen.

An Example of an Inclusive Search

To sort through the Main Directory and find all files having a standard deviation *within* the selected range 0.0%-1.0%, follow these steps:

1. Enter the range 0.0%-1.0% in the STDV RANGE field.
2. Press F1 (INCLUDE OPS).

   The screen displays a different set of command boxes.
3. Press F1 (INCLUDE MAIN DIR).

   StatTrax searches for files having a standard deviation *within* the range of 0.0%-1.0% and includes them in the Hit List.

Table 8-5: Command Boxes in the Directory Sorting Screen with Include Ops Selected

Command Box	Description
F1 (INCLUDE MAIN DIR)	Search the Main Directory for the file or data parameter *within* the selected range, or *equal to* the selected value or string.
F2 (INCLUDE SUB DIR)	Search the Subdirectory for the file or data parameter *within* the selected range, or *equal to* the selected value or string.
F3 (INCLUDE HIT LIST)	Search the current Hit List for the file or data parameter *within* the selected range, or *equal to* the selected value or string. Files that meet the new criteria become the new Hit List.
F5 (ADD TO SUB DIR)	Add the files in the current Hit List to the Subdirectory. If you want to store only the Hit List files in the Subdirectory, be sure to clear the Subdirectory first. Otherwise, all Hit List files will be *added to existing* Subdirectory files. Refer to "Managing Sorted Files" later in this chapter.
F6 (VIEW HIT LIST)	Display the files in the Hit List as a directory. Press F4 (TOGGLE DRCTRY) to display different file summary lines. You can display either the Title Line, the Lot/Wafer ID Line, or the Statistics Line.
F7 (INCLUDE MARK OUT/ EXCLUDE MARK OUT)	If this box displays INCLUDE MARK OUT, the system *includes* the marked-out files in the sorting process. If this box displays EXCLUDE MARK OUT, the system *excludes* the marked-out files from the sorting process.
F8 (RETURN)	Return to the Directory Sorting Screen.

Sorting Files That Do Not Meet Your Sort Criteria (Exclusive Searches)

This section assumes you have established criteria for sorting files. If you have not, refer to the earlier section "Displaying the Directory Screen and Establishing Criteria for Sorting Files."

After you select the sorting parameters from the Directory Sorting Screen, begin the sorting process by selecting EXCLUDE OPS (F2). Exclude Ops displays the Exclude Operations Sorting Screen, which enables you to perform exclusive searches for data files. Exclusive Searches sort files by including all files that do *not* meet the selected range or value in a ***Hit List***.

Table 8-6 describes the command boxes available from the Exclude Operations Sorting Screen.

An Example of an Exclusive Search

To sort through the Main Directory and find all files having a standard deviation *outside* the selected range 0.0%-1.0%, follow these steps:

1. Enter the range 0.0%-1.0% in the STDV RANGE field.
2. Press F2 (EXCLUDE OPS).
3. The screen displays a different set of command boxes.
4. Press F1 (EXCLUDE MAIN DIR).
5. StatTrax searches through the Main Directory for files having a standard deviation *outside* the range of 0.0%-1.0%, and includes those files in the Hit List.

Table 8-6: Command Boxes in the Directory Sorting Screen with Exclude Ops Selected

Command Box	Description
F1 (EXCLUDE MAIN DIR)	Search the Main Directory for the file or data parameter outside the selected range, or not equal to the selected value or string.
F2 (EXCLUDE SUB DIR)	Search the Subdirectory for the file or data parameter outside the selected range, or not equal to the selected value or string.
F3 (EXCLUDE HIT LIST)	Search the Hit List for the file or data parameter outside the selected range, or not equal to the selected value or string.
F5 (ADD TO SUB DIR)	Add the files currently in the Hit List to the Subdirectory. If you want to store only the Hit List files in the Subdirectory, be sure to clear the Subdirectory first. Otherwise, all newly added files will be added to existing Subdirectory files. Refer to the later section "Managing Sorted Files."
F6 (VIEW HIT LIST)	Display the files in the Hit List as a directory. Select TOGGLE DRCTRY by pressing F4 to display different file summary lines.
F7 (INCLUDE MARK OUT/ EXCLUDE MARK OUT)	If this box displays INCLUDE MARK OUT, the system includes marked-out files in the sorting process. If this box displays EXCLUDE MARK OUT, the system excludes marked-out files from the sorting process.
F8 (RETURN)	Return to the Directory Sorting Screen.

Displaying Sorted Files

After sorting data, you can display the results in one of two ways:

- As a directory listing in one of the following directories:
  - Main Directory (all files)
  - Subdirectory
  - Hit List
- As a trend chart according to one of the following directories:
  - Subdirectory
  - Hit List

To activate the display function, press F3 (DISPLAY OPS) from the Main Directory Sorting Screen. Refer to the earlier section "Displaying the Directory Sorting Screen and Establishing Criteria for Sorting Files." The screen displays the command boxes described in Table 8-7.

Table 8-7: *Command Boxes in the Directory Sorting Screen with Display Ops Selected*

Command Box	Description
F1 (VIEW MAIN DIR)	Display the files in the Main Directory (all files in the account).
F2 (VIEW SUB DIR)	Display the files in the Subdirectory.
F3 (VIEW HIT LIST)	Display the files currently in the Hit List.
F5 (TREND SUB DIR)	Display the files in the Subdirectory as a trend chart.
F6 (TREND HIT LIST)	Display the files in the Hit List as a trend chart.
F8 (RETURN)	Return to the Directory Sorting Screen.

Managing Sorted Files

StatTrax enables you to manage your sorted files in one of the following ways:

- Erasing the Subdirectory, Hit List, or the values in the sort fields
- Adding the data files currently in the Hit List to the Subdirectory

To activate the file management function, press F5 (FILE OPS) from the Directory Sorting Screen. Refer to the earlier section "Displaying the Directory Sorting Screen and Establishing Criteria for Sorting Files."

The screen displays the command boxes described in Table 8-8. To return to the Main Engineering Menu from the Directory Sorting Screen, press F8 (MAIN MENU).

Table 8-8: *Command Boxes in the Directory Sorting Screen with File Ops Selected*

Command Box	Description
F1 (ERASE SUB DIR)	Erase the files in the current Subdirectory.
F2 (ERASE HIT LIST)	Erase the files currently in the Hit List.
F3 (CLEAR VALUES)	Erase the values from the sort fields in the Start and Finish tables.
F5 (ADD TO SUB DIR)	Add the files currently in the Hit List to the Subdirectory. When you add data files in the Hit List to the Subdirectory, the system adds the files to the existing Subdirectory files. That is, if you have six files in the Subdirectory and you add eight files from the Hit List to the existing Subdirectory files, you will have fourteen files in the new Subdirectory. If you want your Subdirectory to consist only of files from the current Hit List, erase the Subdirectory before adding the Hit List files.
F8 (RETURN)	Return to the Directory Sorting Screen.

File Transfer & Copy

The File Transfer & Copy selection in the Directory Ops Menu enables you to copy data files to any folder within your StatTrax database.

To set up your file transfer or copy parameters

1. Go to the Main Engineering Menu and highlight DIRECTORY OPS and FILE TRANSFER & COPY.
2. Press F1 (SELECT).

   The system displays the Folder Select Screen.
3. Select a test folder, and press F1 (FOLDER DRCTRY).

   The system displays the Folder Directory Screen that corresponds to the selected folder. The Folder Directory Screen contains the command boxes described in Table 8-9.
4. Use the cursor keys (Home, Page Up, and so on) to scroll through the directory and position the cursor at a file. You can also type a file number, and press Enter.
5. Press F3 (SELECT FILE)

   The color of the selected file changes from white to green. Repeat this process for other files as necessary.
6. Press F5 (COPY FOLDER).

   The COPY TO FOLDER field activates.
7. Enter a target folder ID (111-999), and press Enter.

   If you want a duplicate of the source file in the same folder, just enter the same folder ID.

   Before starting the copy, the system asks if you want to proceed.

   - Press F1 (YES) to start the copy process
   - Press F8 (NO) to stop the process.
8. Once the copy process is completed, press F8 (FOLDER SELECT) to return to the Folder Select Screen.

   The copied files are identical to the originals except that the copied files are assigned the next available file numbers in the Main Directory. At this point, you can mark out the original files as a reminder that they have been uploaded, copied, or printed. (Refer to the earlier section "Marking Out Files in the Folder and Main Directories.")
9. To copy more files, repeat this procedure from step 3.

Table 8-9: Command Boxes in the Folder Directory

Command Box	Description
F1 (DATA DISPLAY)	Displays the test data for the selected file.
F3 (SELECT FILE)	Selects the file(s) to be copied.
F4 (TOGGLE DRCTRY)	Toggles the file directory at the top of the screen according to the information you want to display. Press F4 (TOGGLE DRCTRY) to display different file summary lines. You can display either the Title Line, the Lot/Wafer ID Line, or the Statistics Line.
F5 (COPY TO FOLDER)	Starts the file copy process by selecting the *target* folder ID (111-999).
F6 (RS232 TRANSFER/ SECS-II TRANSFER)	Starts copying the file(s) to the device (serial printer or host computer) connected to the selected data communications port at the rear of the computer. (The selection is made in GENERAL SYSTEM DATA. Refer to the sections "Transferring Copies of Data Files Over the RS232 Line to a Host Computer or Printer" or "Transferring Copies of Data Files to a Host Computer Using Basic SECS-II Protocol" later in this chapter.)
F8 (FOLDER SELECT)	Return to the Folder Select Screen.

Transferring Copies of Data Files Over the RS232 Line to a Host Computer or Printer

The File Transfer & Copy selection in the Directory Ops Menu enables you to transfer copies of data files over the RS232 line to a host computer or printer. To do this you must connect the receiving device to the 25-pin female connector labeled SECS-II on the rear of the computer monitor. If you connect a printer to this port, the printer must be able to automatically perform a carriage return (CR) after a line feed (LF). Table 8-10 lists the RS232 pin assignments. Note that alternate ASCII delimiters (including tabs, commas, and spaces) are available when copying to a host computer. Refer to "Setting General System Parameters" in Chapter 3.

Note

To set up Enhanced SECS-II:

- *Set the DATA COMMUNICATIONS field in the General System Data Screen to RS232. Refer to "Setting General System Parameters" in Chapter 3.*
- *Make sure the DATA COM BAUD RATE field matches that of the receiving device.*

To set up your file and transfer copies of data files over the RS232 line

1. Go to the Main Engineering Menu and highlight DIRECTORY OPS and FILE TRANSFER & COPY.
2. Press F1 (SELECT).

   The system displays the Folder Select Screen.
3. Select a test folder, then press F1 (FOLDER DRCTRY).
4. Position the cursor at a file, or type a file number in the JUMP TO FILE field, and press Enter.
5. Press F3 (SELECT FILE).

   The color of the selected file changes from white to green.
6. Repeat steps 4 and 5 for any other files you want to transfer.
7. Press F6 (RS232 TRANSFER).

   Before starting the transfer process, the system asks if you want to proceed.

   - Press F1 to start the copy process.
   - Press F8 to stop the process.
8. After the copy process is completed, press F8 (FOLDER SELECT) to return to the Folder Select Screen.
9. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

Table 8-10: RS232 Pin Assignments

DB25M (25-pin)	RS232 Mnemonic
7	GND (Signal Ground)
2	TD (Transmit Data)
3	RD (Receive Data)
4	RTS (Request to Send)
5	CTS (Clear to Send)
20	DTR (Data Terminal Ready)
6	DSR (Data Set Ready)
22	RI (Ring Indicator)

Order of File Data Transfer

File data are sent as ASCII characters in the order given below. After all files are printed, the sequence concludes with two <End-of-File> messages. The sequence repeats for each wafer in the file. Refer to Table 3-4 for a description of the available ASCII delimiters.

Folder ID <LF> (delimiter 1)

File ID <LF>

n (number of sites) <LF>

Test Type <LF>

Title <LF>

Headers 1–6 (Operator, Process, Equipment, Shift, Status 1, and Status 2 entries in the Wafer Facts Index Card) <LF>

Before temperature <LF>

After temperature <LF>

Name of Temperature Compensation Curve <LF>

TCR value <LF>

Correct to temperature <LF>

Lot ID <LF>

Wafer ID <LF>

Process date <LF>

Process time <LF>

Collection date <LF>

Collection time <LF>

Minimum <LF>

Mean <LF>

Maximum <LF>

% Standard deviation <LF>

Sort Sigma <LF>

Measured data values <LF>

<End-of-File> (delimiter 2)

Transferring Copies of Data Files to a Host Computer Using Basic SECS-II Protocol

The File Transfer & Copy selection in the Directory Ops Menu enables you to transfer copies of data files to the host computer using basic SECS-II protocol. The basic SECS-II application comes with your system. It enables you to upload data to a host mainframe computer or to a personal computer running host software. This data can be uploaded from existing files or uploaded during manual (non-host-directed) data collection. Refer Table 8-10 for a list of the RS232 pin assignments.

To set up basic SECS-II

1. Set the DATA COMMUNICATIONS field in the General System Data Setup Screen to SECS-II. Refer to "Setting General System Parameters" and "Setting SECS-II Parameters," in Chapter 3.

    - Make sure the DATA COM BAUD RATE field, in the General System Data Screen, matches that of the receiving device.

    - Set the SECS-II PARAMETERS (T1–T4, RETRY, and so on), in the SECS-II Parameters Screen, to match host requirements. (The baud rate in the SECS-II Parameters Screen is the same as the DATA COM BAUD RATE in the General System Data Screen.)

To transfer copies of data files to a host computer using basic SECS-II protocol

1. Go to the Main Engineering Menu, and highlight DIRECTORY OPS and FILE TRANSFER & COPY.

2. Press F1 (SELECT).

    The system displays the Folder Select Screen.

3. Select a test folder, and press F1 (FOLDER DRCTRY).

4. Position the cursor at a file, or type a file number in the JUMP TO FILE field, and press Enter.

5. Press F3 (SELECT FILE).

    The color of the selected file changes from white to green. Repeat for other files you want to transfer.

6. Press F6 to select SECS-II TRANSFER.

    Before starting the transfer sequence, the system asks if you want to proceed.

    - Press F1 (YES) to start the copy process.
    - Press F8 (NO) to stop.

7. When the copy process is completed, press F8 (FOLDER SELECT) to return to the Folder Select Screen.

8. Press F8 (MAIN MENU) to return to the Main Engineering Menu.

Enhanced SECS-II

The Enhanced SECS-II option adds some significant features to the basic SECS-II application. The basic SECS-II package enables you to upload data files and test setups (recipes) to a host computer. In addition to these capabilities, the enhanced package enables you to

- Initialize and diagnose the equipment from the host
- Perform host-directed wafer measurement and data collection
- Communicate the equipment's status to the host
- Download process recipes from the host to the system
- Report errors and alarms

To set up Enhanced SECS-II

1. Set the DATA COMMUNICATIONS field in the General System Data Screen to SECS-II. Refer to "Setting General System Parameters" in Chapter 3.
2. Make sure the DATA COM BAUD RATE field matches that of the host.
3. Set the SECS-II PARAMETERS (T1-T4, RETRY, and so on) to match host requirements. The baud rate in the SECS-II Parameters Screen is the same as the DATA COM BAUD RATE.

To activate Enhanced SECS-II

1. Connect the cable supplied with the Enhanced SECS-II software to the 25-pin D-Shell connector on the Cable Interface board.
2. Return to the Introduction Screen, and press F7 (LOG ON SECS-II).

   The screen displays the message `Initializing SECS-II` while sending an inquiry to the host computer. When the host returns with the proper response, the screen depicted in Figure 8-4 appears. If the system cannot establish communications with the host, the display returns to the Introduction Screen.

   The SECS-II Operations Screen offers the selections described in Table 8-11.

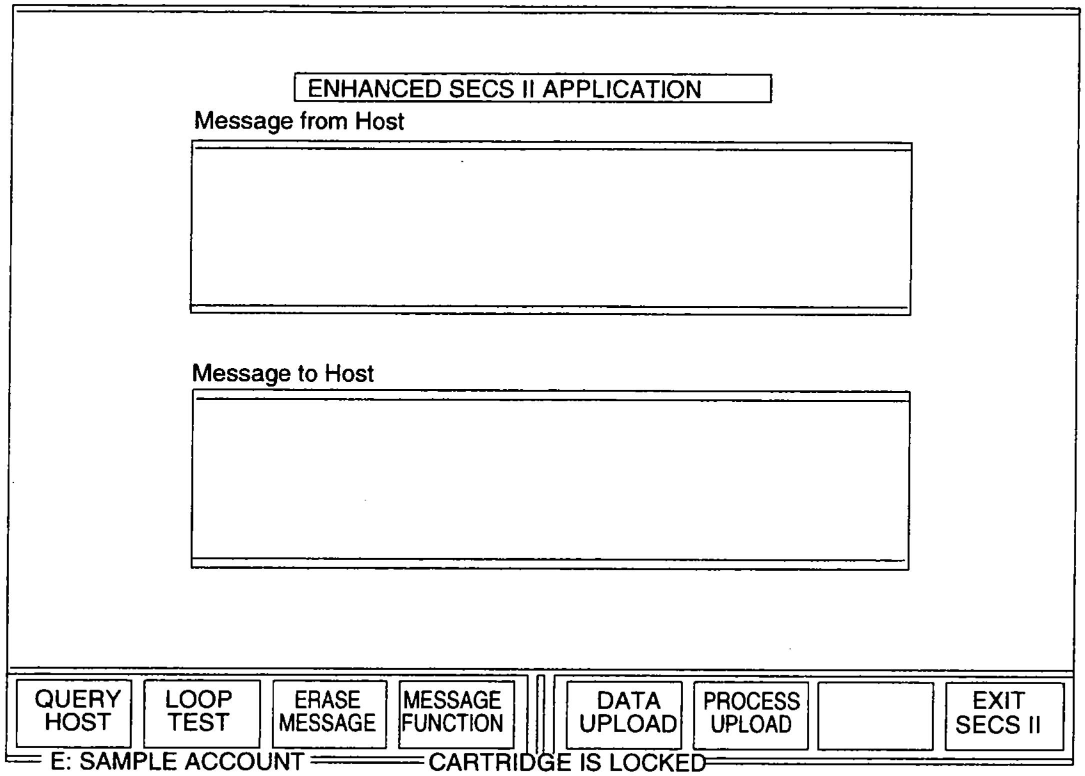

Figure 8-4: *Enhanced SECS-II Operations Screen*

Table 8-11: *Command Boxes in the Enhanced SECS-II Operations Screen*

Command Box	**Description**
F1 (QUERY HOST)	Sends an inquiry to the host as [S1F1 (Are you there?)]. The proper response from the host is [S1F2 (Acknowledge)].
F2 (LOOP TEST)	Initiates a loopback test between the system's computer and the host to check the integrity of the communications lines.
F3 (ERASE MESSAGE)	Erases the message(s) in the Message from Host and Message to Host boxes on the Enhanced SECS-II Operations Screen.
F4 (MESSAGE FUNCTION)	Sends a message of up to 236 characters to the host computer. When you select MESSAGE FUNCTION, a blinking cursor appears in the Message to Host box on the screen. Type in a message, then select F1 (UPLOAD MESSAGE) to send it.
F5 (DATA UPLOAD)	Uploads (copies) data files to the host computer.
F6 (PROCESS UPLOAD)	Uploads one or more test setups (*recipes*) from any cabinet, drawer, or folder in the StatTrax database to the host computer.
F8 (EXIT SECS-II)	Exits the SECS-II Operations Mode, and returns to the Introduction Screen.

To upload data

1. Press F5 (DATA UPLOAD).
2. Select a folder, and press F8 (FOLDER DRCTRY).
3. Select the desired file(s), and press F3 (SELECT FILE).
4. Press F6 (SECS-II TRANSFER).
5. To return to the Enhanced SECS-II Operations Screen after the data upload is complete, press F8 (FOLDER SELECT).
6. Press F8 to exit.

To upload test setups

1. Press F6 (PROCESS UPLOAD).
2. Highlight the cabinet, drawer, or folder containing the desired test setup(s), pressing F1 (SELECT) after each selection.
3. Press F5 (UPLOAD RECIPE).
4. To return to the Enhanced SECS-II Operations Screen after the process upload is complete, press F8 (MAIN MENU).

Refer to the documentation that accompanied your Enhanced SECS-II option for specific information on the SECS-II protocol and its application in the OmniMap system (part numbers 04-0057 B and 04-0150 B).

The Account Ops Menu, File Management Items

The Account Ops (operations) Menu, shown in Figure 8-5, contains several parameters used to manage collected data stored within the account. These selections are

- BACKUP/DELETE FILES
- OPTIMIZE/DELETE FILES
- OPTIMIZE/DELETE RECOVERY

Refer to Table 8-12 for a description of these selections. (Chapter 3 describes the selections used to prepare an account for data collection (EDIT ACCOUNT ID and INITIALIZE ACCOUNT.)

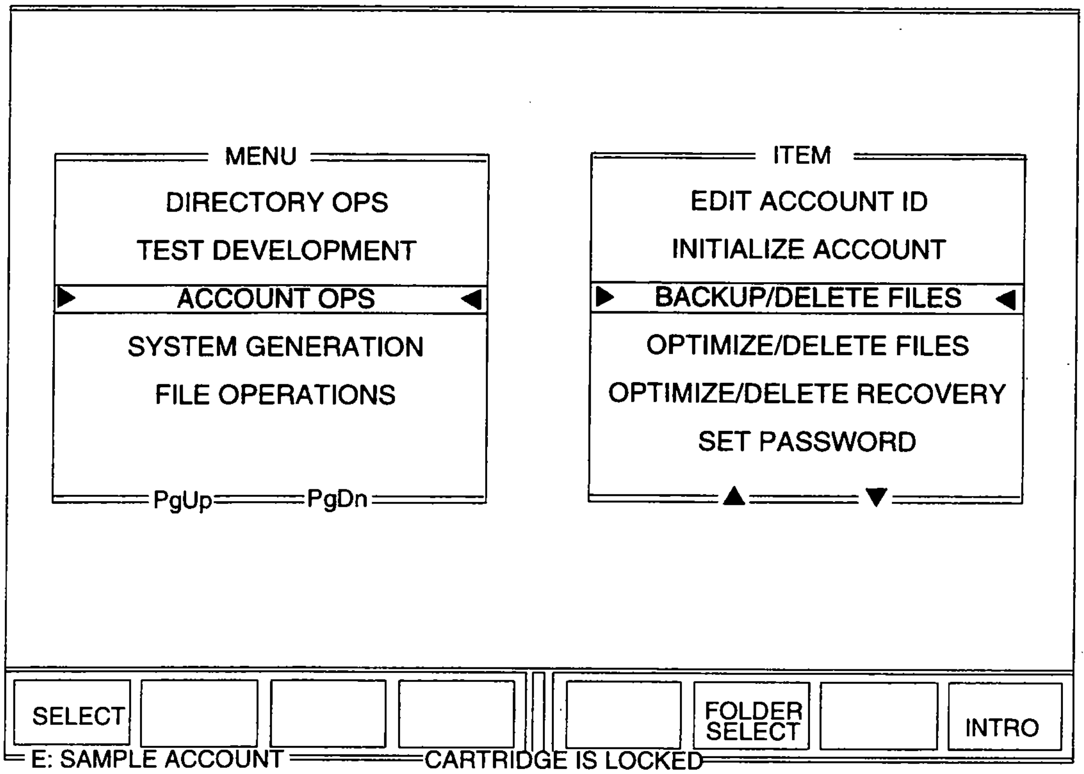

Figure 8-5: Main Engineering Menu, Account Ops

Table 8-12: File Management Items in the Account Ops Menu

ITEM	Description
BACKUP/DELETE FILES	Used to backup files from the active (source) account to another (target) account. Refer to the following section, "Back Up/Delete Files." Individually selected (***marked-out***) files can be omitted from the backup. (See "Marking Out Files in the FOLDER and MAIN DIRECTORIES," in this chapter, for instructions on marking out files.)

Table 8-12: File Management Items in the Account Ops Menu (Continued)

ITEM	Description
OPTIMIZE/DELETE FILES	Used to backup the active account onto itself (marked-out files can be omitted from the backup). • OPTIMIZE rearranges the data in the active account into contiguous files, thus minimizing data retrieval times. • DELETE removes marked-out files and rearranges the data in the active account into contiguous files. Refer to "Optimize/Delete Files" in this chapter.
OPTIMIZE/DELETE RECOVERY	Used to recover files *temporarily* stored on the scratch file. (This selection appears only if an OPTIMIZE/DELETE FILES procedure fails.) Refer to "Recovering from an OPTIMIZE/DELETE Failure" in this chapter.

Back Up/Delete Files

Use this procedure to back up hard drive or cartridge drive accounts. We recommend backing up files when an account is 75% full. (As indicated by the account status message displayed when you log on to an account.) Before backing up files from the active account onto a new (target) account, be sure that the target account has been named and initialized. If you want to exclude certain files from the backup, *mark them out* as described in the earlier section "Marking Out Files in the Folder and Main Directories"

To backup the account

1. From the Main Engineering Menu, press the Page Up or Page Down key to highlight ACCOUNT OPS.
2. Use the computer's up and down arrow keys or trackball to highlight BACKUP/DELETE FILES, and press F1 (SELECT).

   The Backup Screen appears. See Figure 8-6.
3. Use the computer's up and down arrow keys or trackball to highlight the target account (the account that will receive the data).

   The active account's name should be dimmed in this selection list. (The Backup/Delete Files option copies files to a *different* account.)

CAUTION *Backing up the active account will remove all data currently stored in the target account. If you do not want to lose the data in the highlighted target account, select a different target account.*

---

4. Press the desired function key:
   - To copy all data from the active account to the target account, press F1 (BACKUP/COPY).
   - To copy test configurations (test setups) *only*, press F2 (CONFIGS. ONLY).
   - To return to the Main Engineering Menu, press F8 (MAIN MENU).

Note *If the target account is password-protected, you will be asked to enter the target account's password. To continue, you must type in the account's password, and press the computer keyboard's Enter key.*

If you are backing up files from the active account, the following message appears to warn you that if you omit files from the target copy, the file numbers on the target will not match the file numbers on source:

```
Would you like to omit "marked out" files from the target
copy?

(If so, file numbers on target will not match file numbers
on source.)
```

5. Press the desired function key:

   - If you do not want to copy marked-out files, press F1 (OMIT MARKOUT).
   - If you want to copy all files, press F2 (RETAIN ALL FILES).
   - To cancel this procedure, press F8 (CANCEL). You will return to the Backup Screen.

Important *You cannot cancel this procedure once it has begun. If you attempt to cancel it while the procedure is in progress, the system might lock up.*

When backing up files or test configurations from a source account on one cartridge to a target account on a different cartridge, a message appears directing you to insert a new cartridge and to press Continue.

6. Insert the target cartridge, and turn on the cartridge drive. When the cartridge drive's green indicator light stops blinking, press F1 (CONTINUE).

Whenever backing up files or copying test configurations, a message appears telling you which account you are copying to and that you will be overwriting any information in that account.

7. Press the desired function key.

   - To continue the procedure, press F1 (YES).
   - To cancel the procedure press F8 (NO).

As the procedure continues the following sequence of status messages appears (messages appear as the corresponding operations begin; the word `done` appears next to the message when the operation is completed).

```
Clearing target account--done
Transferring information to target--done
Clearing scratch file--done (during cartridge to cartridge copy only)
Press any key
```

8. Press any key to exit to the Main Engineering Menu.

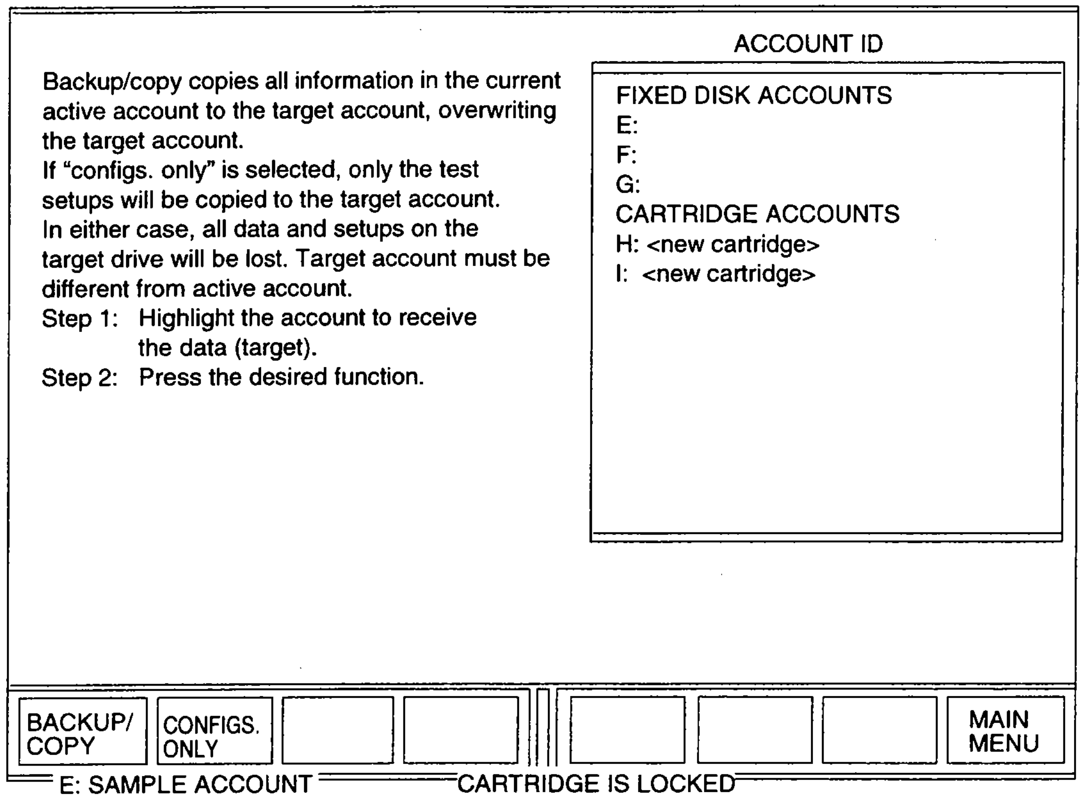

Figure 8-6: *Backup/Delete Files Screen*

Optimize/Delete Files

Use the Optimize/Delete Files selection to rearrange data into contiguous files within the account or to remove files from the account. Optimizing data storage reduces the amount of time the system requires to retrieve files.

To optimize file storage on the active account or to delete files from the active account

1. From the Main Engineering Menu, press the Page Up or Page Down key to highlight ACCOUNT OPS.
2. Use the computer's up and down arrow keys or trackball to highlight OPTIMIZE/DELETE FILES, and press F1 (SELECT).

   The Optimize/Delete Files Screen will appear. See Figure 8-7.

Important *Do not power down or reboot the computer during deletion! If deletion fails for some reason, your data can be restored from internal storage.*
The deletion procedure can take up to twenty minutes. You cannot cancel this procedure once it has begun!

---

3. Press the appropriate function key:
   - To rearrange the data in the active account into contiguous files, press F1 (OPTIMIZE).
   - To remove marked-out files and rearrange the data in the active account into contiguous files, press F2 (DELETE FILES).

   If you select DELETE FILES, a message similar to the following will appear.

   ```
   You are about to delete all " marked out" files from
   account E:SAMPLE. (All remaining files in account E:SAMPLE
   will be re-numbered.) Are you sure you wish to proceed?
   ```

   - To proceed, press F1 (YES).
   - To cancel the deletion, press F8 (CANCEL).

   As the procedure continues the following sequence of status messages will appear (messages appear as the corresponding operations begin; the word done appears next to the message when the operation is completed).

   ```
   Copying information from source account to scratch file.
   Clearing target account--done
   Transferring information to target--done
   Clearing scratch file--done (during cartridge to
   cartridge copy only)
   Press any key
   ```

4. Press any key to exit.

Failure of an Optimize/Delete Files Procedure

If, during the Optimize/Delete Files procedure, the copy from the source account to the scratch file fails, the following message appears.

```
Unable to copy data to scratch file.

Account remains in its original condition.
```

You will be returned to the Optimize/Delete Files Screen. Try the Optimize/Delete Files procedure again, starting from step 2.

If, during this procedure, the initialization or the copy from scratch file to target account fails, the system will automatically try the initialization or copy once again. If the second attempt fails, the following message appears.

```
Writing to target failed.

Data in the account(source) may have been corrupted.

A copy of the original data is retained in the scratch file.

Press any key to proceed to recovery instructions.
```

Refer to the following section, "Recovering from an OPTIMIZE/DELETE FAILURE."

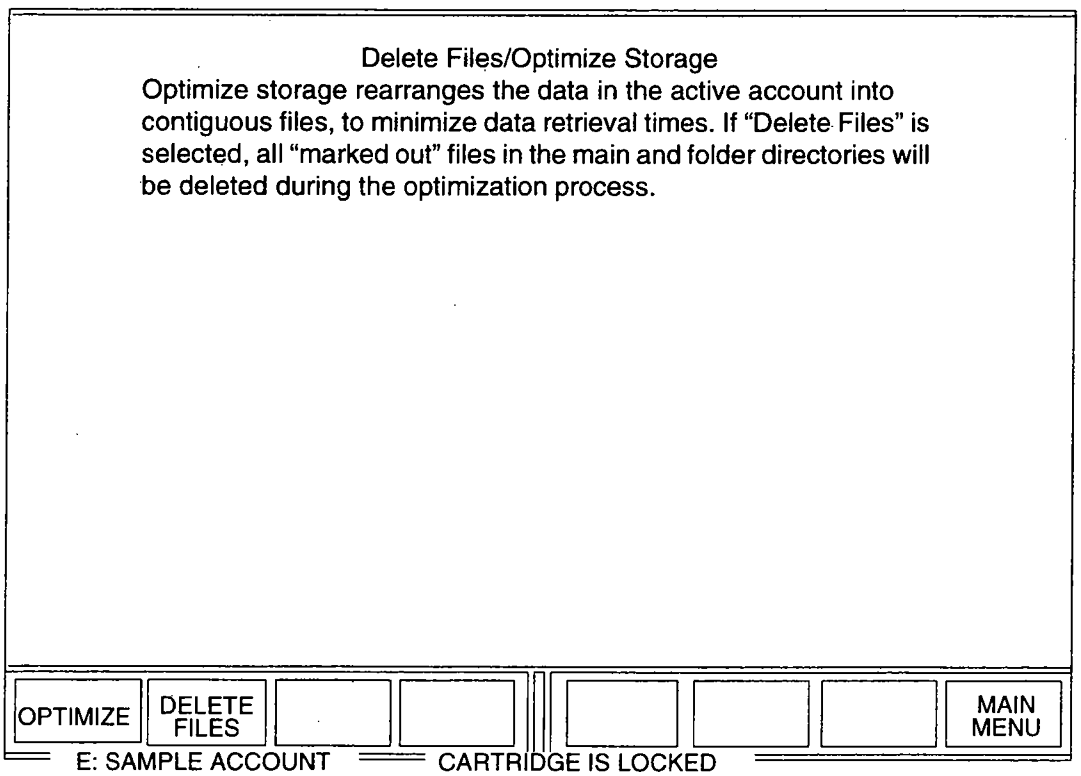

Figure 8-7: Optimize/Delete Files Screen

Optimize/Delete Recovery

The Optimize/Delete Recovery selection is accessible only when an Optimize/Delete Files operation fails. The Optimize/Delete Recovery selection allows you to recover files that have been copied from the active account to the scratch file (temporary, internal memory) but have not yet been copied back to the active account. If an Optimize/Delete Files operation fails, we recommend copying the files to a fresh cartridge, because the original source cartridge might be defective.

(When optimizing or deleting files, the system temporarily stores the files in its internal memory. Next, the system clears the active account. Finally, the system copies the *unmarked* files from its internal memory back to the active account.)

Important *You can only use this option to retrieve the files that are stored in the system's internal memory at the time of a failure. You cannot retrieve files after a successful deletion procedure.*

To recover from an OPTIMIZE/DELETE FILES failure

1. From the Main Engineering Menu, press the Page Up or Page Down key to highlight ACCOUNT OPS.
2. Use the computer's up and down arrow keys or trackball to highlight OPTIMIZE/DELETE RECOVERY, and press F1 (SELECT).

   The Optimize/Delete Recovery Screen (Figure 8-8) appears.
3. Use the computer's up and down arrow keys or trackball to highlight the target account (the account that will receive the data).
4. Press F1 (RECOVER DATA).

   (Pressing F5 [ERASE DATA] will remove the data from the scratch file, and you will not be able to recover it.)

Note *If the target account is password-protected, you will be asked to enter the target account's password. If you wish to copy to the target account, you must type in the target account's password, and press Enter.*

The following messages appear (messages appear as the corresponding operations begin; the word `done` appears next to the message when the operation is completed).

```
Clearing target account--done
Transferring information to target--done
Clearing scratch file--done
Recovery complete. Press any key.
```

5. Press any key to exit.

   You are returned to the Main Engineering Menu. The OPTIMIZE/DELETE RECOVERY selection appears dim and is no longer accessible.

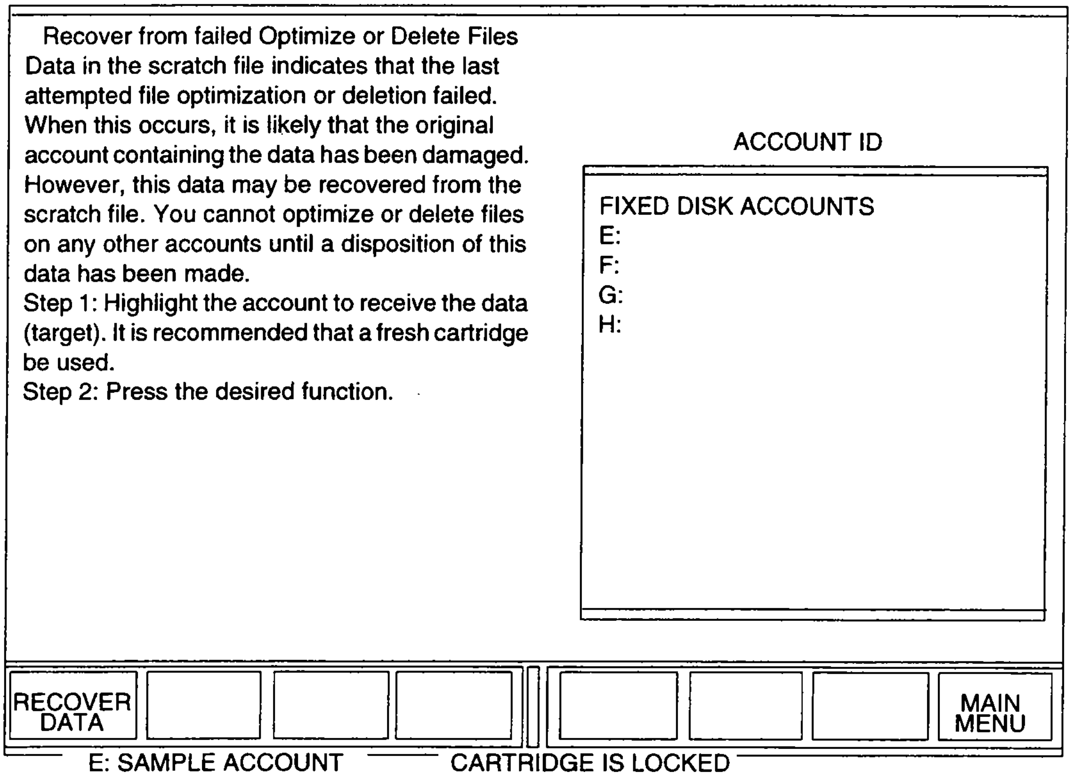

Figure 8-8: *Optimize/Delete Recovery Screen*

The File Operations Menu

This section describes how to use the options available in the File Operations Menu. The File Operations Menu enables you to export and import data and to copy files to diskette in ASCII format. The following sections provide detailed instructions for using these options.

Export Data

Use the Export Data selection when you want to send data to another OmniMap system for analysis. When you export a file, the system writes a binary DOS file to a floppy diskette in drive A. The system's drive A uses 3.5-inch double-sided, high-density, floppy diskettes. Because the system can access only the first fifty files on a diskette when importing data, you should not export more than fifty files to a diskette.

Exported files are unreadable until imported into an OmniMap system. Using the Export Data option in conjunction with the Import Data option enables you to

- Move files from one system to another.
- Print a list of the files in the Folder Directory.
- Print a list of files you have selected to export and import.

To export data

1. Insert a formatted diskette into drive A (the floppy diskette drive).
2. From the Main Engineering Menu, select FILE OPERATIONS in the MENU box on the left. Select EXPORT DATA in the ITEM box on the right.
3. Press F1 (SELECT).

   The system displays the Export Data Folder Select Screen.
4. Highlight the folder containing the data you wish to export, then press F1 (SOURCE SELECT).

   The Export Data Directory Screen (Figure 8-9) appears, displaying the files in the selected folder. The text fields in the lower left portion of the Export Data Directory Screen identify

   - the current directory (DIRECTORY)
   - the total number of files in the selected folder (TOTAL FILES)
   - the location of the diskette that will receive the files (TARGET DISK)
   - the identification number of the cabinet, drawer, and folder containing the displayed files (SOURCE FOLDER)

   Table 8-13 describes the function of the command keys in the Export Data Directory Screen.
5. Use the keys described in Table 8-14 to indicate the file you want to export, then press F3 (SELECT/DESELECT). The system confirms your selection by highlighting the file.

   Repeat this selection process for each file you want to export. If you wish to change your selection, you can deselect the highlighted files by indicating them and pressing F3 again. The system confirms this deselection by removing the highlight from the file.

6. Press F7 (START COPY).

   The screen displays a message asking you to enter a *comments string* that will be stored with the selected files. Type a comments string (up to 39 characters), and press the computer's Enter key.

Note *Enter an accurate description of the files because the comments string will be your method of identifying the files after they have been exported. The system does not warn you if you enter the same comments string for two different files.*

---

7. The system will ask you to insert a new diskette in drive A. If you have not already inserted a diskette in drive A, do so now.

8. Press F1 (CONTINUE) to indicate that there is a diskette in drive A.

   If the target diskette already contains exported files, the screen displays a message informing you of this, and two new command boxes appear:

   - F1 (APPEND) allows you to copy the selected files to the target diskette without overwriting existing files.
   - F3 (OVERWRITE) replaces existing files on the target diskette with the selected files.

Important *To avoid accidentally overwriting data, read all messages that appear on the screen, and follow their instructions carefully.*

After the selected file(s) have been exported, you are returned to the Export Data Directory Screen. You can export files from another folder, or press F8 (MAIN MENU) to return to the Main Menu. (Remember to limit the total number of files on the floppy diskette to fifty.)

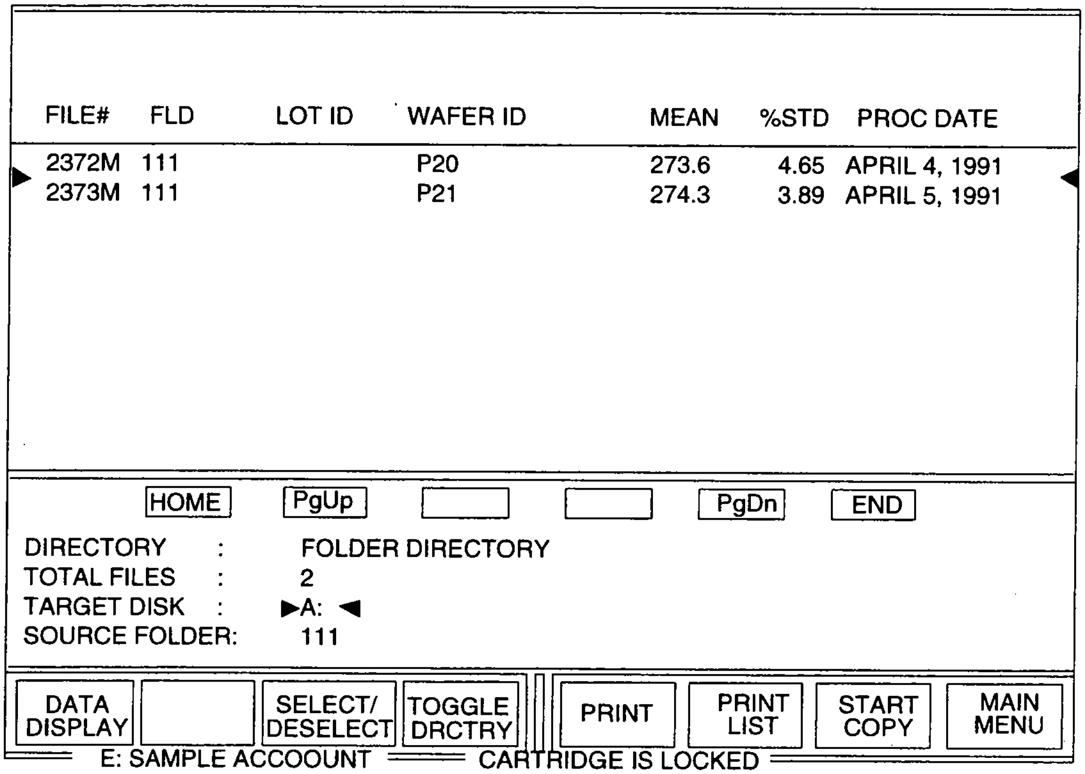

Figure 8-9: Export Data Directory Screen

Table 8-13: Command Boxes in the Export Data Directory Screen

Command Box	Function
(F1) DATA DISPLAY	Displays the test data for the selected file. From the Data Display Screen, you can select the FILE RETRIEVE box to access a file's index cards.
(F3) SELECT/DESELECT	Selects or deselects files.
(F4) TOGGLE DRCTRY	Toggles the directory line at the top of the screen according to the information you want to display. Press F4 (TOGGLE DRCTRY) to display different lines. You can display either the Title Line, the Lot/Wafer ID Line, or the statistics line (Figure 8-10).
(F5) PRINT	Prints the files in the Directory Screen.
(F6) PRINT LIST	Prints the files you have selected.
(F7) START COPY	Instructs the system to start copying (exporting) the selected files to the diskette.
(F8) MAIN MENU	Returns you to the Main Engineering Screen. Selecting MAIN MENU before selecting START COPY cancels the export operation.

Title Line:	FILE#	FLD	TITLE			MEAN		%STD	PROC DATE		
Lot/Wafer ID Line:	FILE#	FLD	LOT ID WAFER ID			MEAN		%STD	PROC DATE		
Statistics Line:	FILE#	FLD	STS	MIN	MAX	MEAN	RANGE	STDV	%STD	PROC DATE	COLL DATE

Figure 8-10: *Directory Line Options in the Export Data Directory Screen*

Table 8-14: *Directional Key Functions in the Export Data Directory Screen*

Key	**Function**
Home	Moves the cursor to the first file in the directory
PgUp (Page Up)	Moves the cursor up one full display page (nine files maximum)
Up-arrow key (▲)	Moves the cursor up one line to the previous file
Down-arrow key (▼)	Moves the cursor down one line to the next file
PgDn (Page Down)	Moves the cursor down one full display page (nine files maximum)
End	Moves the cursor to the last file in the directory

Import Data

In order to access the data exported on a floppy diskette, you must first import the data to your system. The system can import up to fifty files from a single diskette.

To import data

1. Insert the source (data) diskette into drive A (the floppy diskette drive).
2. From the Main Engineering Menu, select FILE OPERATIONS in the MENU box on the left. Highlight IMPORT DATA in the ITEM box on the right.
3. Press F1 (SELECT).

   The system displays the Import Data Folder Select Screen (similar to Figure 8-11).
4. Highlight the folder that will receive the data, and press F1 (TARGET SELECT).

   The Import Data Directory Screen (Figure 8-11) displays the files on the source diskette. The text fields in the lower left portion of the screen identify
   - the current directory (DIRECTORY)
   - the total number of files on the diskette (TOTAL FILES)
   - the location of the diskette from which the files will be imported (SOURCE DISK)
   - the identification number of the cabinet, drawer, and folder that will receive the selected files (TARGET FOLDER)
5. Use the trackball or the keys described earlier in Table 8-14 to indicate the file you want to import, then press F3 (SELECT/DESELECT).

   The system confirms your selection by highlighting the file.
6. Repeat this selection process for each file you want to import. (If you wish to change your selection, you can deselect files by highlighting them and pressing F3 again. The system confirms this deselection by removing the highlight from the files.)
7. Press F7 (START COPY).

   The system begins copying the files from the floppy diskette to the selected TARGET FOLDER.

   After the selected file(s) have been imported, the display returns to the Import Data Directory Screen. You can continue importing files to another folder, or press F8 (MAIN MENU) to return to the Main Engineering Menu.

To import files from another floppy diskette

1. Eject the floppy diskette currently in drive A.
2. Insert the new source diskette in drive A.
3. Press F1 (READ FLOPPY).

   The screen displays a list of the files in the new source diskette.
4. Proceed from step 5 above.

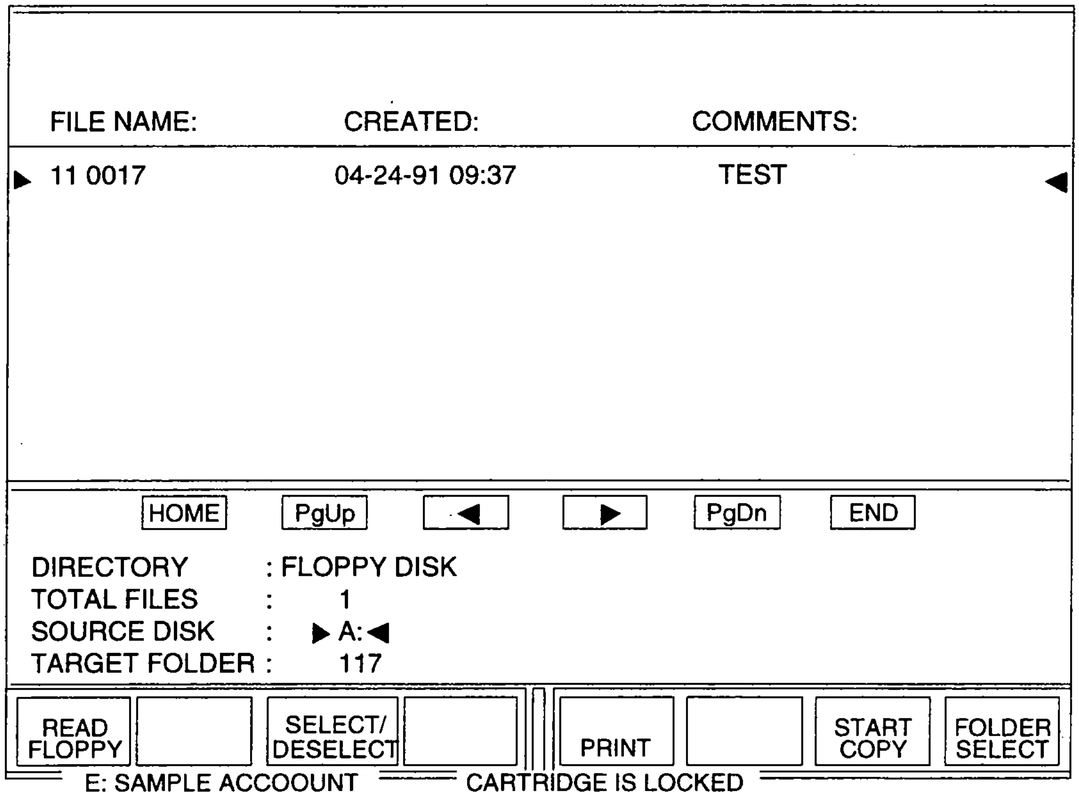

Figure 8-11: Import Data Directory Screen

ASCII Copy to Diskette

StatTrax software enables you to copy files in ASCII format to a floppy diskette. (The system's drive A uses 3.5-inch double-sided, high-density, floppy diskettes.) Think of ASCII COPY TO DISK as an exporting option which translates the files into ASCII format as you export them. This capability allows you to transfer data in a form which can be read by MS DOS-based spreadsheet programs. As with the Export Data option, copy no more than fifty files to a single diskette.

Important *Files copied using* ASCII COPY TO DISK *are stored in folders labeled with the file's StatTrax Folder ID number and the extension* `.dat`. *If you later attempt to store additional files from the same folder onto the diskette, the files originally stored on the diskette will be overwritten.*

To copy files to a diskette (in ASCII format)

1. Insert a formatted diskette into drive A (the floppy diskette drive).
2. From the Main Engineering Menu, highlight FILE OPERATIONS in the MENU box on the left. Select ASCII COPY TO DISK in the ITEM box on the right.
3. Press F1 (SELECT).

   The system displays the ASCII Folder Select Screen.
4. Select a source folder from which to download data, and press F1 (SOURCE SELECT).

   The system displays the files in the selected folder in the ASCII File Directory Screen. The text fields in the lower left portion of the screen identify

   - the current directory (DIRECTORY)
   - the total number of files in the selected folder (TOTAL FILES)
   - the location of the diskette that will receive the files (TARGET DISK)
   - the identification number of the cabinet, drawer, and folder containing the displayed files (SOURCE FOLDER)
5. Indicate the file you want to copy in ASCII format, and press F3 (SELECT/DESELECT). The system confirms your selection by highlighting the file.

   Repeat this selection process for each file you want to export. (If you wish to change your selection, you can deselect these files by indicating them and pressing F3 again. The system confirms this deselection by removing the highlight from the files.)
6. Press F7 (START COPY).

   The system will ask you to insert a new diskette into drive A. If you have not already inserted a diskette into drive A, do so now.
7. Press F1 (CONTINUE) to indicate that there is a diskette in drive A.

   If any files already exist on the floppy diskette, the screen displays a message telling you that you can overwrite the existing file or insert another diskette.

   - If you do not want to overwrite the existing file, remove the diskette from drive A, and insert another diskette before pressing any key.

- If you want to overwrite the existing file, press any key.

Important *To avoid accidentally overwriting data, read all messages that appear on the screen, and follow their instructions carefully.*

8. After the selected file(s) have been copied to diskette, the display returns to the directory screen. You can continue exporting files from this folder, or press F8 (MAIN MENU) to return to the Main Menu.

The data files copied to diskette are located in the directory called DATA. The file name that appears in the directory indicates the cabinet, drawer, and folder of the file. For example, *112* means the file is located in the first cabinet, in the first drawer, and in the second folder in the Folder Directory.

Order of File Data Transfer

File data are sent in the order given below. After all files are printed, the sequence concludes with two <End-of-File> messages. The sequence repeats for each wafer in the file. Refer to Table 3-4 for a description of the available ASCII delimiters.

Folder ID <LF> (delimiter 1)

File ID <LF>

n (number of sites) <LF>

Test Type <LF>

Title <LF>

Headers 1–6 (Operator, Process, Equipment, Shift, Status 1, and Status 2 entries in the Wafer Facts Index Card) <LF> after each

Before temperature <LF>

After temperature <LF>

Name of Temperature Compensation Curve <LF>

TCR value <LF>

Correct to temperature <LF>

Lot ID <LF>

Wafer ID <LF>

Process date <LF>

Process time <LF>

Collection date <LF>

Collection time <LF>

Minimum <LF>

Mean <LF>

Maximum <LF>

% Standard deviation <LF>

Sort Sigma <LF>

Measured data values <LF>

<End-of-File> (delimiter 2)

Export Recipe

The Export Recipe selection, in the File Operations Menu, enables you to transfer individual test setups (recipes) from one system to another using a floppy diskette.

To copy test recipes (export data) to the diskette

1. Log on to the account containing the recipe you want to export.
2. From the Main Engineering Menu, highlight FILE OPERATIONS in the MENU listing and EXPORT RECIPE in the ITEM listing.
3. Insert a formatted diskette into the system's floppy disk drive, and press F1 (SELECT).

   The Folder Select Screen appears. (See Figure 8-12.)
4. Highlight the folder containing the recipe you want to export, and press F1 (SOURCE SELECT).

   Repeat this step for each additional recipe you want to export from this account.
5. Press F5 (START COPY).

   The message EXPORTING flashes at the bottom of the screen.
6. When finished exporting data, remove the diskette from the drive, and press F8 (MAIN MENU) to exit.

   Refer to the next section, "Importing Test Setups (Test Recipes) to Another System" to import the test setups to another system.

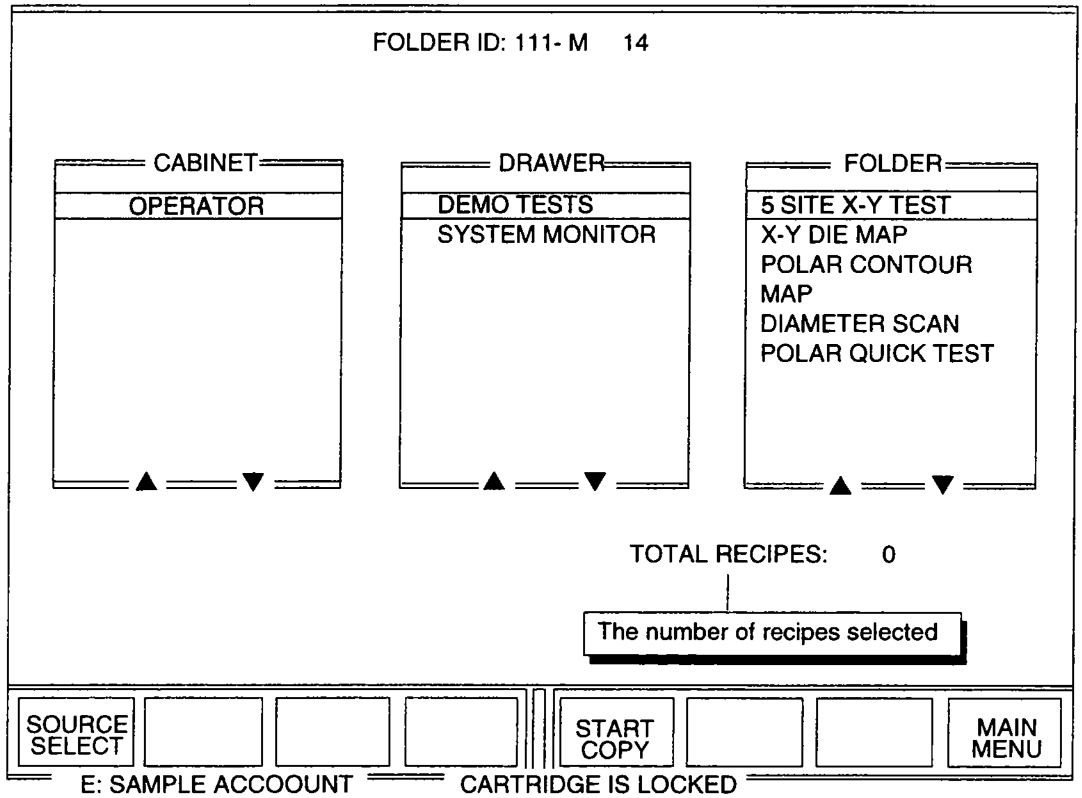

Figure 8-12: *Folder Select Screen for Exporting Recipes*

Import Recipe

The IMPORT RECIPE selection, in the File Operations Menu, enables you to transfer individual test setups (recipes) from one system to another using a floppy diskette.

To import the recipe(s) into another system

1. Log on to the account that you wish to import the recipes into.
2. From the Main Engineering Menu, highlight FILE OPERATIONS and IMPORT RECIPE.
3. Insert the diskette into the system's floppy disk drive, and press F1 (SELECT).

   The Directory Screen appears. (See Figure 8-13.)
4. Use the arrow keys to indicate the recipe you wish to import.
5. Press F3 (SELECT/DESELECT) to highlight the recipe.
6. Press F1 (SELECT/TARGET) to display the Folder Select Screen for importing recipes. (This screen is similar to the figure shown in the previous section "Exporting Test Setups (Test Recipes) to Another System.")
7. Use the arrow keys to indicate the folder you wish to place the recipe in.
8. Press F1 (TARGET SELECT) to highlight the folder.
9. Press F5 (START COPY) to import the recipe.

   If the selected folder already contains a test setup, you will receive a warning message asking if you want to proceed.

   As the recipe is copied to the folder, the message IMPORTING flashes at the bottom of the screen.
10. Repeat steps 1–3 to import the recipe into an additional folder, or remove the diskette from the drive, and press F8 (MAIN MENU) to exit.

CAUTION *You can import more than one recipe at a time by repeating steps 4 and 5 to select several recipes. However, when you import more than one recipe at a time you cannot specify a target folder. Instead, the system automatically places each selected recipe in the folder corresponding to the one from which it was exported. Any test setups already stored in these folders will be overwritten.*

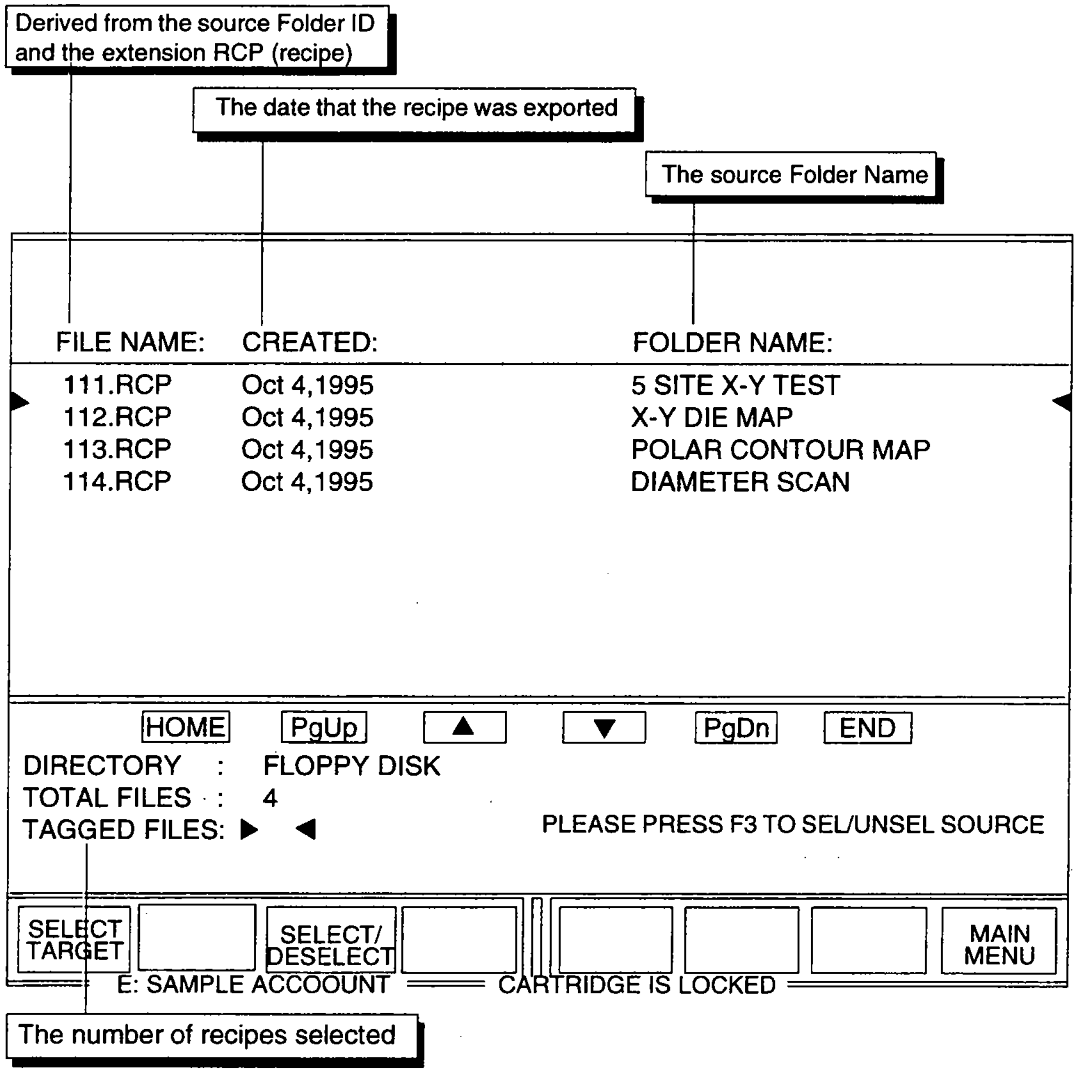

Figure 8-13: *Directory Screen for Exporting Recipes*

Chapter 9
Reference

Introduction

This section defines Auto RS55/tc system and StatTrax software terms. For most entries, this chapter describes the pathway by which you can access the item or function online. This reference chapter lists terms alphabetically. Some terms listed in this reference chapter apply ***only*** to resistivity products which use StatTrax software. If the definition you find does not address your needs, refer to the Index at the end of this User's Guide.

Terms

Absolute Display:

Text field available for 3D Maps and Diameter Scans in the Maps & Graphs Index Card. Selecting this field entry sets the reference plane at the 3D–ABS MEAN value as you define, and plots the values between the limits 3D–ABS MINIMUM and 3D–ABS MAXIMUM. To select this entry, highlight the 3D–DISPLAY field, and select TOGGLE ACTIVE until ABSOLUTE DISPLAY appears.

See also: Normalized Display; Full Scale Display; 3D Display

Account: Fixed and cartridge drives are partitioned into 20 megabyte user accounts. Accounts can be individually password-protected, allowing several users to work on the same system without risk to their data.

Although you can set up tests and collect data in accounts on either the fixed or removable cartridge drive, because the fixed drive is faster and more reliable, we recommend that you operate from a fixed drive account, and use the cartridges for backing up your data.

Account ID: Unique user-defined name assigned to your account. Used for identification of an account.

Account Ops: Menu selection in the Main Engineering Menu. ACCOUNT OPS offers the following ITEM selections:

- EDIT ACCOUNT ID
- INITIALIZE ACCOUNT
- BACKUP/DELETE ACCOUNT
- OPTIMIZE/DELETE ACCOUNT
- OPTIMIZE/DELETE RECOVERY
- SET PASSWORD

Add To Sub Dir:

A command box that adds all of the files currently in the Hit List Directory to the Subdirectory. Files already in the Subdirectory will not be duplicated if included in the Hit List again. Files are ordered in the Subdirectory strictly in collection order; not the order in which they were added to the Subdirectory.

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Text field available for 3D Maps and Diameter Scans in the Maps & Graphs Index Card. Selecting this field entry sets the reference plane at the 3D–ABS MEAN value as you define, and plots the values between the limits 3D–ABS MINIMUM and 3D–ABS MAXIMUM. To select this entry, highlight the 3D–DISPLAY field, and select TOGGLE ACTIVE until ABSOLUTE DISPLAY appears.

See also: Normalized Display; Full Scale Display; 3D Display

Account: Fixed and cartridge drives are partitioned into 20 megabyte user accounts. Accounts can be individually password-protected, allowing several users to work on the same system without risk to their data.

Although you can set up tests and collect data in accounts on either the fixed or removable cartridge drive, because the fixed drive is faster and more reliable, we recommend that you operate from a fixed drive account, and use the cartridges for backing up your data.

Account ID: Unique user-defined name assigned to your account. Used for identification of an account.

Account Ops: Menu selection in the Main Engineering Menu. ACCOUNT OPS offers the following ITEM selections:

- EDIT ACCOUNT ID
- INITIALIZE ACCOUNT
- BACKUP/DELETE ACCOUNT
- OPTIMIZE/DELETE ACCOUNT
- OPTIMIZE/DELETE RECOVERY
- SET PASSWORD

Add To Sub Dir:

A command box that adds all of the files currently in the Hit List Directory to the Subdirectory. Files already in the Subdirectory will not be duplicated if included in the Hit List again. Files are ordered in the Subdirectory strictly in collection order; not the order in which they were added to the Subdirectory.

This is an additive process. If the files in the Hit List are to replace the files in the Subdirectory, then the Subdirectory must first be erased using the ERASE SUB DIR command box which is present when the FILE OPS command box is activated.

See also: Directory Sorting: File Ops; Erase Sub Dir

Ambient Temperature:
The temperature of the specified, surrounding medium (such as air, nitrogen, or a liquid) that comes into contact with a semiconductor device being tested.

Amperage: The entry in Amperage field sets the current value that the system uses as a starting point when the Auto Range Sample Type is selected, or as the fixed current used when the Manual Sample Type is selected. After the current sample is collected, or the test is run, the Amperage field reports the current value used by the system.

Enter a current value in milli-amps (mA). Any value within the following range is acceptable:

0.0001 mA to 200.0 mA

To edit this field, key in the value, and press Enter. This field may ***not*** be sorted using DIRECTORY SORTING.

See also: Measure Type

Applications Keys:
Application keys F1 through F8 at the top of the keyboard correspond to command boxes at the bottom of the monitor. Use these command boxes or keys to select the functions, cards and screens throughout StatTrax. When activated, the command box's shading is reversed.

Arm: *See: Radial Arm Movement*

Approximate Maximum Temperature (APPROX MAX TEMP):
The maximum temperature at which the system measures temperature values for the Temperature Compensation Curve. The actual maximum temperature will depend on the starting temperature (ambient), the wafer size, and the heater output.

ASTM Patterns:
One of four Quick Test patterns provided with StatTrax. The pattern rotational angle for this set of patterns is locked at 30, and the test diameter is locked relative to the wafer diameter.

See also: Quick Test Patterns (Polar Coordinates)" in Appendix B

Auto Range: *See: Sample Type*

Auto Run: *See: Sample Type*

Auto Save: Text field. The AUTO SAVE field is used to select whether or not the collected data is saved to the database automatically. These five selections are available:

- NO AUTO OPERATIONS

- AUTO SAVE, NO UPLOAD
- AUTO SAVE AND UPLOAD
- AUTO UPLOAD IF SAVED
- AUTO UPLOAD

To edit this field, use the TOGGLE ACTIVE box to cycle through the selections.

If the data collection process is canceled for any reason and the Auto Save function is ON, the data is **not** automatically saved! This is to prevent unwanted or invalid data from being stored in the folders.

See also: Test Type (card); Toggle Active

Backup: Tencor recommends that you back up data cartridges frequently. A media failure almost guarantees that all data collected since the last backup is lost! If you *never* make backups, *all* data will be lost. Back up your data using BACKUP/DELETE FILES.

See also: Backup/Delete Files

Backup/Delete Files:
Account operation that enables you to copy a source account for archival purposes. The backup account operates the same, and contains the same data, as the source account. The backup time depends on the amount of information in the source account.

Baud Rate: The speed at which data travels over the communications port data line (for the RS232 or SECS-II line). Select the baud rate in either the SECS-II Parameters Screen or the General System Data Screen. Regardless of the screen you select, there's only one value for the port. The port is shared by both the RS232 and the SECS-II data link. The baud rates available for selection are

150, 300, 1200, 2400, 4800, and 9600

The printer and the tester are on separate, independent ports.

Begin Copy: Command box available from the Duplicate Tests Screen. This function does not copy data files, only test setup configurations and prompts. Although the software modifies the configurations during the copy process, the prompts are updated at the end of duplication. If you cancel the operation, you should log on again.

See also: Duplicate Tests; Configurations; Prompts

Card File Display:
Appears in several sections of StatTrax, with the main parts of the display being common through all sections. These main parts are the Card Index, the Index Card Directory, and the two command boxes: TOGGLE ACTIVE and EDIT ACTIVE.

The Card Index is the smaller set of selections on the left side of the display. The Cards are the large rectangles with the tabs on top. The standard boxes are TOGGLE ACTIVE and EDIT ACTIVE at the bottom of the screen.

See also: Card Index; Cards

Card Index: Index card directory on the left side of the display. Each card category in the directory consists of as many as three different index cards. Move the cursor within the Card Index by pressing the PgUp and PgDn keys.

As you move the cursor over the Card Index entries, the cards to the right of the Card Index change accordingly. Table 9-1 lists the items in the Card Index and their corresponding index cards.

Table 9-1: *StatTrax Index Cards*

Index Card Directory (Card Index)	**Index Cards**
Wafer Setup	Wafer Facts
	Memos & Notes
	Wafer Handler (if the handler is enabled)
Test Setup	Test Type
	Measure Type
Test Results	File Summary
	Data Summary
	Maps & Graphs
Trend Charts	Trend Setup
	Trend Scaling
SQC Charts	SQC Setup
	SQC Scaling

See also: Card File Display; Cards

Cards: *See: Index Cards*

Change Poly: Command box located in the Curve Fitting Screen. Use this box to change the degree of the curve-fit polynomial from second, to first, and then back, depending on the number of points in the curve file:

4 points:Third, second, or first-degree polynomial

3 points:Second or first-degree polynomial

2 points:first-degree polynomial only
Note that you cannot change the degree of the fit polynomial to one less than the number of data points.

Selecting CHANGE POLY enough times returns you to the original-degree polynomial.

See also: Curve Fitting

Change Status: Command box available only within Engineering Mode under the Folder Directory Screen. When you select CHANGE STATUS, you make a selected file invisible in Operations Mode. The entry dims to signify its deselected status. This is called *marking-out*. You can delete marked-out files by performing the BACKUP/DELETE FILES procedure. To make a marked-out file visible in Operations Mode, choose the file, and select CHANGE STATUS again.

See also: Directory Ops; Directory Display; Main Directory; Mark Out

Collection Date:

Set Date & Time function under System Generation. The Collection Date is the calendar date on which you saved the collected data. Ensure that the current system date is correct, as the system uses this date as the collection date.

Collection Time:

The Collection Time should be the accurate time of day on which you saved the collected data. Ensure that the current system time is correct so that your collection time is correct.

Collect New Data/Collect Off:

Command box in the Folder Select Screens under Test Setup (Engineering) and Data Collection (Operations). In Engineering Mode, use the box to activate or prohibit Data Collection. The default is COLLECT NEW DATA. If you toggle COLLECT NEW DATA the box reads COLLECT OFF. While you can see the box in both Engineering and Operations Mode, you cannot modify it in Operations Mode. When you select COLLECT NEW DATA in Operations Mode, either the Wafer Handler Index Card or the Wafer Facts Index Card appears, depending on whether the Wafer Handler is enabled in the General System Data Screen.

See also: Folder Select Screen

Color Codes: Color codes for text fields and monitor screen borders. The process engineer specifies the text field colors as part of the test format for each folder. The process operator then enters information into these text fields as specified by the process engineer. Table 9-2 describes the function of each color code.

Table 9-2: *Text Field Options*

Screen Display	**Status**	**Meaning**
Blue on black	Locked	An operator cannot change text in a Locked field.
Cyan	May Change	An operator can change a *May Change* field as appropriate.
Red	Forced Every Test	The operator must edit the field prior to beginning data collection *each time the test is run.*
Orange	Forced Once	The operator must edit the field before starting data collection for the first time. After editing the field once, it changes to a *May Change* field for as long as the operator remains within that folder.

Monitor screen borders are colored either green or orange depending on which mode

StatTrax is running in. *Green* means StatTrax is running in Operations Mode. *Orange* means StatTrax is running in Engineering Mode.

See also: StatTrax Color Codes

Combine Old Data/Combine Off:
In Engineering Mode, toggle COMBINE OLD DATA/COMBINE OFF to activate or prohibit the data combining feature for a particular drawer or folder. In Operations Mode, toggle COMBINE OLD DATA/COMBINE OFF to select Data Combining for a specific folder.

See also: Folder Select Screen

Combining Data:
The act of merging data from two or more files, or of performing a mathematical manipulation on the test-site values. (For example, *Log10* calculates the base10 logarithm of each site value in the selected file.)

Command Boxes:
Selections at the bottom of the monitor that correspond to keys F1 to F8 at the top of the keyboard. Use these boxes to select functions, cards, and screens throughout StatTrax.

See also: Application Keys

Computer Monitor:
The computer monitor displays the StatTrax software in color. You implement software commands by selecting the appropriate command boxes at the bottom of each screen. You can select these command boxes by

- Pressing one of eight function keys on the keyboard, labeled f1 through f8. These function keys correspond to the command boxes.
- Using the mouse or trackball to position the cursor over one of the command boxes and pressing the mouse or trackball button.

Conf's: *See: Configurations*

Configurations:
Often referred to as *test setups*, configurations are test designs specified in Engineering Mode. These test designs govern everything from how many test sites the tester measures to the way the system displays the data.

Copy Conf's: Command box available from the Engineering Folder Select Screen after you select the DUPLICATE TESTS ITEM selection. Pressing COPY CONF'S enables duplication of test setups after you begin copying (duplicating) tests. You can toggle COPY CONF's to IGNORE CONF'S to prevent test setups from being copied.

See also: Duplicate Tests; Ignore Conf's; Configurations

Copy Folder: *See: File Transfer & Copy*

Copy Prompt: Command box available from the Engineering Folder Select Screen after you select the DUPLICATE TESTS ITEM selection. Pressing COPY PROMPT enables the name (prompt) of the test folder to be copied after you begin copying (duplicating tests). Toggle COPY PROMPT to IGNORE PROMPT to prevent the name of the test folder from being copied after you begin copying.

See also: Duplicate Tests; Ignore Prompt; Prompts

Corrected Sheet Resistance (Rs(Tt)):

Rs(Tm) * TCF
where Tt = Target temperature and Tm = Measured temperature.

Correct To Temp. (Target) (Tt):

The temperature to which you want the sheet resistance measurement corrected. The default value is 23 degrees Celsius.

Correlation: Field used to select the correlation values to be applied to raw data values.

Select a Correlation by toggling through the correlation curve choices. (You can also press EDIT ACTIVE to activate the Correlation editing application.)

Each raw data point passes through the selected correlation curve before being used. You can select a correlation that does not change the raw data values (that is the default for all configurations on a newly initialized account). The raw data value is placed in position X in the following correlation equation:

Y = (S1/S2) * [A + BX + CX^2 + DX^3]

S1, S2, A, B, C and D are the correlation constants, and Y is the resulting modified data value.

See also: Test Type (card); Data Summary; Toggle Active; Edit Active

Correlation Coefficients:

Numerical constants S1, S2, A, B, C, and D in the equation

Y = (S1/S2) * [A + BX + CX^2 + DX^3]

where *X* represents the data value being modified by the correlation equation and *Y* represents the new data value.

Correlation Curves:

From the Main Engineering Menu, select TEST DEVELOPMENT and CORRELATION CURVES to display the Correlation Curves Screen. Using CORRELATIONS CURVES, you can convert measurement units to units other than ohms/sq, or introduce an offset or slope using the given curve.

The screen display is composed of two columns of data: The left column is a list of Correlation Names, and the right column is a list of Correlation Values associated with the names. The display shows only 15 correlation names at one time. To see a different set of 15, select the PAGE command box. The PAGE command enables you to see 60 (4 sets of 15) different correlation names.

The command boxes available in the Correlation Screen are

- PAGE

- TOGGLE ACTIVE
- UPDATE
- MAIN MENU (a RETURN function)

Just above the name and value columns is a copy of the equation used with the correlation values. X in the equation represents the data value being modified by the correlation curve:

$$Y = (S1/S2) * [A + BX + CX^2 + DX^3]$$

To modify a correlation name, highlight the appropriate name in the Correlation column. Then enter the new correlation name.

There is one set of nine correlation values associated with each correlation name. To modify a correlation value associated with a correlation, highlight the specific correlation name in the Correlation column. Then, highlight the Values column and the correlation value to be modified. Enter the new value as either a standard floating point number or in scientific notation, toggle the value, or enter the text as appropriate.

When using the toggle function to cycle through the X or Y modifiers, the selections available are

1. X Y
2. 1/X 1/Y
3. LOG10 X LOG10 Y
4. LOG10 1/X LOG10 1/Y
5. 10^X 10^Y

Correlation Curve #60 is used by other applications to store the correlation data of a retrieved file. The user cannot modify this correlation curve.

See also: Toggle Active

Current: *See: Amperage*

Curve Fitting: Curve fitting enables you to

- Generate curve files of wafer and process data.
- Correlate these data using a third-degree linear or logarithmic polynomial.
- Define and plot the best fitting curve for your data.

See also: Correlation; Correlation Curves

Data Cartridge:

The data cartridge used in Tencor systems are specially formatted for use only with Tencor systems. *Off-the-shelf* cartridges do not perform properly without formatting and initializing. These cartridges and the drives they run in are very fragile, and should not be subjected to extremes in temperature, magnetic fields, or impact shock.

Data Com Baud Rate:

See: Baud Rate

Data Communications:

Three settings are available for data communications:

1. NONE
2. RS232
3. SECS-II

RS232 and SECS-II are used for data upload. Both protocols use the same port, but only one can be active. You can upload data from the FILE TRANSFER & COPY ITEM selection. If you select NONE, no Data Communications box appears on the screen.

See also: Baud Rate; SECS-II Parameters

Data Display: Command box available in various directory screens, such as the Folder Directory Screen and the Main Directory Screen. This box displays test data for the selected file. When you press DATA DISPLAY, the format the displayed data takes depends on the type of test in the file. For example, if you press DATA DISPLAY for Quick Test data, a data value listing appears. Table 9-3 lists the data types and corresponding formats.

Table 9-3: *Display Formats by Test Type*

Test Type	**Display Format**
Contour Mapping	Contour Map/3D Map/Data Values
Diameter Scan	Diameter Scan/Data Values
Quick Test Data	Data Value Listing
Qual Procedure	Data Value Listing
Pattern Testing	XY, Contour, or 3D Maps/Data Values

After pressing DATA DISPLAY to display the test data for a selected file, the following command boxes appear:

- FILE RETRIEVE
- PRINT
- RETURN

See also: File Retrieve; Return

Date Entry: *See: Edit Date*

Data Points Are:

Text field located in the Trend Setup Index Card. Use this text field to specify how your data points are grouped for display. You can choose between

- INDIVIDUAL WAFERS
- GROUPED BY DAY
- GROUPED BY MONTH

When you choose Individual Wafers, the system plots each point on the Trend Chart as the average of all points on a single wafer. Grouped by Month means that a year of data appears as twelve data points on the Trend Chart Screen.

Data Summary:

Index Card. This card is displayed on the screen after you collect data or retrieve a file. It displays a set of information fields summarizing the numeric results of the test.

This card contains nine fields:

- MEAN
- STD DEV
- MINIMUM
- MAXIMUM
- RANGE
- # SITES/GOOD
- SORT SIGMA
- CORRELATION
- UNITS

See also: Card File Display; Card Index; Cards

Data Upload: Command box available in the Enhanced SECS-II Operations Screen. Press DATA UPLOAD to upload one or more data files from a selected folder in the StatTrax database to a host computer.

Data Values: Command box available for all cards in the Card Index. Pressing DATA VALUES displays the raw data values for the selected file in the current index card. For a Quick Test, selecting DATA VALUES is the same as pressing DATA DISPLAY from the corresponding folder directory.

Deg C: Degrees Celsius = 5/9 (degrees F-32)

Delay Value: Selection found in the General System Data Screen (from the SYSTEM GENERATION MENU) that determines the system response rate after you use the trackball. Decrease the Delay Value for a faster response; increase for a slower response. Enter a value between 0 and 99. The default is 25.

Demo Mode: State of the system when no tester is connected to the system. All functions are available in Demo Mode, but the collected data originates from a demonstration data file instead of files from actual wafers measured on the tester. Activate Demo Mode (press F4 from the Introduction Screen) whenever you want to use the system without the tester, such as during Tutorials. With Demo Mode active, the words DEMO MODE appear in the upper-left screen border.

See also: Turn On System

Directory: *See: Directory Display; Directory Status Information*

Directory Cursor:

Six selections on the computer screen with six corresponding keys on the keyboard. Use these selections to move the directory lines up and down in the directory display:

- Home
  Moves the directory to the first entry.
- PgUp
  Moves nine entries closer to the first entry.
- Up arrow
  Moves one entry closer to the first entry.
- Down arrow
- Moves one entry closer to the last entry.
- PgDn
  Moves nine entries closer to the last entry.
- End
  Moves the directory to the last entry.

The screen cursor boxes are always active. If the directory scrolls too rapidly, modify the response rate by changing the Delay Value.

See also: Delay value; Directory Display; Directory Lines

Directory Display:

A screen with file information displayed in a standard directory format so you can access and display directories. Several components comprise this format:

- Directory Line Headers
- Directory Lines
- Directory Cursor Keys and boxes
- Directory Status Information
- TOGGLE DRCTRY box

Although the basic directory display remains consistent for all functions, the available command boxes vary from function to function.

See also: Directory Ops

Directory Lines:

Lines of test information displayed on all directory screens. You can display as many as nine lines at one time. Display these directory lines in one of three different ways to display different information. That is, you can display any combination of the following:

- Wafer/Lot ID line
- Title line
- Statistics line

The directory initially appears with the last entry selected. The Trend Chart also has a directory line at the top of the Trend Chart Screen, a line which displays summary information on the particular wafer.

See also: Directory Display; Directory Line Headers; Toggle Drctry Box

Directory Line Headers:

Displayed directly above the directory lines, they are a line of header information. There are three types of directory line header displays:

1. Lot/Wafer ID:

FILE#	File number and test type letter:
M	Contour *M*ap
S	Diameter *S*can
Q	*Q*uick Test
P	Qualification *P*rocedure
XY	*XY* Map
FID	Folder ID
LOT ID	First 15 characters of the Lot ID
WAFER ID	First 15 characters of the Wafer ID
MEAN	The mean of the data set
PROCESS DATE	The date entered as the process date
STDV	The standard deviation of the data set as a percentage of the mean

2. Statistics

FILE#	Same as #1
FID	Same as #1
STS	The number of test sites in the data set
MIN	The lowest measured value in the data set
MAX	The highest measured value in the data set
MEAN	Same as #1
RANGE	The difference between the max- and min- data values
STDV	The standard deviation of the data set in measurement units
COLLECTION DATE	The system-level date on which the collected data were saved
% STDV	The standard deviation of the data set as a percentage of the mean

3. Top Title

FILE#	Same as #1
FID	Same as #1
TITLE	First 25 characters of the title
MEAN	Same as #1
STDV	The standard deviation of the data set as a percentage of the mean
PROCESS DATE	Same as #1

If the file has been *marked out* (made unavailable), the status line appears dimmed, and the test type letter is lowercase (m, s, q, p, x).

See also: Directory Display; Directory Lines; Toggle Drctry

Directory Ops: The MENU from the Main Engineering Menu that contains several ITEM selections. The ITEM selections include:

FOLDER DIRECTORY

MAIN DIRECTORY

DIRECTORY SORTING

FILE TRANSFER & COPY

See also: Main Menu; Directory Display

Directory Print:

Command box. Press DRCTRY PRINT within a directory application to generate a printout of the directory listings. The printout begins with the currently selected directory listing, and continues to the end of the directory. You can cancel at any point.

See also: Directory Ops; Directory Display

Directory Sorting:

DIRECTORY SORTING enables you to sort files by ranges, single values, or text strings. Access DIRECTORY SORTING from the Main Engineering Menu. Select DIRECTORY OPS in the MENU box on the left. Select DIRECTORY SORTING in the Item box on the right. At this point, you can sort files from

- The MAIN DIRECTORY (all files on the cartridge)
- The SUBDIRECTORY (a saved directory of sorted files you create)
- The HIT LIST (a temporary list of files created anew each time you activate a sorting function)

DIRECTORY SORTING also enables you to

- Search for one or more sort criterion. For example, you can search for all files in folders with IDs between 232 and 343 that have a site count of 121.
- Display files by directory or as data in a Trend Chart.

See also: Directory Display, Trend Charts

Directory Status Information:

Two status lines directly below the cursor boxes at the left side of the Directory Screen. These lines describe the directory origin (such as Main Directory) and the total number of files displayed in the directory. Directly below these lines, you can type in a file number and the directory jumps to and selects that file.

See also: Directory Display

Display Ops: Command box available after you select DIRECTORY OPS and DIRECTORY SORTING from the Main Engineering Menu. Press DISPLAY OPS to access options for viewing files in the directory. The command boxes available after you press DISPLAY OPS are

- VIEW MAIN DIR
- VIEW SUB DIR
- VIEW HIT LIST
- TREND SUB DIR
- TREND HIT LIST
- RETURN

See also: Directory Sorting

Downloading ASCII Files:

Download ASCII files in the same way you export files. One reason for downloading files in ASCII format is to transfer data to a 3.5-inch floppy diskette in a form which can be read by MS DOS-based spreadsheet programs.

See also: Export and Import Files

Drawer: *See: Folders*

Duplicate Tests:

ITEM selection available from the TEST DEVELOPMENT MENU. Select the DUPLICATE TESTS item to copy the test names and setups from one folder or set of folders to another folder or sets of folders. The Duplicate Tests Screen looks similar to the Folder Select Screen, except that the Duplicate Tests Screen displays a different set of command boxes and a new status line. The command boxes are

- SOURCE
- TARGET
- IGNORE/COPY PROMPT
- IGNORE/COPY CONF'S
- IGNORE/COPY PATTERNS
- IGNORE/COPY C2C
- BEGIN COPY
- MAIN MENU

The status line describes the selected source as indicated by its Folder ID number, and the total number of targets.

When you select Source from the Folder column, an individual folder is copied from the Source folder to the target folders. When you select Source from the Drawer column, the group of 9 folders associated with that drawer are copied on a one-to-one basis to the groups of 9 folders associated with the target drawers.

You can cancel the copy operation by pressing CANCEL during the copy process.

Edge Exclusion: The minimum distance from the edge of a film (or edge of a bare wafer) at which the tester can accurately measure sheet resistance.

Edit Account ID:

ITEM selection under ACCOUNT OPS that lets you modify the text identifying a data account (up to 20 characters). The Account ID appears on all printouts produced by the system.

See also: Account ID; Account Ops

Edit Active: Command box that enables you to edit text fields in various index cards. Press EDIT ACTIVE to set up Polar-coordinate or XY Map tests. Pressing EDIT ACTIVE in an index card displays different selection boxes or a list of toggle selections available for the selected field. To accept an edit, press SELECT or ACCEPT, and then choose RETURN to return to the index card. To delete an edit, select RETURN without choosing SELECT or ACCEPT.

Edit Date: Command box available from the Set Date & Time Screen (from the SYSTEM GENERATION MENU). To display the Date Screen, press EDIT DATE. Make changes by selecting the appropriate command boxes at the bottom of the screen. Press ACCEPT to save changes or RETURN to delete changes.

See also: Collection Date; Process Date; Set Date & Time

Edit Probe Data:

Use this feature to enter the appropriate probe ID and probe spacing each time you change the four-point probe. You can change the probe ID and probe spacing in both Engineering and Operations Modes. Refer to Appendix D for instructions on how to change the probe head. (The term *probe space* means the same as *tip space*.)

To edit probe data in Engineering Mode

1. Starting from the Main Engineering Menu, highlight TEST DEVELOPMENT in the MENU box on the left and EDIT PROBE DATA in the ITEM box on the right.
2. Press SELECT.

   The Probe Data Editing Screen appears. The cursor is positioned at the first field, PROBE ID. The probe ID is typically the serial number that appears on the probe itself. The PROBE ID field accepts up to 20 characters.
3. Type in the probe ID, then press Enter.
4. Select the PROBE SPACING field. Standard probe spacings include
   - 0.025 in (0.635 mm)
   - 0.040 in (1.016 mm)
   - 0.0625 in (1.587 mm)

   These values are indicated on the probe under the label PITCH.
5. Type in the correct probe spacing, then press Enter.
6. Press UPDATE to store the new probe information, then press F8 (MAIN MENU) to exit to the Main Engineering Menu.

To edit probe data in Operations Mode

1. Starting from the Introduction Screen, press F1 (FOLDER SELECT).
2. Press F3 (CHANGE PROBE).

   The Probe Data Editing Screen appears. The cursor is positioned at the first field, PROBE ID.
3. Continue with steps 3, 4, and 5 above (Edit Probe Data in Engineering Mode).
4. Press UPDATE to store the new probe information.
5. Press F8 (MAIN MENU) to display the Folder Select Screen.

See also: Probe ID; Tip Space; Appendix D

Edit Time: Command box available from the Set Date & Time Screen (from the SYSTEM GENERATION MENU). You edit the time in the same fashion as the date, except that you should use a different format: `00:00`, with the hour as a pair of numbers from 00 to 24 and the minute as a pair of numbers from 00 to 59.

You can have the system automatically enter the time in the same way it automatically enters the date.

See also: Collection Time; Edit Date; Process Time; Set Date & Time

Engineering Mode:
The branch of StatTrax where you create the test patterns that control the data collection process, and set general parameters to use in Operations Mode. You can also create a account-level password to protect Engineering Mode against unauthorized use.

Access Engineering Mode by pressing F8 (SET UP) from the Introduction Screen.

See also: Set New Password; Main Menu; Operations Mode; Password

Enhanced SECS-II:
Optional application available with Tencor equipment. Enhanced SECS-II enables host-directed wafer measurement and data collection, in addition to the ability to upload data and test setups (recipes) to a host computer. Without the Enhances SECS-II option, host control of Tencor products is limited to transferring data only when data upload is initiated from the equipment.

See also: SECS

Equipment: The EQUIPMENT field is used as a general comment field describing the type of equipment on which the wafer data were collected. To edit this field, begin typing, and press Enter when the desired text has been entered.

See also: Wafer Facts; Text Editor

Erase Hit List: Command box available from the Directory Sorting Screen with which you can erase the file entries currently stored in the Hit List Directory. The Hit List Directory is erased and created anew each time you perform any Include or Exclude Sorting procedures.

See also: Directory Sorting; File Ops

Erase Sub Dir: A command box available after you press FILE OPS from the Directory Sorting Screen. It is used to erase the file entries currently stored in the Subdirectory. The Subdirectory file is a permanent file, and the only way to clear it for use with a new sorting run is to use this application command box.

See also: Directory Sorting; File Ops

Escape: *See: Master Escape*

Exclude Hit List:

Command box available from the Directory Sorting Screen with which you begin the Exclude Sort Process. Search the Hit List for the file or data parameter *not within* the selected range, or *not equal* to the selected value or string. Any files that are found having these characteristics are excluded from the subsequently created Hit List.

Pressing CANCEL while using the sorting process prevents only the current files from being transferred to the Hit List. All others can be transferred.

See also: Directory Sorting; Exclude Ops; Sorting Parameters; Exclude Sorting Parameters

Exclude Main Dir:

Command box available from the Directory Sorting Screen with which you can begin the Exclude Sort Process. Search the Hit List for the file or data parameter *not within* the selected range, or *not equal* to the selected value or string. Any files that are found having these characteristics are excluded from the subsequently created Hit List.

Pressing CANCEL while using the sorting process prevents only the current files from being transferred to the Hit List. All others can be transferred.

See also: Directory Sorting; Exclude Ops; Sorting Parameters

Exclude Ops: Command box available from the Directory Sorting Screen. By selecting the EXCLUDE OPS box, you can access all of the Exclude Sorting procedures available in DIRECTORY SORTING.

The command boxes available are

- EXCLUDE MAIN DIR
- EXCLUDE SUB DIR
- EXCLUDE HIT LIST
- ADD TO SUB DIR
- VIEW HIT LIST
- RETURN

See also: Directory Sorting; Exclude Sorting Procedures

Exclude Sorting Procedures:

The exclude sorting procedures sort through the selected directory and build a Hit List Directory of all the files that *do not match* the Sorting Parameters. In other words, all the files that *do* match the Sorting Parameters are *excluded* from the Hit List. The first parameter found in a file that does not match a corresponding Sorting Parameter will cause that file to be rejected for exclusion from the Hit List of remaining files, and the application will move directly to the next file to be examined.

See also: Directory Sorting; Sorting Procedures; Sorting Process

Exclude Sub Dir:

Use the EXCLUDE SUB DIR command box (available when you select the EXCLUDE OPS command box from the Directory Sorting Screen) to begin the Exclude Sort process. Use the Subdirectory as the source of files to compare with the sorting parameters. Any matching files are excluded from the subsequently created Hit List directory.

Pressing CANCEL while using the sorting process prevents only the current files from being transferred to the Hit List. All others can be transferred.

See also: Directory Sorting; Exclude Ops; Sorting Parameters; Exclude Sorting Procedures

Export and Import Data:

Export and import data when you want to move a file from the cartridge you are currently working on to another cartridge or floppy diskette.

See also: Downloading ASCII Files

Files in Main Dir/ Sub Dir / Hit List:

Three status lines in the Directory Sorting Screen. They display the total number of files in the various directories, including those which are marked out.

See also: Sorting Status Information; Main Directory; Sub Directory; Hit List

File # (number):

Unique identifiers for each data file in the database, beginning with 1. As files are created in the database, they are assigned the next available file number. Marking out files does not change the file number of any file, because the marked out file is not deleted from the database. It is simply not available in Operations Mode.

See also: Directory Display

File Ops: A command box available from the Directory Sorting Screen. After you press this box, you can

- Erase the Subdirectory, the Hit List, or the values in the sort fields.
- Add the data files currently in the Hit List to the Subdirectory.

The command boxes available after you press F5 (FILE OPS) from the Directory Sorting Screen:

- ERASE SUB DIR
- ERASE HIT LIST
- CLEAR VALUES
- ADD TO SUB DIR
- RS232 TRANSFER/SECS-II TRANSFER/blank command box

- RETURN

The RS232 and SECS-II Transfer functions, when accessed through DIRECTORY SORTING, transfer the entire Subdirectory of data files. You cannot select or deselect individual files within the Subdirectory; all files currently in the Subdirectory must be sent.

See also: Directory Sorting

File Retrieve: Command box available from the Folder Directory, the Main Directory, and the Trend Chart Screens. When viewing a data display (such as a Diameter Scan or Quick Test), selecting FILE RETRIEVE sends you back to the File Summary Index Card, where you can edit the display parameters. When you exit from the File Summary Index Card by pressing F8, the Folder Directory or Main Directory Screens are displayed. You can also access FILE RETRIEVE from within Operations Mode after having established a combine operation, or after having entered and then displayed curve file data.

See also: Data Display; Folder Directory; Main Directory

Files Searched: *See: Sorting Status Information*

Files To Search: *See: Sorting Status Information*

File Summary: Index Card that appears

- When you retrieve data after viewing a data display.
- After you collect data.

In either case, the card displays a set of seven fields summarizing the nature and results of the test:

- FILE NUMBER
- TEST TYPE
- TEST SITES
- MEAN
- STD DEV
- UNITS

You cannot edit any of these fields from the File Summary Index Card.

See also: Card File Display; Card Index; Cards

File Transfer & Copy:
An ITEM selection available from the DIRECTORY OPS MENU (in Engineering Mode). Use this operation to transfer or copy files from a specific folder to a different system or folder using either the RS232 or SECS-II applications. To transfer data to another system, you must activate either RS232 or SECS-II in the General System Data Screen. Select the DATA COMMUNICATIONS field and press Toggle Active to select either RS232, SECS-II or None. Use the SECS-II selection in the General System Data Screen if you are using the optional Enhanced SECS-II application, as well.

To transfer or copy a file, first select the file using the SELECT FILE box. Then, select either the COPY TO FOLDER or the TRANSFER box to begin the process. You should then enter the target folder ID number. If you enter an invalid folder ID number, the system cancels the copy operation.

See also: Directory Display; Folder Select; SECS-II Parameters; Folder Directory

Folder Directory:
Directory that lists data files contained in a specific folder that you chose in the Folder Select Screen. All options available in the Main Directory are available from this directory as well. Files in the Folder Directory Screen can be displayed in order of their collection dates, which might not be the order in which they were saved.

To jump directly to a specific file, type in the appropriate file number; the application displays and selects that file. Not all files you search for can be accessed from here. If you have difficulty locating a specific file, look in the Main Directory.

See also: Directory Ops; Directory Display; Directory Print; Main Directory; Collection Date

Folder Drctry: Command box accessible from certain screens. Use it to display the Folder Directory Screen to select a folder.

See also: Folder Directory; Folder Select

Folder ID (number):
Three-digit number which represents a StatTrax data folder. Each digit in the folder ID can have a value from 1 to 9. The first folder reads 111 and the last reads 999. The Folder ID also has other associated symbols that provide information on the contents of the folder. The ID might look like this

146M 87

The following describes the components of the ID.

- The *146* is the folder ID.
- The *M* describes the current test type associated with the folder (Contour Mapping). The available test types are

M	Contour Mapping
S	Diameter Scan
Q	Quick Test
P	Qualification Procedure
XY	XY Map

The *87* denotes the number of data files present in the folder. In empty folders the *87* is replaced by EMPTY. Marked-out files are not counted.

When StatTrax prompts you to enter a Folder ID, you only need to enter the corresponding three-digit number.

See also: Folder Select

Folder Select (Command box):
Available in many screens throughout both Operations and Engineering Modes. Pressing FOLDER SELECT returns you to the Folder Select Screen.

Folder Select (Screen):
Directory of cabinets, drawers, and folders available on the current cartridge. This screen is available in both Engineering and Operations Modes. To display this screen in Operations Mode, press F1 (FOLDER SELECT) from the Introduction Screen. In Engineering Mode, select TEST SETUP from the Main Engineering Menu.

In Engineering Mode, use the Folder Select Screen to select folders either for test setup or to modify data collection parameters. In Operations Mode, use the Folder Select Screen to select the folder in which you want to collect data.

To modify a test, first select the appropriate cabinet, drawer, and folder, and then press F1 (SELECT) to access Test Setup.

See also: Folder Select; Prompts

Full Scale: Trend Chart display limit. In the Trend Chart Screen, select TOGGLE LIMITS to toggle the display limits between full scale, specification limits, and user-defined limits.

Full-Scale Display:
Text field available for 3D Maps in the Maps & Graphs Index Card. Selecting this field entry shows a full 3D Map from its maximum to its minimum values plotted about the mean. To select this entry, highlight the 3D DISPLAY field and select TOGGLE ACTIVE until FULL-SCALE DISPLAY appears.

See also: Absolute Display; 3D Display; Normalized Display

GEM Generic equipment model (equipment automation software). A generalized model that describes a specific implementation of the SEMI Equipment Communications Standard II.

General System Data:
An Item selection available from the System Generation Menu. When you select General System Data, the General System Data Screen appears. From this screen, you can modify certain data communications, system identifier, and system convenience parameters. The fields available are

- DELAY VALUE
- QUICK TEST PRINTOUT
- SYSTEM LINE 1–3
- SYSTEM NAME
- DATA COMMUNICATIONS
- DATA COM BAUD RATE
- SCREEN SAVER DELAY
- DIRECTORY LINE TYPE
- PRINTER TYPE

- PRINTER BAUD RATE
- AUTO PRINT
- WAFER HANDLER
- WAFER CASSETTE TYPE

See also: SECS-II Parameters

Ignore Conf's:

After you select TEST DEVELOPMENT and DUPLICATE TESTS from the Main Engineering Menu, the Engineering Folder Select Screen appears. F4 (IGNORE CONF'S) causes the system to ignore the folder configurations after the copy process is begun. You can toggle this box to change its status to COPY CONF'S, which causes the system to copy folder configurations after the copy process is begun.

See also: Duplicate Tests; Copy Conf's; Configurations

Ignore Prompt:

After you select TEST DEVELOPMENT and DUPLICATE TESTS from the Main Engineering Menu, the Engineering Folder Select Screen appears. Press the IGNORE PROMPT command box to avoid copying the name of the cabinet, drawer, or folder from the source cartridge to the target cartridge. IGNORE PROMPT changes to COPY PROMPT when you press F3 or click on IGNORE PROMPT.

See also: *Duplicate Tests; Copy Prompt; Prompts*

Include Hit List:

Command box, available from the Directory Sorting Screen, used to begin the Include Sort Process. If you press INCLUDE HIT LIST, the files in the Hit List Directory are sorted, and any files matching the sort parameters are included into a new Hit List Directory.

Pressing CANCEL while using the sorting process prevents only current files from being transferred to the Hit List. All others can be transferred.

See also: Directory Sorting; Include Ops; Sorting Parameters; Include Sorting Procedures

Include Main Directory:

Command box, available from the Directory Sorting Screen, used to begin the Include Sort Process. The files in the Main Directory are sorted, and any files matching the sort parameters are included in a new Hit List Directory.

Pressing CANCEL while using the sorting process prevents only THE current files from being transferred to the Hit List. All others can be transferred.

See also: Directory Sorting; Include Ops; Sorting Parameters; Include Sorting Procedures

Include Ops: Command box available from the Directory Sorting Screen enabling access to all of the Include Sorting procedures. By selecting this command box, the following command boxes appear

INCLUDE MAIN DIR

INCLUDE SUB DIR

INCLUDE HIT LIST

ADD TO SUB DIR

VIEW HIT LIST

RETURN

See also: Directory Sorting; Include Sorting Procedures

Include Sorting Procedures:

Procedures enabling you to sort through the selected directory and build a Hit List Directory of all the files that match the sorting parameters. The first parameter found in a file that does not match a corresponding sorting parameter will be rejected for inclusion into the Hit List of matched files and the application will move directly to the next file to be examined.

See also: Directory Sorting; Sorting Parameters; Sorting Process

Include Sub Dir:

After you press INCLUDE OPS from the Directory Sorting Screen, F1 (INCLUDE SUB DIR) appears. Press INCLUDE SUB DIR to begin the Include Sort Process (using the Subdirectory as the source of files to compare with the sorting parameters). Any matching files will be included into the subsequently created Hit List Directory.

Pressing CANCEL while the system is sorting files stops the system from sorting. However, any files the system found before CANCEL was pressed are placed into the Hit List.

See also: Directory Sorting; Include Ops; Sorting Parameters; Include Sorting Parameters

Initialize Account:

Account operation that prepares an account for use in the system. ***All*** data currently on the data account will be lost during initialization. To retain the configurations currently residing on a data account, press F4 (SAVE CONF'S) before beginning the initialization.

See also: Save Config's; Data Cartridge; Account Ops; Appendix C, Default Test Configurations

Initializing: The act of preparing an account for use in your system. Initializing loads the default test configurations, the default film constants, and so on.

Introduction Screen:

This screen appears immediately after the software is loaded. The Introduction Screen includes the copyright notices, site license terms, patent numbers, trademarks and the software version number.

The Introduction Screen provides access to the main menus for test setup (Engineering Mode) and to folder selection for testing and analysis displays (Operations Mode).

The command boxes available in the Introduction Screen are

- FOLDER SELECT
- ACCOUNT SELECT
- TURN ON SYSTEM

- BATCH RECIPE
- STAGE UP/DN
- LOG ON SECS-II (Optional)
- SET UP

See also: Demo Mode; Stage Up/Dn

Jump To File: *See: Directory Status Information*

Linear Fitting: Refers to the following cubic equation applied to curve file data:

$$y = f(x) = a + bx + cx^2 + dx^3$$

You can toggle the equation between a log fit and linear fit by selecting the LOG/LINEAR FITTING command box in the Curve Fitting Screen.

Log Fitting: Refers to the following exponential equation applied to curve file data:

$$y = f(x) = 10(a + b(\log x) + c(\log x)^2 + d(\log x)^3)$$

You can toggle the equation between a log fit and linear fit by selecting the LOG LINEAR FITTING command box in the Curve Fitting Screen.

See also: Data cartridge

Lot ID: Text field in the Wafer Facts Index Card. Use LOT ID to enter the Lot ID of the wafer currently being tested. Maintain a logical and consistent Lot ID system. To edit this field, begin typing, and press Enter after entering your text.

See also: Wafer Facts

Lower ID: SECS-II parameter that specifies the Device ID. It specifies the identifier assigned to the equipment. Enter a value between 0 to 255. This value represents the least significant byte of a two-byte integer.

See also: Upper ID; Book of SEMI Standards, Vol. 2, Equipment Division; Standard E4

Main Dir: *See: Main Directory*

Main Directory:
An ITEM selection available from the DIRECTORY OPS MENU. The Main Directory Screen lists all collected data files in numerical order, regardless of the folder in which they are stored. Once displayed, you can *mark out* any files you do not want to appear in Operations Mode, or edit individual data values within selected files.

The boxes available in the main directory are

- DATA DISPLAY
- CHANGE STATUS
- TOGGLE DRCTRY

- PRINT
- MAIN MENU (a *return* function)

See also: Directory OPS; Directory Display; Directory Print

Main Menu: Command box located in various screens throughout the Engineering side of StatTrax. Pressing MAIN MENU prompts the system to display the Main Engineering Menu.

If you do not save your changes from the screen where you selected Main Menu, the system asks if you want to exit to the Main Engineering Menu without saving changes. To exit without saving, select YES. To save changes, select NO, and then press UPDATE.

See also: Main Menu Screen; Master Escape

Main Menu Screen:

Also referred to as the Engineering Menu or Main Engineering Menu. It provides access to all setup routines for the system and the test parameters used within it.

In the Main Menu Screen, choose from the Menu and Item column selections listed inTable 9-4.

Table 9-4: *Main Menu Screen's Menu and Item Selections*

Menu	Item
Directory OPS	Folder Directory
	Main Directory
	Directory Sorting
	File Transfer & Copy
Test Development	Test Setup
	Quick Test Patterns
	Correlation Curves
	Edit Probe Data
	Duplicate Tests
	Probe Conditioning
	Cont. Map Patterns
	Temp. Comp. Curves
	Batch Recipe Setup
Account OPS	Edit Account ID
	Initialize Account

Table 9-4: Main Menu Screen's Menu and Item Selections (Continued)

Menu	Item
	Backup/Delete Files
	Optimize/Delete Files
	Optimize/Delete Recovery
	Set Password
System Generation	Set Date & Time
	General System Data
	SECS-II Parameters
File Operations	Export Data
	Import Data
	ASCII Copy to Disk
	Export Recipe
	Import Recipe

See also: Master Escape; Password; Introduction Screen; individual Menu entries

Manual: *See: Sample Type*

Maps & Graphs:

Index card for setting viewing parameters for Contour Maps, 3D maps and Diameter Scans. Access it in either Operations or Engineering Modes. In Engineering Mode, select Test Results in the Card Index at the left of the screen inside Test Setup. In Operations Mode, follow this pathway:

1. From the Introduction Screen, choose FOLDER SELECT.
2. From the Folder Select Screen, choose FOLDER DIRECTORY.
3. Indicate the file you want to retrieve, and choose DATA DISPLAY.
4. Select FILE RETRIEVE.
5. From within the Test Results Card Index, select the Maps & Graphs Index Card.

   The card displays different text fields for each map type.

The Contour Mapping and 3D Maps & Graphs display parameters appear on the same card. They are

Contour Display

- Interval

3D Display

- Interval
- ABS Minimum
- ABS Mean
- ABS Maximum
- Rot Angle
- Tilt Angle

The fields in the Diameter Scan Maps & Graphs card are

Scan Display

- Interval
- Interval
- ABS Minimum
- ABS Mean
- ABS Maximum

See also: Card File Display; Card Index; Cards

Mark Out: The action of making a file invisible in Operations Mode by selecting CHANGE STATUS in Engineering Mode's Folder Directory Screen. *Marked-out* files in a directory appear dimmed, and the letters indicating the test types (M, S, Q, P or X Y) appear in lowercase both online and in directory printouts.

See also: Change Status

Master Escape: ESC key. It initiates the Master Escape Sequence. If the system is currently in Engineering Mode, you escape to the Main Menu Screen. If the system is currently in Operations Mode, you escape to the Folder Select Screen. After you press ESC, the system asks you to verify that you indeed want to move to the target screen. This is your last reminder to save changes.

If you have a map, graph or chart displayed, you cannot initiate the escape sequence. Select RETURN or FILE RETRIEVE, then press the ESC key.

See also: Return

Maximum Time:

The length of time the system can take to generate a TCR curve. The entered time must be between 15 and 6000 seconds. The default time is 180 seconds.

Mean Target: Text field in the Trend Scaling Index Card. Use this field to enter the target sheet resistance for the film being measured.

Mean Spec: Text field in the Trend Scaling Index Card. Use this text field to enter the specification limits for the film sheet resistance on the wafer being measured. Values that exceed these limits appear highlighted (bright green) in data displays, such as Contour Maps and the raw data display in Trend Charts. Enter these values as a number or as a percent.

Mean Warning:

Text field in the Trend Scaling Index Card. Use this text field to enter the Warning limits for the film sheet resistance on the wafer being measured. Values that exceed these limits appear highlighted (bright green) in data displays such as Contour Maps and in the raw data display in Trend Charts. Enter these values as a number or as a percent.

Measure Tolerance:

The maximum delta in temperature for the system to achieve in order to reach temperature stabilization (default = 0.01 degrees Celsius).

Measure Type:

Select Test Setup in the Card Index box to access the Measure Type Index Card. Enter values for the monitor wafer's current, voltage, current sample, probe data, and probe measurement configuration to right of the fields on this card.

The six fields on this card are

- SAMPLE TYPE
- AMPERAGE
- VOLTAGE
- PROBE ID
- PROBE SPACING
- CONFIGURATION

See also: Card File; Display Cards; Index Cards

Measured Temperature (Tm):

The wafer temperature (in degrees Celsius) the system measures and stores before and after the test. The average of the before and after temperature measurements is included in the ASCII output files.

Memos & Notes:

Index card used to communicate information between system users. To access Memos & Notes, select the Wafer Setup Index Card in the index at the left of the screen inside Test Setup. The Memos & Notes card has two named fields:

- TO OPERATOR
- TO SUPERVISOR

Each of these named fields gives you five lines for entering text.

See also: Card File Display; Card Index; Cards

Message Function:

Command box available from the SECS-II Operations Screen. Press this box to send a message of up to 236 characters to the host computer. When you press MESSAGE FUNCTION, a blinking cursor appears in the Message to Host area on the screen. Type in a message, and then press UPLOAD MESSAGE to send the message.

Naming Cabinets, Drawers, and Folders:

Text fields for naming cabinets, drawers, and folders in the Folder Select Screen. From the Main Engineering Menu, select TEST DEVELOPMENT MENU and TEST SETUP. Press F1 (FOLDER SELECT) to display the Folder Select Screen. You can select a text field in the CABINET, DRAWER, or FOLDER box, and enter up to 20 characters to identify the cabinet, drawer, or folder entry.

See also: Folder Select; Option

Normalized Display:

Text field available for 3D maps in the Maps & Graphs Index Card. Selecting this field entry sets the reference plane at the 3DABS MEAN value as you define, and plots the values between the limits 3D–ABS MINIMUM and 3D–ABS MAXIMUM. To select this entry, highlight the 3D–DISPLAY field and select TOGGLE ACTIVE until NORMALIZED DISPLAY appears.

See also: Absolute Display; Full Scale Display; 3D Display

Number Of Points:

The number of measurement points you want to include in the Temperature Compensation Curve. Values range from 2 to 25 measurements.

On line: Describes control by a central computing unit, such as during a manufacturing process.

Operations Mode:

The branch of StatTrax where you collect resistivity data and print wafer maps or plots. Collect data using the predefined test configurations created by the process engineer in Engineering Mode.

Operator: Text field available in the Wafer Facts Index Card. This is a general comment field that identifies the operator who performed data collection. To edit this field, select it, type in the desired text, and press Enter. Note that this field is not the same as *To Operator* in the Memos & Notes card.

See also: Wafer Facts

Option: There are two definitions for the term *option*. They are

- Command box in various Card File displays under Test Setup. Use it to toggle the selected text field to a different state. The different states define the information an operator must enter before working in Operations Mode. To toggle a text field, simply select the field, and select OPTION.
- Command box in the Folder Select Screen under Test Setup. Use it to enable or disable the selected drawer of folder entry when in Operations Mode. When disabled for Operations Mode, the entry appears in Engineering Mode as cyan text on a black background. In Operations Mode, that particular drawer or folder will not be visible and the cursor skips over the spot it would occupy if enabled. To enable or disable an entry, select it and select OPTION. The entry toggles to its opposite status.

See also: Folder Select for Test Setup; Option Prompt, Color codes

Page: Command box that appears on displays with more text fields in their data lists than can be shown at once. Pressing PAGE moves the display to the next set of items in the list.

Password: Once a password is assigned, it must be entered in order to access Engineering Mode for the selected account. To change the password from its default (pressing Enter), use the ACCOUNT OPERATIONS/SET PASSWORD option in the Main Engineering Menu.

If the logged-on account is password-protected, after you select MAIN MENU from the Introduction Screen, type in the password, and press Enter. Note that the system distinguishes between upper and lowercase letters.

See also: Set Up

Pattern Rotational Angle:
The angle (in absolute numbers from vertical) at which the tester selects test sites to measure for a Quick Test. This angle differs with different Quick Test patterns. Refer to the section "Quick Test Patterns (Polar Coordinates)" in Appendix B.

Pause: *See: Sample Type*

Plot Limits: Text field in the Trend Scaling Index Card from where you can select a y-axis scale from these possibilities:

- FULL SCALE
- SPEC SCALE
- USERDEFINED LIMITS

Polar Coordinate Map Tests:
Consist of Contour Maps, Diameter Scans, Quick Tests, and Qual Procedures. The following is a description of each test:

- Contour Map: A high-density test pattern consisting of concentric rings of measurement sites. See Appendix B.
- Diameter Scan: A linear scan across the wafer in a user-specified direction.
- Quick Test: Consists of up to thirty test sites, and has no graphical data output.
- Qual Procedure: Takes five measurements, each one-quarter degree apart, at four different sites on the wafer. The four sites are ninety degrees apart from one another.

Print: Command box for printing data on the screen. If you press CANCEL, the system stops sending data to the printer. (Because the printer has a large buffer, the printing might continue for a while after you press CANCEL.)

See also: Print Screen

Printout: Command box available from any index card in Engineering Mode. Pressing PRINTOUT prints a list of the current field values contained on the index cards.

Probe ID: General comment text field used to describe the probe with which the wafer data was collected. This field is cannot be sorted using the TEXT STRING sorting field from the Directory Sort Screen.

You can edit this field only when you are editing probe data, or when you are performing a Qualification Procedure. At all other times, the Probe ID is a locked field and cannot be edited.

- To edit this field, highlight the field, and type in the new Probe ID, and press Enter.
- Press OPTIONS to change the field's entry status as required for the test folder you are setting up.

Changing the entry status does not affect any test other than a Qualification Procedure.

See also: Measure Type; Edit Probe Data; Printout Format

Probe Spacing: Text field used to enter the distance between probe tips. This field is not used by the system's database. Therefore, it cannot be sorted using the TEXT STRING sorting field in the Directory Sort Screen. If you enter a probe spacing value that causes the probe to be too close to the edge of the wafer, a warning message appears on the screen during the test, informing you of this error.

You can enter the value in millimeters or inches. You do not need to enter the unit range next to the value. The system knows which units to use because there is no numeric overlap in the allowed unit ranges. The allowed unit ranges are:

- 0.001 inches to 0.099 inches
- 0.101 mm to 2.539 mm

You can edit this field only when you are editing probe data, or when you are performing a Qualification Procedure. At all other times, the Probe ID is a locked field and cannot be edited.

- To edit this field, highlight the field, type in the new Probe ID, and press Enter.
- Press OPTIONS to change the field's entry status as required for the test folder you are setting up.

Changing the entry status does not affect any test other than a Qualification Procedure.

See also: Measure Type

Process: There are two definitions for the term *process*. They are

- Text field used for general comments on the process by which the wafer was made. To edit the field, type in the desired text, and press Enter.

  See also: Wafer Facts

- Command box available in the Combine Data Screen. Selecting it initiates the selected combine operation, then displays a map and summary of the data.

Process Date: Text field in the Wafer Facts Index Card where you can enter the date when the wafer was processed by the production equipment. Edit this field using EDIT DATE or by typing in the correct date.

Take great care to enter the correct Process Date. If you do not enter a Process Date before saving the collected data, the system uses the Collection Date as the Process Date.

See also: Wafer Facts; Edit Date

Process Time: *See Process Date*

Process Upload:

Command box available in the SECS-II Operation Screen. Pressing PROCESS UPLOAD uploads test setups from StatTrax to a host computer.

Prometrix Staggered Patterns:

Quick Test pattern that offsets the inner ring of measurements from outer rings.

See also: Appendix B

Prometrix Standard Patterns:

Quick Test patterns that provide flexibility for defining a semi-custom pattern. With standard patterns, you can specify the number of sites (1, 3, 5, 6, 9 or 10), the test diameter, and the pattern rotational angle as desired.

See also: Appendix B

Quick Test: Text field available by pressing TOGGLE ACTIVE from the Test Type Index Card. Use it to select Quick Test Patterns for use during the wafer test.

See also: Test Type (card); File Summary; Toggle Active; Edit Active; Quick Test Patterns

Quick Test Patterns:

Function available in the Quick Test Setup Screen. Use it to select any of the 15 standard polar Quick Test patterns for wafer testing. You can also create up to 15 additional Quick Test patterns in polar or Cartesian coordinates.

The screen displays two columns of data: The left-hand column lists the Quick Tests; the right-hand column lists the measurement site coordinates corresponding to each test.

You can view only 15 Quick Tests at a time. To view the next set of 15, select the PAGE box and the application will toggle through the Quick Test names.

To change a Quick Test name, select the appropriate Quick Test name in the Quick Test column. Then enter the new Quick Test name.

The command boxes available in Quick Test Patterns are

- PAGE
- TOGGLE MODE
- UPDATE
- MAIN MENU (a RETURN function)

To create a Cartesian-coordinate Quick Test, select the second set of 15 fields, type in the Quick Test name, select the TOGGLE MODE box, then enter the coordinates in the X POS and Y POS fields.

You can have up to 30 measurement-site coordinates for each Quick Test. When the cursor is in the Values column you can select PAGE to toggle through these values. To change a Quick Test Value, select the Quick Test name in the Quick Test column. Then highlight the Values column and the coordinate value to be modified. Enter the new value as either a standard floating point number or in scientific notation. The Radial value is expressed as a fraction of the Test Diameter; the Theta value is in degrees of rotation. X and Y values are in millimeters.

See also: Radial Arm Movement; Rotary Stage Movement; Quick Test Patterns in Appendix B

Quick Test Printout:

A pair of options that tell the system whether to perform a form feed after printing Quick Test data or to print the next set of Quick Test data immediately after the previous printout. Located in the General System Data Screen, the two options are

- Form Feed Each Print
- Form Feed On Exiting

This option applies only to Quick Test printouts. All other printouts automatically form feed at the end of each printout.

Radial Arm Movement:

Action performed by the tester. Radial Arm movement is expressed as a Test Diameter with the center of the Test Diameter being at the Radial Arm Home position. The arm Home position has the probe positioned directly over the center of the Rotary Stage. During a test, the Radial Arm moves to the position which establishes the proper Test Diameter as dictated by the testing parameters you specify in Test Setup.

If the wafer is not centered on the Rotary Stage, the tester will not measure the correct area of the wafer.

See also: Rotary Stage Movement; Quick Test Patterns (in Appendix B)

Raw Corrected Data:

Raw data after the probe thickness correction factor and the temperature correction factor is applied.

Reset: There are two definitions for the term Reset.

- Key located on the tester's front panel that halts current tester operation.
- Function that occurs when you select TURN ON SYSTEM from the Introduction Screen, or during fatal system communications errors.

If the system is unable to reset the tester, a communications error occurs and the system goes to Demo Mode automatically.

See also: Turn On System; Demo Mode

Retry: SECS-II parameter that specifies the maximum number of times you can attempt to upload data to a host computer with SECS-II. Enter a whole number between 0 and 31.

See also: Book of SEMI Standards, Vol. 2, Equipment Division; Standard E4

Return: Generic command box, always appearing in position F8. Use to return to the previous screen or function. While the text displayed in position F8 might differ, its function always remains the same.

See also: Master Escape

Rotation: Text field used when setting up Diameter Scans and Quick Tests to select the amount that the stage rotates (clockwise from home position) to reorient the wafer during a test. Enter values between 0 and 360 (in 1° increments), and press Enter.

When you set a Diameter Scan Rotation and enter a multiple of 45, a message appears to clarify the scan direction. For example, 45° is top right to bottom left.

See also: Test Type (card)

Sample Type: Text field in the Measure Type Index Card which determines measurement current for a test wafer of a given sheet resistance. From the Measure Type Index Card, press TOGGLE ACTIVE box to choose one of the following routines in the SAMPLE TYPE field (Table 9-5)

Table 9-5: *Routines in the Sample Type Field*

Routine	Description
AUTO RANGE – AUTO RUN	Before the measurement sequence begins, the probe contacts the wafer and the system automatically searches the full current range, beginning with the value in the AMPERAGE field, until it finds a current that results in a voltage drop equal to the target voltage in the VOLTAGE field. The system then replaces the value in the AMPERAGE field with this new value and immediately begins the measurement (AUTO RUN). The system will continue to use this new current for subsequent test sites on the wafer until you start another test. AUTO RANGE – AUTO RUN is the quickest and most common method of current selection used in a production environment.
MANUAL – PAUSE	MANUAL – PAUSE enables you to enter a specific test current for a given wafer. Before the measurement sequence begins, the probe contacts the wafer and uses the current you enter to determine the resulting voltage given the wafer's actual sheet resistance. You can then enter a different current in the AMPERAGE field in the Measure Type Index Card before initiating the wafer measurement.

Table 9-5: Routines in the Sample Type Field

Routine	Description
MANUAL – AUTO RUN	MANUAL – AUTO RUN enables you to input a specific test current for a given wafer. Before the measurement sequence begins, the probe contacts the wafer and uses the current you enter later to determine the resulting voltage given the wafer's actual sheet resistance. The system steps then begins the measurement sequence without pause (Auto Run).
AUTO RANGE AND PAUSE	Before the measurement sequence begins, the probe contacts the wafer and the system automatically searches the full current range. The system begins searching the value beginning with the value in the AMPERAGE field, until it finds a current that results in a voltage drop equal to the target voltage in the VOLTAGE field. The system then replaces the value in the AMPERAGE field with this new value and displays the Measure Type Index Card so you can see the result, and you can then enter a different current before initiating the wafer measurement. Once you have made a selection, use the OPTION box to set the Operations Mode entry status for this field.

Save Conf's: Command box available from the Account Initialization Screen. Press SAVE CONF'S to transfer your test setups from the source account to the target account. This is useful, for example, if your data cartridge account is full and you need to begin a new data cartridge using the same test setups.

See also: Initialize Account

Screen Saver: A rolling display that prevents image burn-in when the system is left on and unused for extended periods of time. Specify in minutes how long after the last keystroke the screen displays the screen saver. When the screen saver appears, the tester stage lowers, and the door closes. Enter any value between 1 and 99999. Default = 15. To exit the screen saver, press any key.

SECS- II Parameters:

Data transmission settings available under System Generation. These parameters available for modification and their default values are

- T1 1.0
- T2 1.0
- T3 45
- T4 45
- RETRY 1
- BAUD RATE 9600

- UPPER ID 0
- LOWER ID 0
- EOC MSG YES

You can change these parameters at any time from the Enhanced SECS-II Parameters Screen).

Select: Command box that activates the currently highlighted function or item. For instance, in the Main Menu Screen, the Select command activates the function that you have highlighted. In the Folder Select Screen, the Select command calls up a folder for use within the current function.

Select File: Command box used within the Folder Directory to flag an entry. For example, when inside File Transfer & Copy, SELECT FILE selects the file(s) to be copied.

Select Point: Command box available in the Curve Fitting Screen. Use this command to display the coordinates of the selected point in a curve file. Choose a point on the curve by selecting the point on the screen, by moving the cursor with the Arrow, PgUp, and PgDn keys, or by using the corresponding directional boxes on the screen. Then choose SELECT POINT.

Selected points are printed in the curve plot printout and appear on the plot curve as small green squares.

Select Process: Command box available in the Combine Data Screen. Use this command box to view a list of arithmetic expressions so you can select the desired combine operation rapidly.

Set Date & Time:
Feature under the System Generation Menu that enables you to set the system-level date and time. It is *very* important that the system date and time are entered correctly, because many special StatTrax features depend upon them.

See also: Edit Date; Edit Time

Set Password: Item in the Account Ops Menu. Use this operation to assign the password for a currently logged-in account. If you incorrectly identify the current password or incorrectly verify the new password, the system moves you back to the Main Engineering Menu without changing the current password.

Set Up: Command box appearing in the Introduction Screen as the entry point into Engineering Mode. After selecting this box, you must enter the appropriate password (if one has been assigned). The monitor then displays the Main Engineering Menu. From the Main Engineering Menu, you can move back and forth between Engineering Mode (by choosing SELECT) and Operations Mode (by choosing FOLDER SELECT), thus bypassing the Introduction Screen.

See also: Password

Shift: Text field used as a general comment field to describe the work shift when the wafer data was collected. Type in the appropriate information, and press the Enter key.

See also: Wafer Facts

Site Count: The Site Count is the number of test sites that were collected on the wafer.

See also: Sorting Parameter; Test Sites

Slope: The change in sheet resistance divided by the change in temperature.

Sorting: *See: Directory Sorting*

Sorting Sigma:

Text field appearing in the Test Type Index Card where you select the test site values to be included in calculations and data displays. Select these sites by entering a sorting sigma value between 0.10 and 100.00, and pressing Enter. One sorting sigma equals one standard deviation from the wafer mean. Tencor recommends the value of 3.0, because it includes 99.7% of all data points. Any test site with a value outside these limits is excluded from the calculations; on a map, such a site is identified by an asterisk (*), and appears highlighted in the raw data display.

See also: Test Type (card)

Sorting Status Information:

Seven status lines available in the Directory Sorting Screen. Three lines, located on the left side of the screen directly above the command boxes, give information about the number of files in the Main Directory, Subdirectory, and Hit List. The status lines for these directories give the total number of files currently in the directories, including *marked-out* files.

Another four lines, located on the right of the screen, directly above the command boxes, give information on the sorting process. The group of four status lines to the right of the display provide dynamic and summary information on the sorting process currently being run:

Files To Search	The total number of files selected for the sort process. This could be files from the Main Directory, the Subdirectory or the Hit List.
Files Searched	The number of files sorted through thus far.
Found Thus Far	The number of files found thus far that meet the sorting criterion.
Total # Found	The total number of files found in the sort process that meet the sorting criterion.

See also: Directory Sorting

Sort Sigma: *See: Sorting Sigma*

Sorting Parameters:

Eleven parameter fields available from the Directory Sorting Screen used in the sorting process. Six of the eleven fields require you to enter a range of values. Each range is inclusive. For example, if you enter 372 to 440 in the FOLDER ID parameter, all files in folders 372 and 440 as well as those in between are matched during the sort.

The parameters available are

- FOLDER ID
- PROCESS DATES
- COLLECTION DATES
- FILE NUMBERS
- MEAN RANGE
- STDV RANGE
- TEST TYPE
- SITE COUNT
- LOT ID
- WAFER ID
- TEXT STRING

The TEXT STRING parameter sorts through all seven text fields (more slowly than other sort routines), so we recommend that you perform all other sorts prior to a text string sort. Type in an alphanumeric string of no more than 20 characters.

See also: Directory Sorting; Sorting Process

Source: Command box available in the Folder Select Screen under Duplicate Tests. Use it to select a cabinet, drawer, or folder as your template when copying tests. Select only one source at a time. When you select a source cabinet from the Folder Select Screen, the nine drawers associated with that cabinet become a group template for all subsequent cabinet-to-cabinet copy operations. To deselect a source, position the cursor at the currently selected source, and press SOURCE again.

Targets for the copy operation can only be selected from the same level at which the source was selected: cabinet to cabinet, drawer to drawer, or folder to folder.

See also: Duplicate Tests; Target

Source Cassette: Storage device that holds unmeasured wafers for the handler. If you are measuring a single cassette of wafers, you must place the cassette in the shoeplate on the right side.

Stage: *See: Rotary Stage Movement*

Stage Up/Dn: Command boxes available from the Introduction Screen used to move the wafer stage up or down. Changing the stage position from the Introduction Screen does not affect system operation. For example, when the screen saver appears, the stage automatically lowers even if STAGE UP is displayed from the Introduction Screen.

See also: Screen Saver

Status 1: Text field used for general commentary about the state of the system at the time of testing. This field can be sorted using the Text String sorting field from the Directory Sorting Screen.

See also: Wafer Facts

Status 2: Text field used for comments describing the state of the system at the time of the test. To enter a comment, type the desired text, and press Enter.

See also: Wafer Facts

Sub Directory: A list of data files generated by performing sorting procedures in DIRECTORY SORTING. All of the command boxes available while in the Subdirectory are also available in the Main Directory.

- DATA DISPLAY
- CHANGE STATUS
- TOGGLE DRCTRY
- PRINT
- DRCTRY SORTING

To find a specific file, enter the file number. If the file is in that directory, the file appears highlighted.

See also: Directory Ops; Directory Display; Directory Print; Main Directory

System Generation:
The SYSTEM GENERATION MENU contains ITEM selections used to configure the fundamental computer system parameters. The routines available from this menu selection are

- SET DATE & TIME
- GENERAL SYSTEM DATA
- SECS-II PARAMETERS

See also: General System Data; Main Menu

System Lines 1–3:
Text field with three lines, each of which can contain up to 20 characters. Use these lines to identify the test system.

System lines 1–3 appear at the top of every printout produced by the system. These system lines are part of the main system and do not identify your disks.

T1: SECS-II parameter where you specify the Inter-character Timeout. It detects an interruption between characters during transmission. The valid range for this parameter is 0.1 to 10.0 (seconds) with a resolution of 0.1.

See also: Book of SEMI Standards, Vol. 2, Equipment Division; Standard E4

T2: SECS-II parameter where you specify the Protocol Timeout. T2 detects the lack of protocol response. Its valid range is 0.2 to 25.0 with a resolution of 0.2 second.

See also: Book of SEMI Standards, Vol. 2, Equipment Division; Standard E4

T3: SECS-II parameter where you specify the Reply Timeout. T3 detects the lack of a reply message. The valid range for this parameter is 1 to 120 with a resolution of 1 second.

See also: Book of SEMI Standards, Vol. 2, Equipment Division; Standard E4

T4: SECS-II parameter where you specify the Inter-Block Timeout. T4 detects an interruption in a multi-block message. This parameter can range from 1 to 120 with a resolution of 1 second.

See also: Book of SEMI Standards, Vol. 2, Equipment Division; Standard E4

Target: Command box available in the Folder Select Screen after you select the DUPLICATE TESTS ITEM selection (from the Main Engineering Menu). Target is the expected measurement value (Mean Target) used with warning and spec limits. Use it to select a cabinet, drawer, or folder as your target when copying tests. You can select more than one target folder or drawer at one time. If you copy one drawer to another drawer, the folders within the source are also copied. To deselect a target, select it and press TARGET.

Targets for the copy operation can only be selected from the level at which the source was selected: drawer-drawer or folder-folder. The Source *must* be selected before any Targets can be selected.

See also: Duplicate Tests; Source

Temperature Correction Factor (TCF):
1-TCR*(Tm-Tt)

Temperature Coefficient of Resistance (TCR):
The temperature coefficient (per degrees Celsius). TCR = $[(R_s1-R_s2) / (T1-T2)] / R_s(23)$= SLOPE/$R_s(23)$. This is determined from a linear fit of R_s vs., T (Temperature Compensation Curve). This is actually the linear temperature coefficient, sometimes referred to as Ct.

Test Development:
The TEST DEVELOPMENT MENU contains ITEM selections that enable you to work with a wafer testing folder. The ITEM selections are

- TEST SETUP
- QUICK TEST PATTERNS
- CORRELATION
- EDIT PROBE DATA
- DUPLICATE TESTS
- PROBE CONDITIONING
- CONT. MAP PATTERNS

- TEMP. COMP. CURVES
- BATCH RECIPE SETUP

Test Diam: Text field used to select the test diameter within which the selected test pattern applies.

Enter the test diameter in millimeters or inches. You need not specify units, as the system knows which units to use. The ranges are

0.01 inches to 8.00 inches

or

8.1 mm to 200.00 mm

To enter a value, highlight a field, type the value and press Enter.

After you select a Test Diameter and then press either UPDATE or LOAD WFR, the system checks the Wafer Diameter against the Test Diameter and displays a warning message if the Test Diameter is too close to the Wafer Diameter. For some Quick Test types, changing the Wafer Diameter automatically changes the Test Diameter.

Test diameter does not apply to Qual Procedure because the system takes all measurements in the center of the wafer.

See also: Test Type (card)

Test Results: Card Index. Three index cards are associated with this Card Index entry

- File Summary
- Data Summary
- Maps & Graphs

In general, the information contained on these three cards is used for summarizing data or file information in numeric or graphic format.

See also: Card File Display; Card Index; Cards

Test Setup: ITEM selection from the TEST DEVELOPMENT MENU where you set up test parameters.

Test Setup (Card Index):
This card category contains two cards: Test Type and Measure Type. In general, use these cards to set up parameters that define how the tester measures wafers. These parameters include the type of test, the number of sites, the test diameter, and so on.

See also: Card File Display; Card Index; Cards; Test Type

Test Sites: Text field located in the File Summary Index Card. Use it to select the number of sites to be examined during data collection.

Five different test types are available

- Contour Mapping
- Diameter Scan
- Quick Test

- Qual Procedure
- Pattern Testing

The number of test sites used for standard Contour Maps and Diameter Scans is fixed at one of the following

- 49 sites
- 81 sites
- 121 sites
- 225 sites
- 361 sites
- 441 sites
- 625 sites

For Quick Tests, the number of test sites can vary from 1 to 30 depending on which Quick Test you select. To edit Quick Test patterns select EDIT ACTIVE. When you select a Quick Test, the Test Sites field automatically adjusts.

For the Qual Procedure, the number of test sites is fixed at 20 and cannot be changed.

For patterned wafer tests, a maximum of 1264 sites can be selected.

To edit the Test Sites field, (for tests *other* than Qual Procedure) use the TOGGLE ACTIVE box to cycle through the selections.

See also: Test Type (card); Toggle Active; Edit Active

Test Type (card):

Index card containing parameter fields used to enter values that define the fundamental test definitions for wafer testing. Each of the five test types has a different format for the Test Type Index Card.

The fields on the Contour Mapping's Test Type Card are

- TEST TYPE
- TEST SITES
- WAFER DIAM
- TEST DIAM
- SORTING SIGMA
- MAP PATTERN
- TEMPLATE MAP
- AUTO SAVE
- CORRELATION
- UNITS

The fields on the Diameter Scan's Test Type Card are

- TEST TYPE
- TEST SITES
- WAFER DIAM
- TEST DIAM
- SORTING SIGMA
- ROTATION
- AUTO SAVE
- CORRELATION
- UNITS

The fields on the Quick Test's Test Type Card are

- TEST TYPE
- TEST SITES
- WAFER DIAM
- TEST DIAM
- SORTING SIGMA
- QUICK TEST
- ROTATION
- AUTO SAVE
- CORRELATION
- UNITS

The fields on the Qual Procedure's Test Type Card are

- TEST TYPE
- TEST SITES
- WAFER DIAM
- TEST DIAM
- SORTING SIGMA
- AUTO SAVE
- CORRELATION
- UNITS

The fields on the Pattern Testing's Test Type Card are

- TEST TYPE
- MODE
- WAFER DIAMETER

- STEP SIZE
- PATTERN
- FLAT ORIENTATION
- SORTING SIGMA
- AUTO SAVE
- CORRELATION
- UNITS

See also: Card File Display; Card Index; Cards

Test Type (field):
This text field, which appears in the Test Type Index Card, is used to select the type of test to be performed on the wafer. Five different test types are available

- Contour Mapping (M)
- Diameter Scan (S)
- Quick Test (Q)
- Qual Procedure(P)
- Pattern Testing XY)

To edit this field, select TOGGLE ACTIVE to cycle through the five selections. The other fields on the Test Type Card also change as you cycle through Test Type.

Rotary Stage Movement:
Action expressed as degrees of rotation in a clockwise direction originating at the stage Home position. Stage Home positions the stage's tweezer slot at the front of the tester. (Moving the stage clockwise is functionally the same as moving the radial arm, and therefore the probe, counter-clockwise around the wafer.)

See also: Radial Arm Movement; Appendix B

Source Cassette:
Storage device that holds unmeasured wafers for the handler. If you are measuring a single cassette of wafers, you must place the cassette in the shoeplate on the right side.

Time Entry: *See: Edit Time*

Tip Space: The Tip Space is the distance between the probe tips on the four-point probe. The tip space value may be entered in inches or millimeters within the following ranges:

- 0.001 to 0.100 inches
- 0.025 to 2.54 mm

The tip spacing affects the reporting of the Test Diameter/Wafer Diameter proximity warning message.

See also: Edit Probe Data

Toggle Active: Command box. This box indicates that you can cycle through two or more selections in the currently highlighted field by pressing F4 (TOGGLE ACTIVE).

See also: Edit Active

Toggle Drctry: Command box used to cycle through the three types of directory line displays

- Title Line
- Lot/Wafer ID Line
- Statistics Line

These lines are available

- in the Main Directory Screen
- under File Transfer & Copy
- under Data Combining
- in the Trend Chart Screen

When in a Trend Chart, you can also choose to display

- Mean of Means
- Std Dev of Means
- # of Samples

As the directory lines change, the directory line headers also change, showing the position and meaning of the information contained in the directory lines.

See also: Directory Ops; Directory Display; Directory Line Headers

Toggle Length: Command box. Available for diameter scans, this box lets you view and print a Diameter Scan over one, two, or three pages. Selecting this box toggles the length of the scan from 1X to 2X and through 3X, then back again to 1X.

Toggle Process:

Command box located under data combining. Use it to cycle through the following combine operations:

ADD CONSTANT

AVERAGE

DIFFERENCE

DIVIDE BY CONSTANT

FILE REVIEW

INVERSE

LOG10

LOGE

MULTIPLY

MULTIPLY BY CONSTANT

NORMALIZE DIFFERENCE

PARALLEL ADD

PARALLEL SUBTRACT

RATIO

REFERENCE AVERAGE

Select the desired operation by cycling to the operation and pressing SELECT.

Toggle X (Y) Axis:
Command boxes located under Curve Fitting. Select these boxes to toggle the axes in a curve file plot.

To Operator: Text field located in the Wafer Facts Index Card used to communicate information to system operators. Use the four subsequent lines for more text.

To edit this field, type in the desired text, and press Enter.

See also: Memos & Notes

To Supervisor:
Text field located in the Wafer Facts Index Card used to communicate information to system supervisors. Use the same as the TO OPERATOR field.

See also: Memos & Notes; To Operator

Total Files: *See: Directory Status Information*

Trend Charts: There are two definitions for Trend Charts.

- Card Index entry at the left of the screen with these two associated Index Cards:

  - Trend Setup Index Card

  - Trend Scaling Index Card

  Use the information contained on these two cards for setting up the parameters that define the type of Trend Chart, the limits data and other values used to format the Trend display. Use some for value checking and error/warning messages after data collection.

  See also: Card File Display; Card Index; Cards

- Charts that enable you to view the means and standard deviations of several wafers arranged in a specified chronological sequence.

Trend Hit List: Command box that displays the trend of all files currently in the Hit List Directory. This is not a standard Trend Chart function. Therefore, not all of the formatting features of the standard Trend Chart are available from this Trend Chart.

See also: Directory Sorting; Display Ops

Trend Scaling: Index card. Enter values in the first three fields that describe the format of Trend Charts associated with the selected folder. Use text fields five through eight to define the Mean and STDV Target/Warning/Spec limits.

The eight fields on this card are

- PLOT LIMITS
- - MIN
- - MAX
- MEAN TARGET
- - WARNING
- - SPEC
- STDV WARNING
- - SPEC

See also: Card File Display; Card Index; Cards

Trend Setup: Index card that contains text fields where you enter values that describe the format for Trend Charts associated with the selected folder.

The seven fields on this card are

- PLOT
- SIGMA BRACKET
- SEQUENCED BY
- USING
- - N EQUALS
- - END DATE
- DATA PTS. ARE

See also: Card File Display; Card Index; Cards

Turn On System:
Command box, in the Introduction Screen, used to initiate a reset of the tester. TURN ON SYSTEM is displayed whenever the system is in Demo Mode. When the system tester is active, this box changes to DEMO MODE.

See also: Demo Mode; Reset

Units: Text field that displays the units associated with the selected Correlation field. Edit this field from within Correlation Curves.

See also: Test Type (card)

Update: Command box present on many screens. Use it as a save function. If you exit a screen without selecting UPDATE, the system asks if you want to exit the current routine without saving changes. To save changes, select NO, and press UPDATE. If you select YES, all changes entered since the last update will become lost.

Upper Id: SECS-II parameter that specifies the Device ID. That is, it specifies the identifier assigned to the equipment. The valid range of values for this parameter is 0 to 127. This value represents the most significant byte of a two-byte integer.

See also: Lower ID; Book of SEMI Standards, Vol. 2, Equipment Division; Standard E4

User-defined Limits:
A y-axis scale in the Plot Limits field inside the Trend Scaling Index Card. Select these limits by highlighting PLOT LIMITS and selecting TOGGLE ACTIVE until USER DEFINED LIMITS appears. Use this selection to plot the selected files about the average of the limits entered in the fields below PLOT LIMITS in the Trend Scaling Index Card.

See also: Plot Limits; Full Scale; Spec. Scale

View Hit List: Command box available from the Directory Sorting Screen displaying all files currently in the ***Hit List***.

See also: Directory Display; Hit List Directory; Directory Sorting

View Main Dir:
Command box available from the Directory Sorting Screen. Use it to display all files currently in the Main Directory.

See also: Directory Display; Main Directory; Directory Sorting

View Sub Dir: Command box available from the Directory Sorting Screen. Displays files currently in the Subdirectory.

See also: Directory Display; Sub Directory; Directory Sorting

Voltage: Text field available in the Measure Type Index Card. In this field, enter the voltage value you want to be your target voltage when the Auto Range function is selected. After the current sample is collected and the test is run, the VOLTAGE field reports the voltage value generated by the selected amperage value.

Enter the value in millivolts (mV). You need not specify units. The field accepts any value within the range of 0.01 mV to 999.9 mV

To edit this field, highlight the field, enter your new value, and press Enter.

See also: Measure Type

Wafer Diam: Text field on the Test Type Index Card is used to select the diameter of the wafer to be tested. Eight different wafer diameters are available:

- 50.80 mm / 2.00 in
- 57.15 mm / 2.25 in
- 76.20 mm / 3.00 in

- 82.55 mm / 3.25 in
- 100.0 mm / 3.94 in
- 125.0 mm / 4.92 in
- 150.0 mm / 5.91 in
- 200.0 mm / 7.87 in

To edit this field, use the TOGGLE ACTIVE box to cycle through the eight selections.

Once the Wafer Diameter is selected and the UPDATE or LOAD WFR function is selected, the application will check the entered Wafer Diameter against the entered Test Diameter and display an appropriate warning or error message if the Test Diameter is too close to the Wafer Diameter.

For some Quick Test types, changing the Wafer Diameter will automatically change the Test Diameter.

See also: Test Type (card); Toggle Active

Wafer Diameter:
Text field in the Wafer Handler Index Card which is exactly the same as WAFER DIAM in the Test Type Index Card.

See also: Wafer Diam

Wafer Facts: Index card in the Wafer Setup Card Index. It contains text fields used to uniquely identify each file of wafer data. The TITLE field can be edited from any card.

The following fields are associated with the Wafer Facts Index Card:

- WAFER ID
- LOT ID
- PROCESS DATE
- PROCESS TIME
- OPERATOR
- PROCESS
- EQUIPMENT
- SHIFT
- STATUS 1
- STATUS 2

See also: Card File Display; Card Index; Cards

Wafer Handler:
Optional system component that automatically transfers wafers from a cassette to the tester, and back again. It also performs flat-notch alignment and centering. To place your online, select HANDLER MENU from the Introduction Screen. To have your system recognize the wafer handler, select WAFER HANDLER in the General System Data Screen.

Wafer Id: Text field available in the Wafer Facts Index Card and various other screens throughout StatTrax. Enter the Wafer ID in the Wafer Facts Index Card. Take care to use a logical and consistent method of specifying Wafer IDs. To edit this field, type the desired text and press Enter.

See also: Wafer Facts

Wafer Setup: Card Index containing the following index cards:

- Wafer Facts
- Memos & Notes
- Wafer Handler

The information contained on the first two cards is used for identification, comments, and messages. The Wafer Handler Index Card is used for setting up the wafer handler. It appears only when the wafer handler is set for operations under the General System Data Item selection in the System Generation Menu.

See also: Card File Display; Card Index; Cards

A SHEET RESISTANCE MEASUREMENT THEORY

Appendix A
Sheet Resistance Measurement Theory

A Tool for Sheet Resistance Measurement

To achieve maximum control over the many process steps involved in semiconductor processing, the engineer must be able to evaluate the performance of the mask aligners, etching systems, ion implanters and other process equipment used in wafer fabrication.

For many process steps, it is possible to evaluate equipment performance by using monitor wafers. These wafers can offer the process engineer valuable information about the factors that might contribute to process variability.

The OmniMap® RS55/tc is designed to provide all hardware and software required for the rapid collection, analysis and presentation of sheet resistance data from monitor wafers. Two-dimensional contour maps such as that shown in Figure A-1 are used to represent non-uniformities that can occur because of the design or operation of processing equipment. But to understand the usefulness of the RS55/tc system, it is important to understand the usefulness of sheet resistance measurements in general, as well as techniques for measuring sheet resistance.

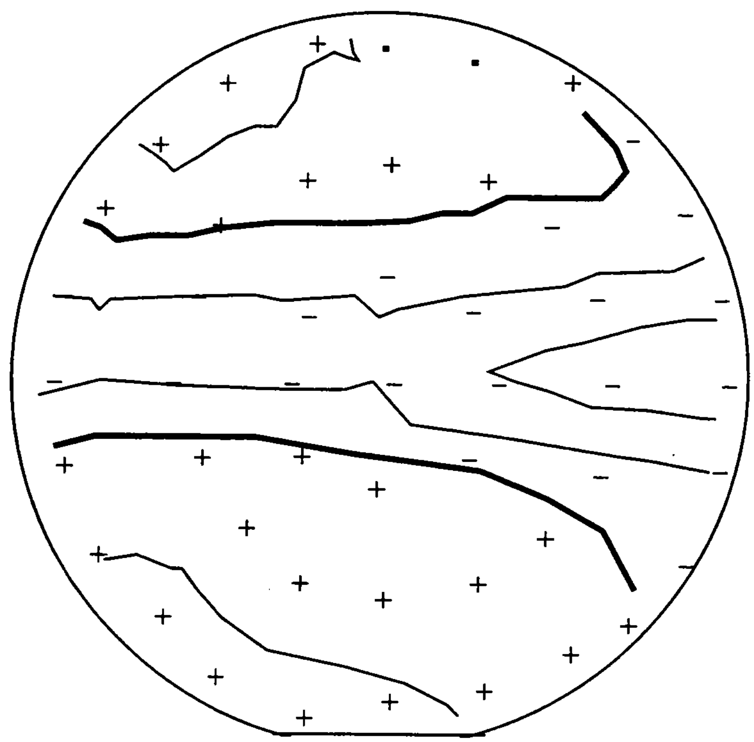

Figure A-1: Contour Map

Appendix A
Sheet Resistance Measurement Theory

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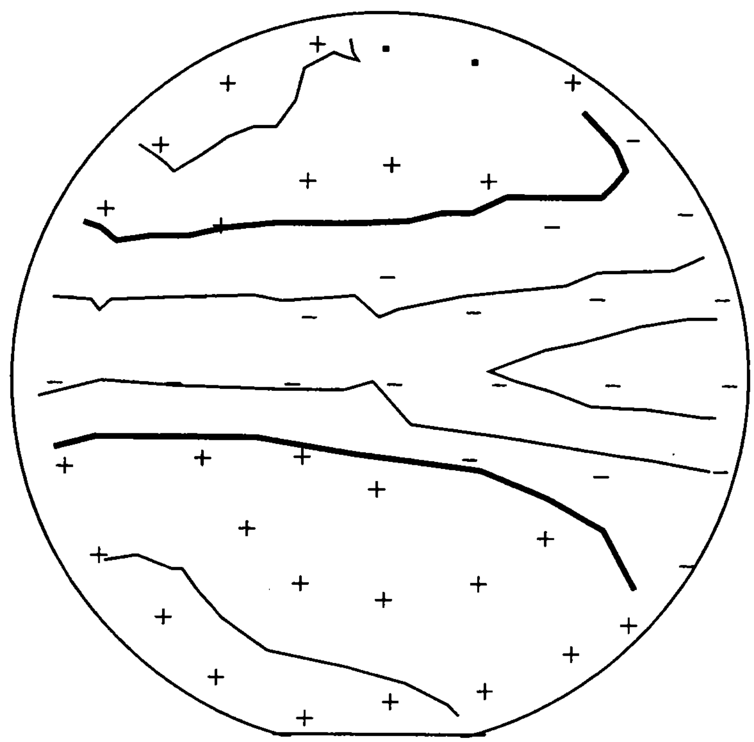

Figure A-1: Contour Map

Why Sheet Resistance Measurements Provide Useful Information

Resistivity, ρ, is a measure of the inability of a film to support the conduction of electrical carriers. In a metal layer, these carriers are electrons. For semiconductor layers, these carriers can be electrons (n-type material) or holes (p-type material). Resistivity, whose units are ohm-centimeters (Ω-cm), is a bulk property of the material. It is a function of the carrier concentration, ***n***, and the carrier mobility, μ, as expressed in the equation

$$\rho = \frac{1}{ne\mu} \tag{A.1}$$

where ***e*** is the electronic charge.

When characterizing thin films, it is useful to introduce the concept of resistance per unit area, or *sheet resistance*. The sheet resistance R_s of a homogeneous layer is defined as

$$R_s = \frac{\rho}{t} \tag{A.2}$$

where ***t*** is the thickness of the layer. For example, a 2- micron thick epitaxial layer for which $\rho = 0.1$ Ω-cm has a sheet resistance of $Rs = 0.1$ Ω-cm / 2×10^{-4} cm, or 500 Ω/sq.

Resistance, ***R***, is defined as

$$R = \rho(l/A) \tag{A.3}$$

where the cross-sectional area $A = t \cdot w$ (see Figure A-2). Therefore $R = \rho\left(\frac{l}{t \cdot w}\right)$*

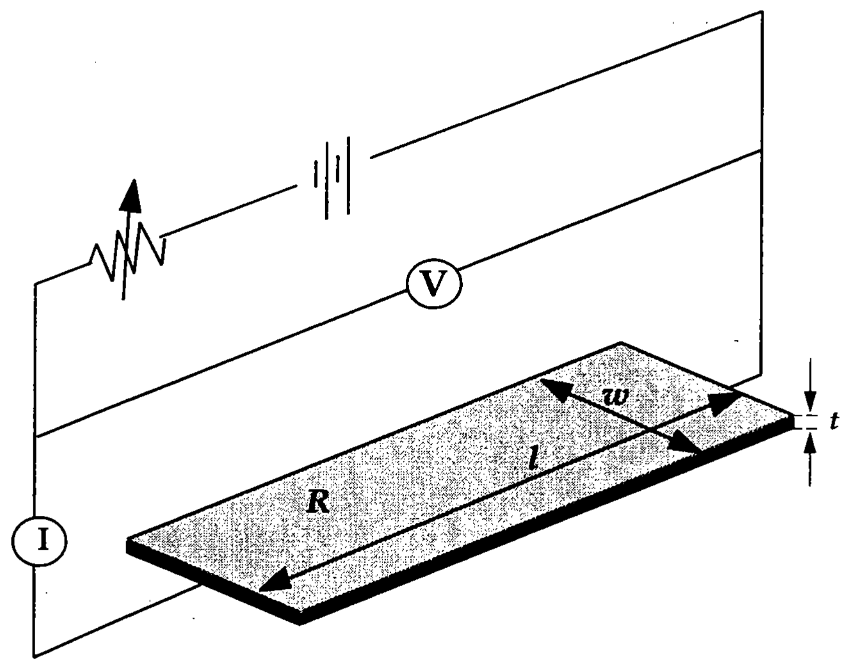

Figure A-2: Measuring the Resistance of a Rectangular Bar

* If we set $l = w$ (for a square of thickness t) we get $R = \frac{\rho}{t}$. This ***R*** is actually sheet resistance R_s (see A.2) with units Ω/square.

Using Ohm's Law (V=IR), we can write A.3 as

$$R = \frac{V}{I} = \rho\left(\frac{l}{A}\right) \tag{A.4}$$

and substituting for ρ (see equation A.2), we get

$$\frac{V}{I} = R_s \cdot t\left(\frac{l}{A}\right)$$

$$\frac{V}{I} = R_s \cdot t\left(\frac{l}{t \cdot w}\right) \tag{A.5}$$

therefore

$$R = \frac{V}{I} = R_s\left(\frac{l}{w}\right) \tag{A.6}$$

Thus, a rectangular bar for which $R_s = 100\ \Omega$/sq., $l = 100$ mm and $w = 10$ mm, has a resistance (R) of 1000 Ω

In most semiconductor applications, the carrier concentration, and therefore the resistivity, varies as a function of the depth z below the surface of the layer; that is,

$$\rho(z) = \frac{1}{n(z) \cdot e \cdot \mu(n)} \tag{A.7}$$

where the mobility μ is also a function of the carrier concentration ***n***. See Figure A-3.

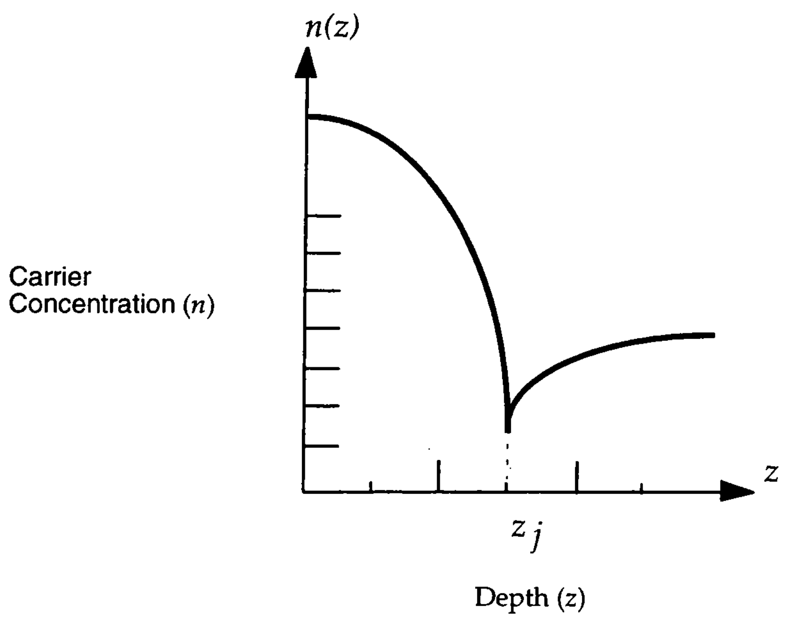

Figure A-3: *Carrier Concentration as a Function of Junction Depth*

Thus, the measured sheet resistance is a weighted average given by the equation

$$R_s = \frac{1}{\int^{t} n(z)\; e\; \mu(n)\, dz} \tag{A.8}$$

where the integration is performed over the full thickness of the film. For the case of a p-n junction isolated layer, the thickness t is equal to the junction depth z_j.

The sheet resistance of the conducting layers employed in semiconductor processing varies over a range of about 0.02 Ω/sq. (as with aluminum) to 1,000,000 Ω/sq (as with threshold adjust implants in MOS applications).

Sheet resistance measurements are routinely employed in semiconductor manufacturing facilities because of the accuracy, repeatability, and relatively low cost of the measurement equipment. In the case of semiconductor layers, they are frequently supplemented by various depth profiling techniques such as Secondary Ion Mass Spectroscopy (SIMS), spreading resistance measurements on beveled samples, and, for lightly doped layers, capacitance voltage techniques.

Techniques for Measuring Sheet Resistance

One of two test techniques are generally employed for characterizing sheet resistance—***van der Pauw*** resistor structures, which are designed to confine the measurement current within a limited region, and the four-point probe, which is used on large-area or unpatterned samples.

Using van der Pauw Structures to Characterize Sheet Resistance

Microelectronic resistor structures must be designed in such a way that the determination of sheet resistance is not influenced by the dimensions of the structure. This objective is accomplished by employing a long, rectangular structure whose width w is much greater than any anticipated dimensional variations (Figure A-2). Then (from equation A.6),

$$R_s = \left(\frac{w}{l}\right)R$$

However, it is preferable to use a test structure that is totally independent of geometric effects.

The van der Pauw sheet resistor is a geometry-independent test structure commonly used in semiconductor process characterization. It involves the use of paired resistance values, ***R1*** and ***R2***, to eliminate the need for any specific knowledge of the pattern dimensions. Separate taps are used to force current and measure voltage drop in order to eliminate resistive losses from the current. For a nominally symmetric van der Pauw structure,

$$R_s = \left(\frac{\pi}{ln 2}\right)\left(\frac{R1 + R2}{2}\right)$$

$$= 4.532\left(\frac{R1 + R2}{2}\right)$$

where $R1 = V_1/I$ and $R2 = V_2/I$.

A typical geometry used for obtaining van der Pauw sheet resistance measurements is shown in Figure A-4.

When measuring very shallow or lightly doped layers, it might be necessary to employ heavily doped regions to carry current from the probe pads to the resistor structure. Moreover, if contact metallization is also used, there might be a significant time delay before the structures can be measured. For these reasons, the four-point probe is often an attractive alternative for obtaining sheet resistance data.

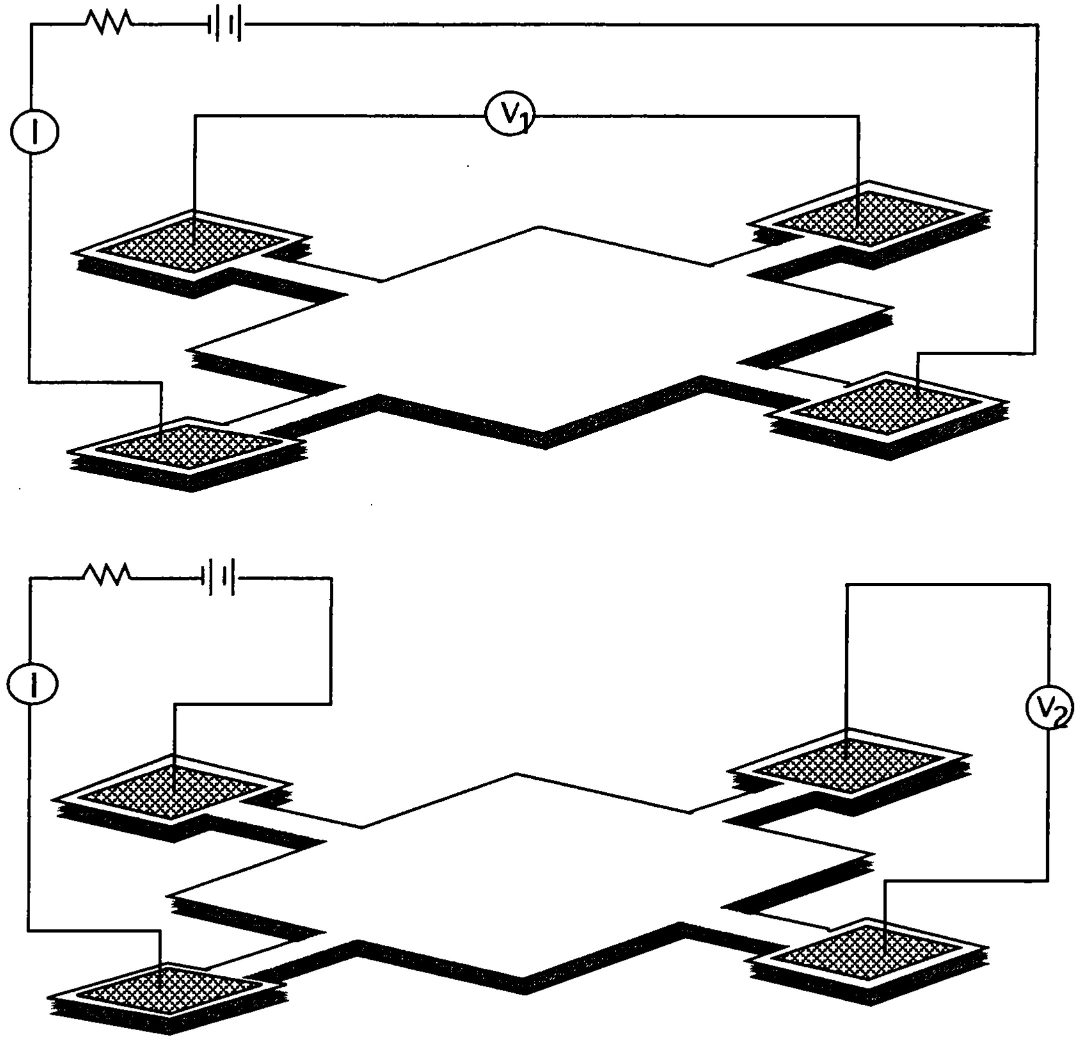

Figure A-4: Van der Pauw Structures

Using the Four-Point Probe to Characterize Sheet Resistance

The four-point probe is commonly used to measure the resistivity of large-volume samples, such as ingots and wafers, and the sheet resistance of thin layers, such as epitaxial silicon and sheet diffusions. The resistivity and surface preparation of the material are important determinants of the accuracy of the measurements that can be made with the four-point probe. As discussed below, sample geometry must also be taken into account to ensure accurate readings.

Probe head assemblies are available in two different arrangements of the probe tips or pins: The linear array (Figure A-5) and the square array (Figure A-6).

Probe-tip spacings typically range from 0.025 inches to 0.062 inches. Precision four-point probe assemblies employ ruby guides and individually adjusted springs for each probe tip. Probe force, tip radius, and probe material must be selected with consideration fort he resistivity, hardness, and thickness of the layer to be measured.

The sheet resistance R_s is obtained by introducing a current I through two pins and determining the voltage drop V across the two remaining pins. For the square array, adjacent probe pairs carry current and measure voltage (Figure A-6). If the probe tip spacing is equal ($S_1=S_2=S_3=S_4$), and the sample area is very large compared to the probe tip spacing ($A >> S_n$), then

$$R_s = \left(\frac{2\pi}{ln 2}\right)R$$
$$= 9.064R$$

where $\mathbf{R} = V/I$.

For the colinear array, it is customary for the outer two pins to carry current and the inner two pins to measure the resulting voltage (Figure A-5). Again, if the probe-tip spacing is equal ($S_1=S_2=S_3$) and the sample area is large compared to the probe tip spacing,

$$R_s = \left(\frac{\pi}{ln 2}\right)(R_a)$$
$$= 4.532R_a$$

where $R_a = V_a/I$.

Because of the difference in geometric correction factors between the square and colinear arrays, the latter measures twice the voltage with an equal amount of current.

Note *$\mathbf{R}$ and $\mathbf{R_a}$ represent the average of the two resistance values obtained by reversing the polarity of the current supply. This procedure eliminates any voltage offsets in the measuring circuit.*

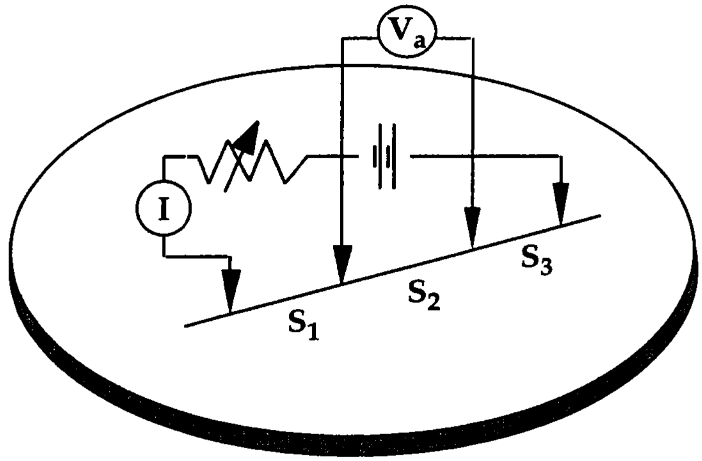

Figure A-5: Linear Array

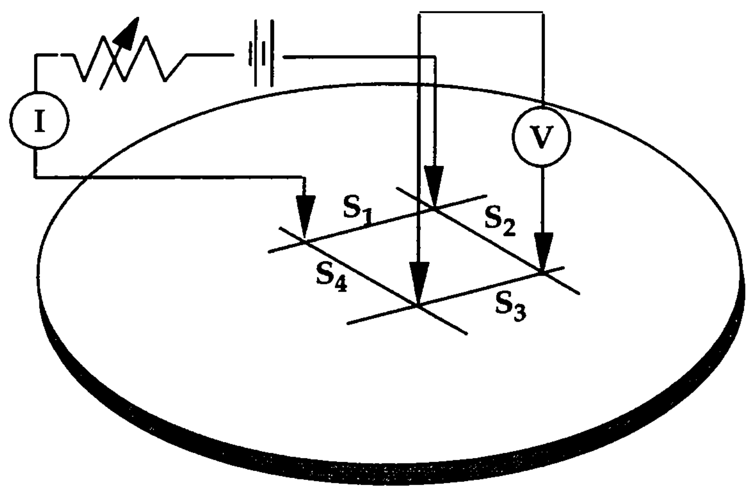

Figure A-6: Square Array

Geometric Effects in Four-Point Probe Measurements

As in the case of microelectronic resistor structures, four-point probe sheet resistance measurements are susceptible to geometric errors. Accurate measurements require compensation both for variable probe-tip spacing and the influence of non-conducting wafer boundaries. If these effects are known, the sheet resistance is

$$R_s = k\left(\frac{V}{I}\right)$$
$$= kR$$

where k is a correction factor (Cf) that takes into account geometric effects.

Probe-tip spacings (S_1, S_2, S_3, S_4) can be determined by measuring the distance between the pin impressions made on a clean, polished surface. The correction factor k may then be computed for circular wafers provided one knows the wafer radius r, the probe orientation with respect to the radius β, and the distance from the center of the wafer to the center of the probe tip array r_o. See Figure A-7.

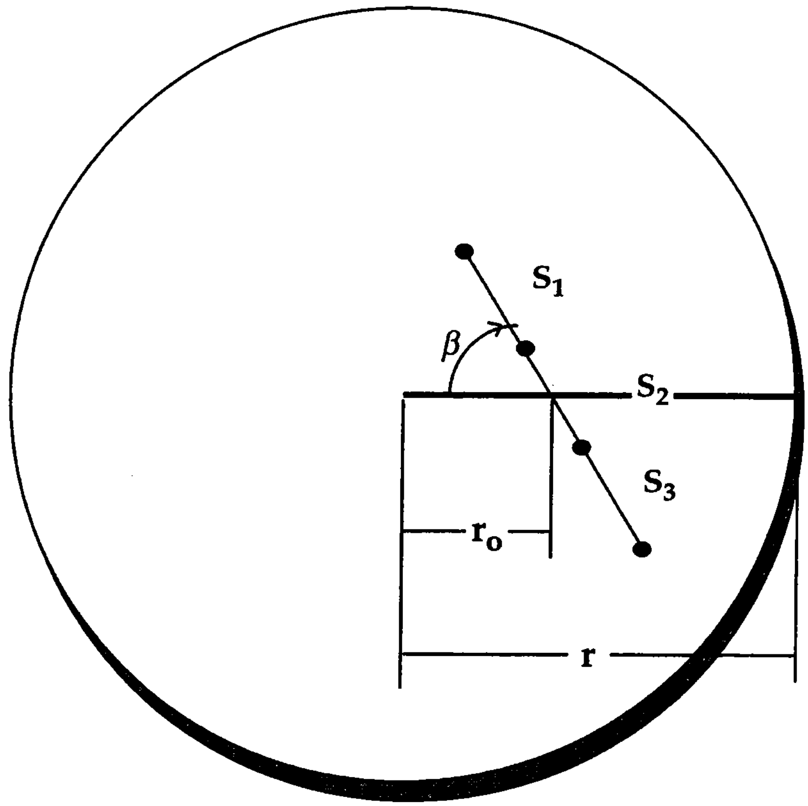

Figure A-7: Probe Tip Spacing

Determination of sheet resistance using calculated geometric correction factors is accurate to about ±1% at the center of the wafer and ± 2–3% near the edge of the wafer. Moreover, because tip spacings vary slightly each time the probe tip array contacts the wafer (*probe wobble*), measurement repeatability is generally limited to about ±0.5%.

Self-Compensation for Geometric Effects Using Paired Resistance Measurements

Sheet resistance mapping of highly uniform layers, such as those obtained by ion implantation, requires a greater accuracy and measurement repeatability than can be achieved using the conventional measurement technique and the correction procedures previously discussed.

Fortunately, for the case of the colinear array there exists a self-compensation technique for eliminating geometric sources of error, analogous to that used with van der Pauw sheet resistors. This technique requires the four pins to be parallel to the radius of a circular wafer ($\beta = 0$). (However, the technique is still valid even if the probe tip array is perpendicular ($\beta = \pi/2$) to the radius as long as $r - r_o > 5S$, where S is the average probe tip spacing.)

Two resistances are measured using this technique. The first, R_a, is obtained in the conventional manner with the outer pins carrying current while the inner pins measure the resulting voltage drop (Figure A-8). The second value, R_b, is obtained by passing current between the first and third pins and measuring voltage across the second and fourth pins (Figure A-9). Then, the sheet resistance is calculated as

$$R_s = k(\xi)R_a$$

where $k(\xi)$, the geometric correction factor, depends only on the ratio $\beta = R_a/R_b$

For the ideal case of equal probe tip spacing (S_1=S_2=S_3) on an infinite sheet ($r = \infty$),

$$\xi = \frac{R_a}{R_b} = 1.269\,;\ldots k = \frac{\pi}{ln 2} = 4.532$$

Using paired-resistance measurements, one can achieve a measurement accuracy of about ±0.5% and a 1σ repeatability of 0.1–0.2%.

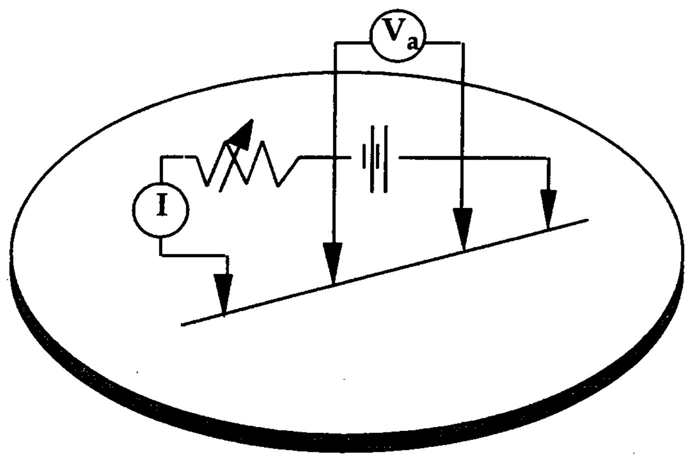

Figure A-8: Using the Linear Array for Paired Resistance Measurement: R_a

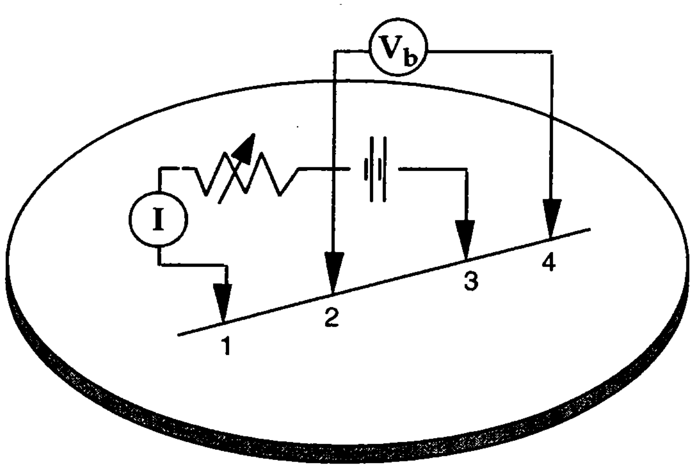

Figure A-9: Using the Linear Array for Paired Resistance Measurement: R_b

B TEST MEASUREMENT PATTERNS

Appendix B
Test Measurement Patterns

Contour Map Patterns (Polar Coordinates)

OmniMap polar-coordinate contour maps use standard arrays of 49, 81, 121, 225, 361, 441, or 625 test sites. These sites are located on uniformly-spaced concentric circles with one site at the center of the wafer. The distance between circles is determined by the Test Diameter for each test, with the diameter of the outer circle for the test being equal to the Test Diameter.

The number of circles in a given test pattern depends on the selected test-site array as shown in Table B-1. For instance, a 49-site test has 3 circles, an 81-site test has 4, a 225-site test has 7, and so forth. The starting and ending sites for each circle are also shown in Table B-1 (site 1 is always at the center of the wafer). The actual test site distributions are shown in Figure B-1 through Figure B-7.

Table B-1: *Contour Map Test Site Distribution*

Circles in Test Pattern	Starting Test Site	Ending Test Site
1	2	9
2	10	25
3	26	49*
4	50	81*
5	82	121*
6	122	169
7	170	225*
8	226	289
9	290	361*
10	362	441*
11	442	529
12	530	625
* These numbers indicate site arrays used by the RS55/tc.		

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11	442	529
12	530	625
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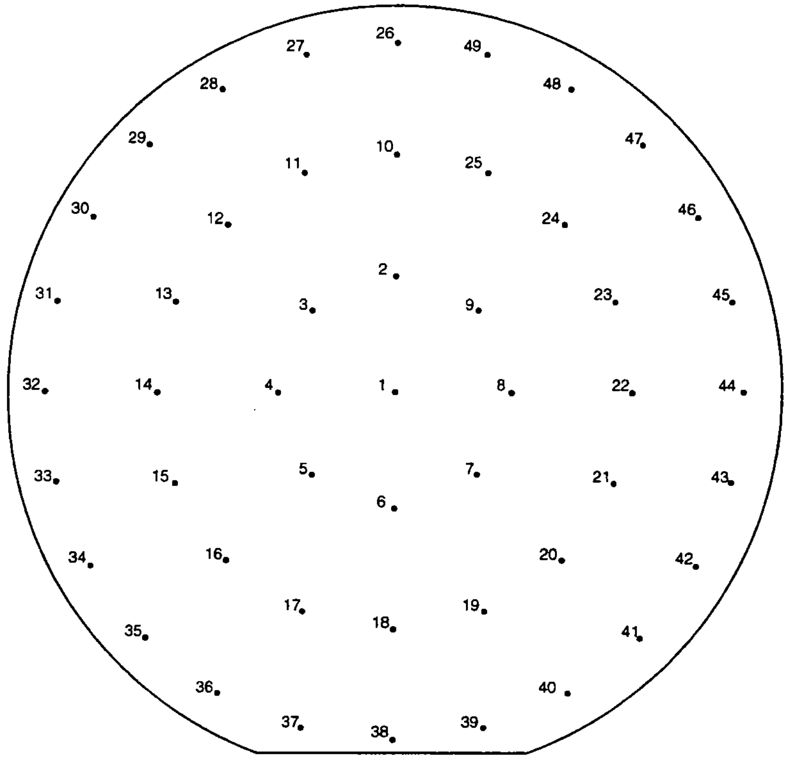

Figure B-1: *49-Site Contour Map*

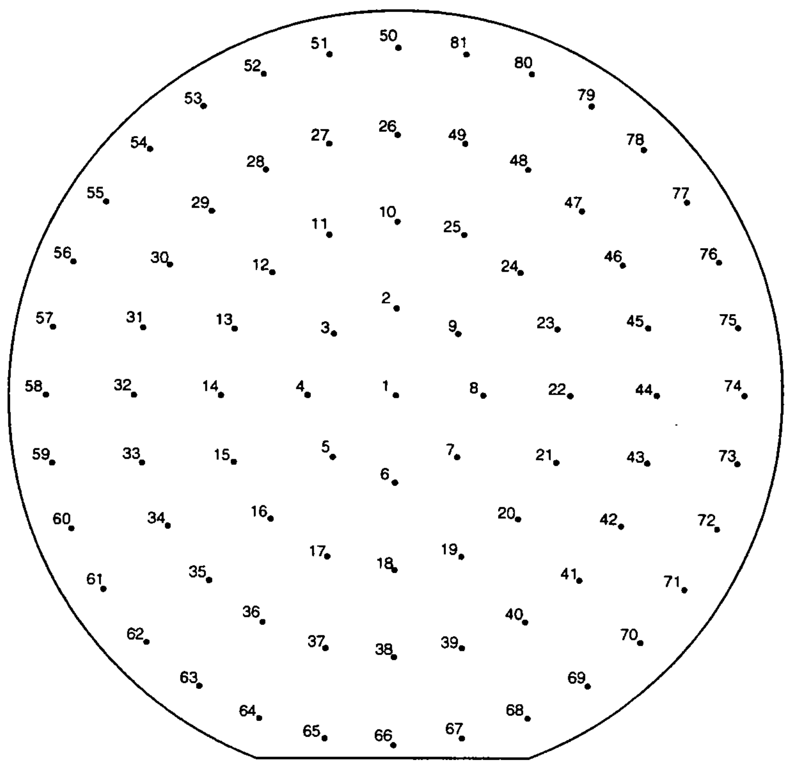

Figure B-2: *81-Site Contour Map*

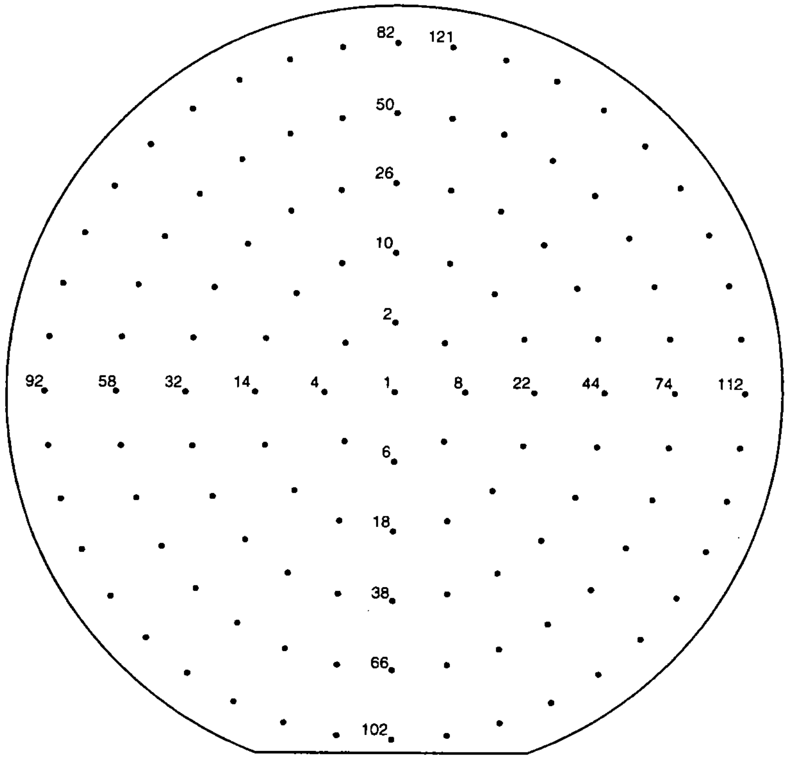

Figure B-3: 121-Site Contour Map

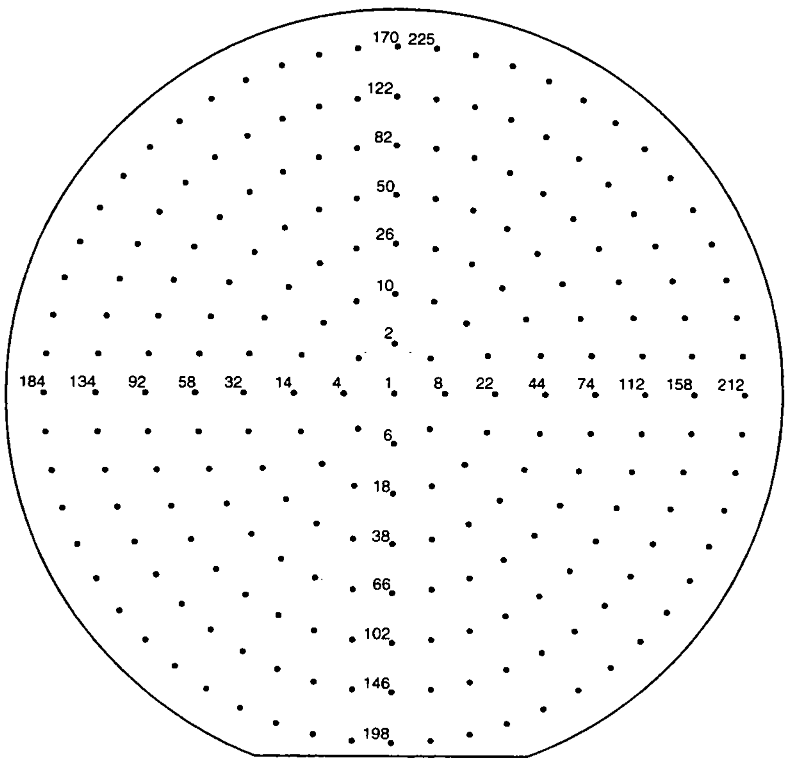

Figure B-4: 225-Site Contour Map

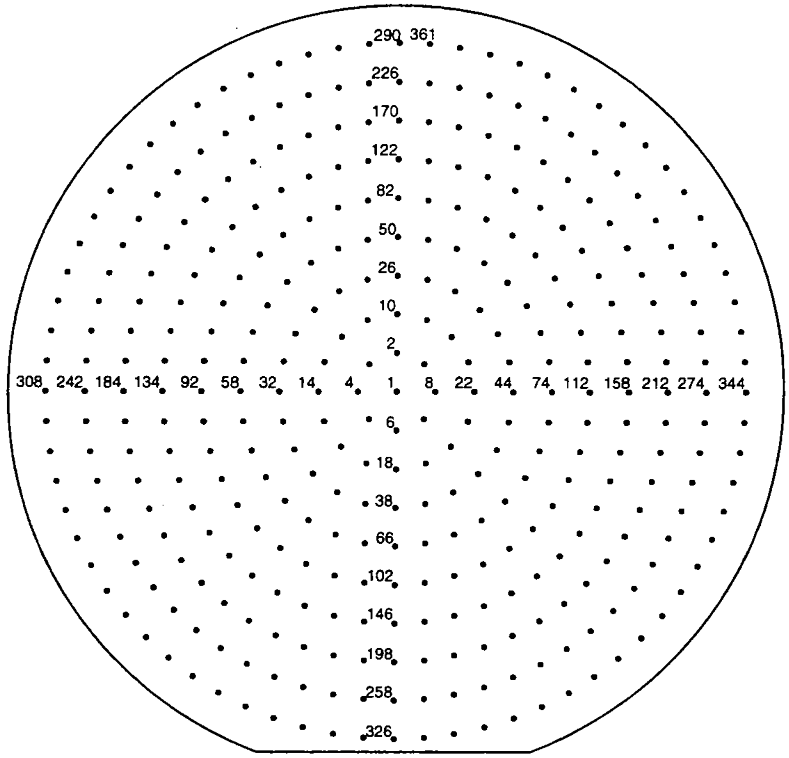

Figure B-5: *361-Site Contour Map*

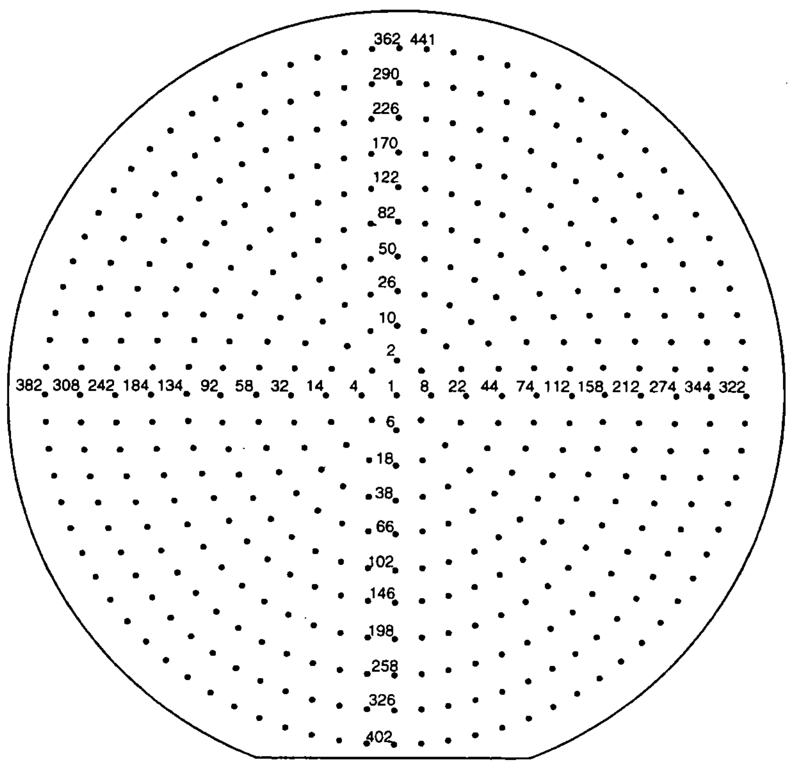

Figure B-6: *441-Site Contour Map*

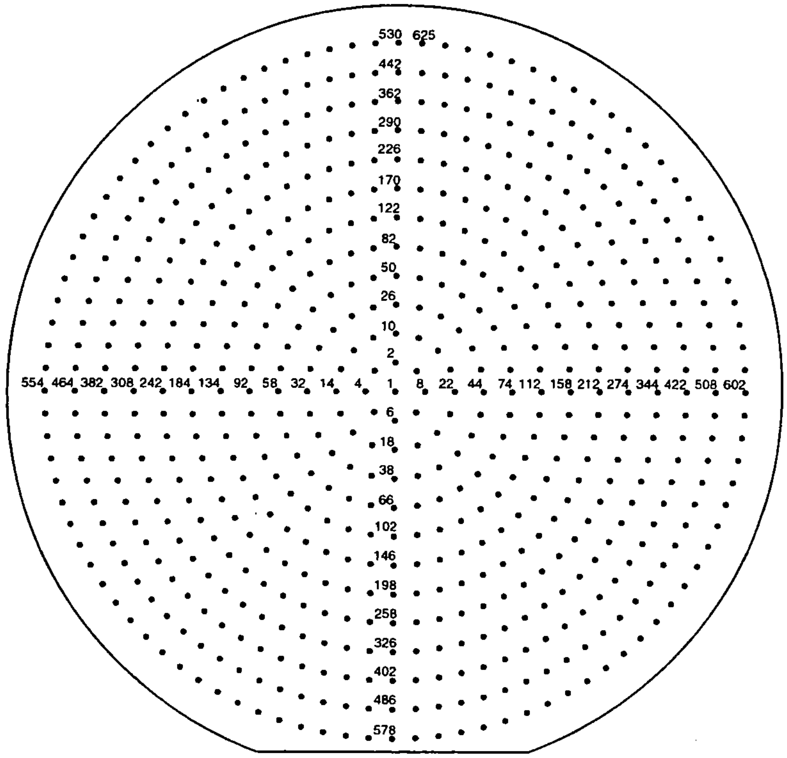

Figure B-7: *625-Site Contour Map*

Diameter Scan Probing Patterns (Polar Coordinates)

Diameter Scan data are collected using the standard arrays of 49, 81, 121, 225, 361, 441 or 625 test sites. These sites are uniformly spaced in a straight line across the wafer, with an equal number of points on either side of the center. The distance between individual points is determined by the user-specified Test Diameter for each test. The points are spaced so that the length of the scan equals the Test Diameter.

The direction of the scan is specified by the Angle of Scan. This angle defines a starting angle on the wafer with respect to the top of the wafer. For the RS55/tc, the *top* of the wafer is the edge closest to the back of the tester when the wafer is placed on the tester's platen. In graphic representations it is assumed that the wafer was placed on the platen with the flat closest to the front of the tester, and therefore is at the *bottom*. An angle of 0° defines a scan from top to bottom, 90° from right to left, 180° from bottom to top, and 270° from left to right. These four directions are illustrated in Figure B-8. You can select any whole angle (that is, no fractions) from 0° to 360°. If you select a multiple of 45°, the system will display a short message with the angle as a reminder of the direction of the scan. These messages are shown in Table B-2.

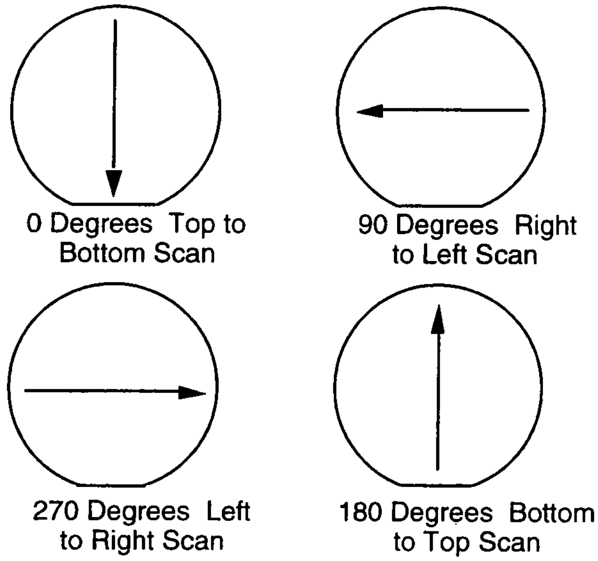

Figure B-8: *Diameter Scan, Major Directions*

Table B-2: *Diameter Scan, Direction Abbreviations*

0°	TOP TO BTTM	Top to Bottom
45°	TRT TO BLFT	Top Right to Bottom Left
90°	RIGHT TO LEFT	Right to Left
135°	BRT TO TLFT	Bottom Right to Top Left
180°	BTTM TO TOP	Bottom to Top
225°	BLFT TO TRT	Bottom Left to Top Right
270°	LEFT TO RIGHT	Left to Right
315°	TLFT TO BRT	Top Left to Bottom Right
360°	TOP TO BTTM	Top to Bottom

Quick Test Patterns (Polar Coordinates)

This chapter provides a brief explanation of the built-in RS55/tc Quick Test patterns. Table B-3 describes the Quick Test Patterns and Figure B-9 displays the Quick Test Patterns.

Five- and six-site tests follow the same pattern; however, for a six-site test the center point is measured twice. (This is in accordance with the ASTM-defined test patterns; refer to ASTM Standard Method F81 for more information.) Similarly, the nine- and ten-site tests are the same pattern, with the center site repeated for the ten-site test.

Table B-3: *Description of Quick Test Patterns*

Quick Test Pattern	Description
Prometrix Standard Patterns	Offer the greatest flexibility in defining a semi-custom pattern. You can specify the number of sites (1, 3, 5, 6, 9 or 10), the test diameter, and the pattern rotational angle as desired.
Prometrix Staggered Patterns	Offsets the four sites at half-radius by 45° relative to the four sites that form the outer ring.
ASTM Patterns	Follow specific rules. The pattern rotational angle is locked at 30°, and the test diameter is locked relative to the wafer diameter.
Semi Patterns	Follow the rules of the ASTM patterns that the pattern rotational angle is locked at 45°.

In addition to these defined patterns, you can create your own custom test patterns using polar (R-θ) or Cartesian (X-Y) coordinates. R is given in fractions of the test radius (0 to 1) and is equal to half the test diameter; θ is expressed in degrees. The center of the wafer is the radial origin (R=0), and 0° is at the *twelve o'clock* position with the angle increasing in the counterclockwise direction.

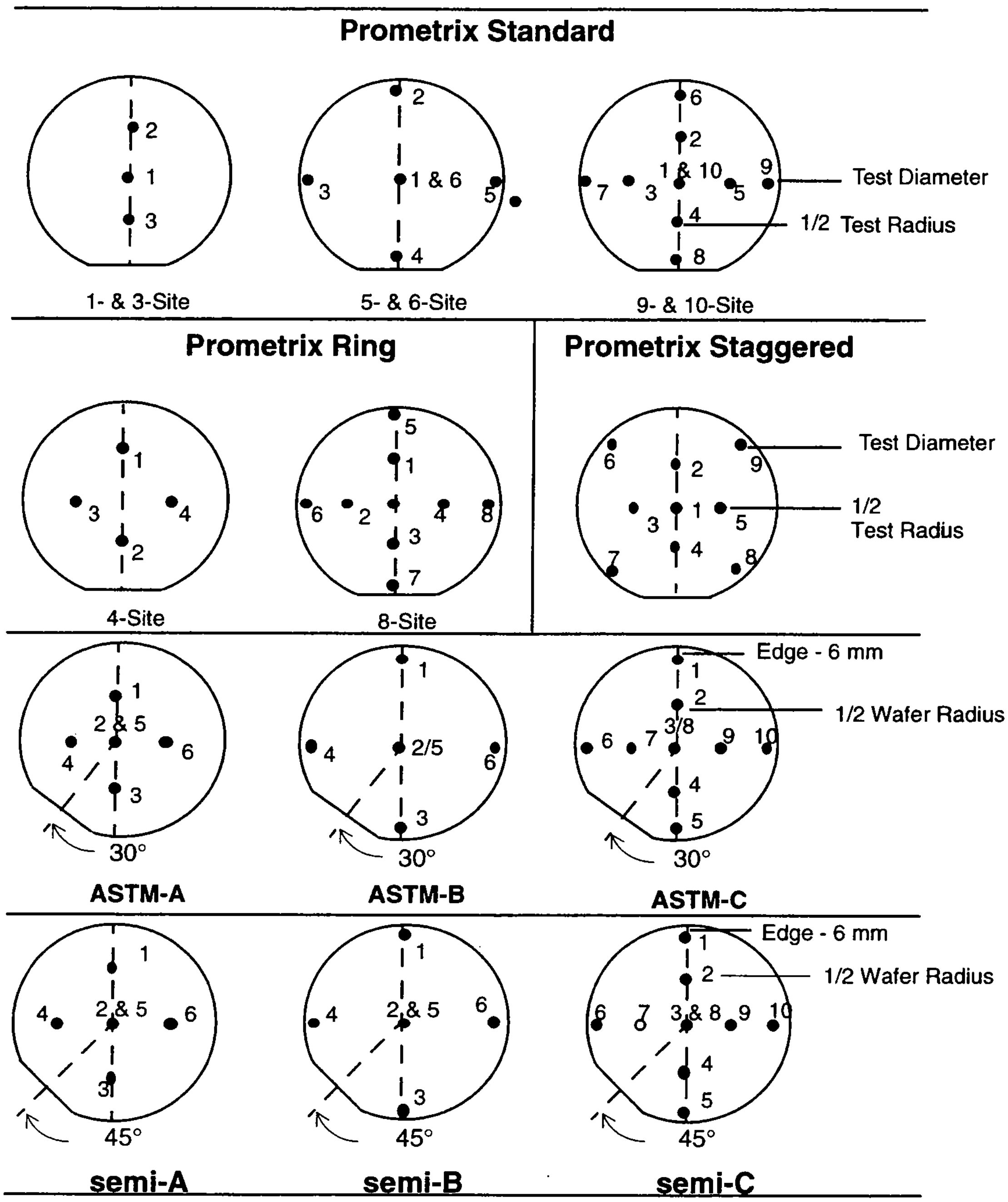

Figure B-9: OmniMap Standard Quick Test Patterns

X-Y Maps (Cartesian Coordinates)

In addition to measuring polar-coordinate patterns, the OmniMap can measure wafers in a Cartesian, or X-Y coordinate pattern. This feature enables you to select up to 1264 measurement sites on a single wafer of any standard diameter between 2 inches and 200 millimeters.

Test pattern arrays are set up in the Test Type Index Card. First, select the appropriate wafer diameter, and set the Step Size dimensions. (This establishes a Cartesian-coordinate pattern of test sites; each site is assigned a row and column number.) Then highlight the PATTERN field, press EDIT ACTIVE, and select the sites you want to measure from the total number of fields available. Finally, select a reference location; the system uses the reference location as the origin of an X-Y coordinate grid. During measurement, the OmniMap steps the probe precisely to each selected measurement site. Figure B-10 shows an example of a 45-site custom pattern created out of 121 available sites on a 125-mm wafer. The step size was set to x = y =10 mm.

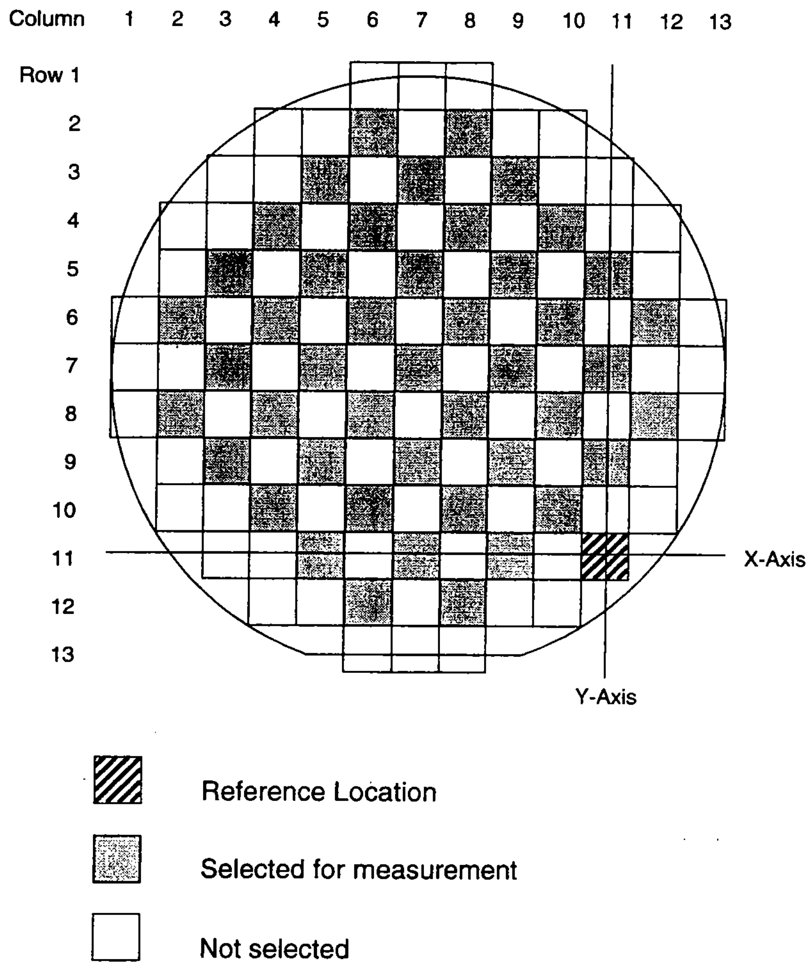

Figure B-10: *45-Site X-Y Map Pattern*

When the measurement sequence is complete, test data are presented as a color X-Y map (Figure B-11). Sites that are within spec, as well as those that exceed the warning limits or the control limits, are respectively colored green, yellow, or red, according to the values entered for these limits in the Trend Scaling Index Card.

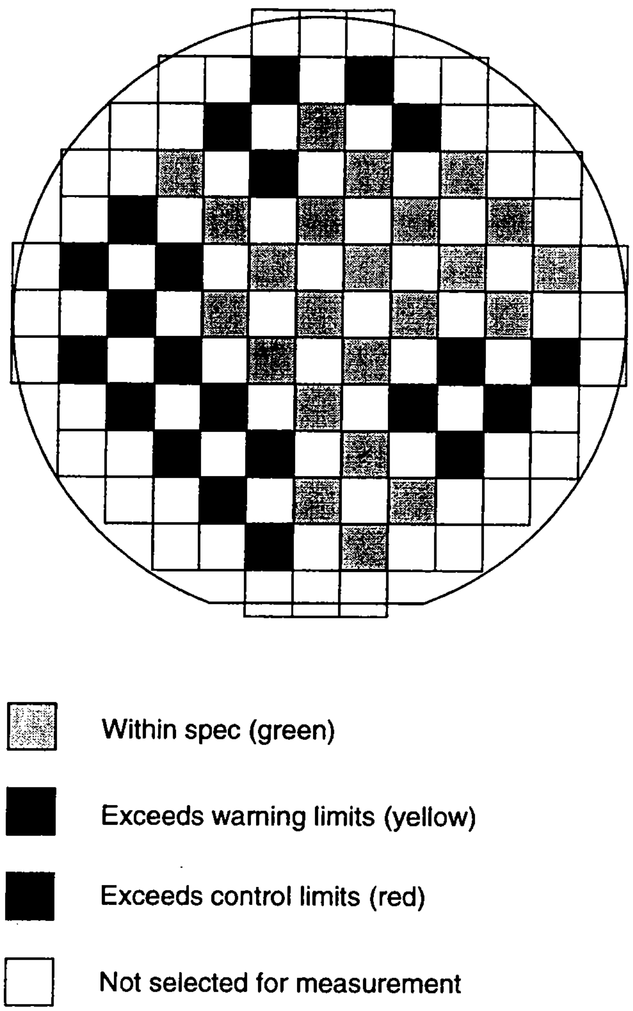

Figure B-11: X-Y Map Test Results

Displaying X-Y Map Data as a Contour or 3D Map

You can plot X-Y map data in the form of contour maps and 3D maps only if the test array is a solid pattern or arranged in a *checker-board* pattern; that is, a pattern in which every other field is selected for measurement like the example in Figure B-10. The test array may otherwise assume any shape and comprise up to 1264 sites, including five- or nine-site quick tests.

C BASIC SYSTEM
MAINTENANCE

Appendix C
Basic System Maintenance

Introduction

This appendix describes basic maintenance for the automatic resistivity tester (ART). The purpose of this appendix is to help Auto RS55/tc system users and service personnel identify and correct system problems. Most sections describe basic tests and troubleshooting procedures without giving detailed instruction. Your system's maintenance manual includes detailed instruction for many of these procedures. For comprehensive maintenance procedures and schedules, refer to the maintenance manual for your system.

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Moving the Tester/Computer

Before you move the tester

- Remove the probe head and make sure the probe arm is in the home (Probe In) position. For information on removing the probe head, refer to your system's maintenance manual. If the probe head is not removed and the probe arm is not in the home position, the probe head tips and the wafer platen may become damaged.

Before you ship or move the computer

- Insert the plastic shipping insert that came with the system into the 3.5-inch diskette drive to prevent head misalignment.
- Remove any cartridge from the system's cartridge drive.

The internal fixed drive should not be subjected to shock during movement or transport.

WARNING *For the user's safety, power cords supplied with the computer monitor have grounded plugs. The power cords should be used with properly grounded 3-hole wall outlets to avoid electrical shock. (You may also use multiple outlet strips that have their own circuit breakers.)*

Disk Drive Maintenance

The disk drives in the computer require no regular maintenance. However, Tencor recommends waiting at least 30 seconds after turning off the computer before turning the power on again. This interval allows the hard-disk drive to slow to a complete stop before starting up again. Failure to do so can seriously damage a hard-disk drive.

Tester Maintenance

When you're not using the tester, keep the lightbox door closed. This will help protect the probe arm and wafer platen.

Monitor Maintenance

Static electricity generated by the CRT can attract dust particles to the screen and bezel. Dust buildup can affect the clarity of the display. Periodically clean the screen and bezel with a soft, static-free cloth, or with the wipes included in the system's startup kit.

Facilities, Reset, and Manual PerformanceTests

To ensure continuous, trouble-free operation, the tests in this section should be performed in addition to normal maintenance procedures. The facilities, reset, and manual performance tests described in this section reveal problems before major difficulties arise. All three tests take about ten minutes to perform.

These tests are executed from the Diagnostics Panel. The Diagnostics Panel is behind the front panel of the system's cabinet, just below the wafer handler. To access the Diagnostics Panel:

1. While pressing downward, unscrew each of the three screws located at the top of the system's front panel. When adequately loosened, the screws pop up. (Figure C-1 shows the location of the three screws.)
2. Lift the front panel off its hinges, being careful not to damage the grounding wire attached to the bottom of the front panel.

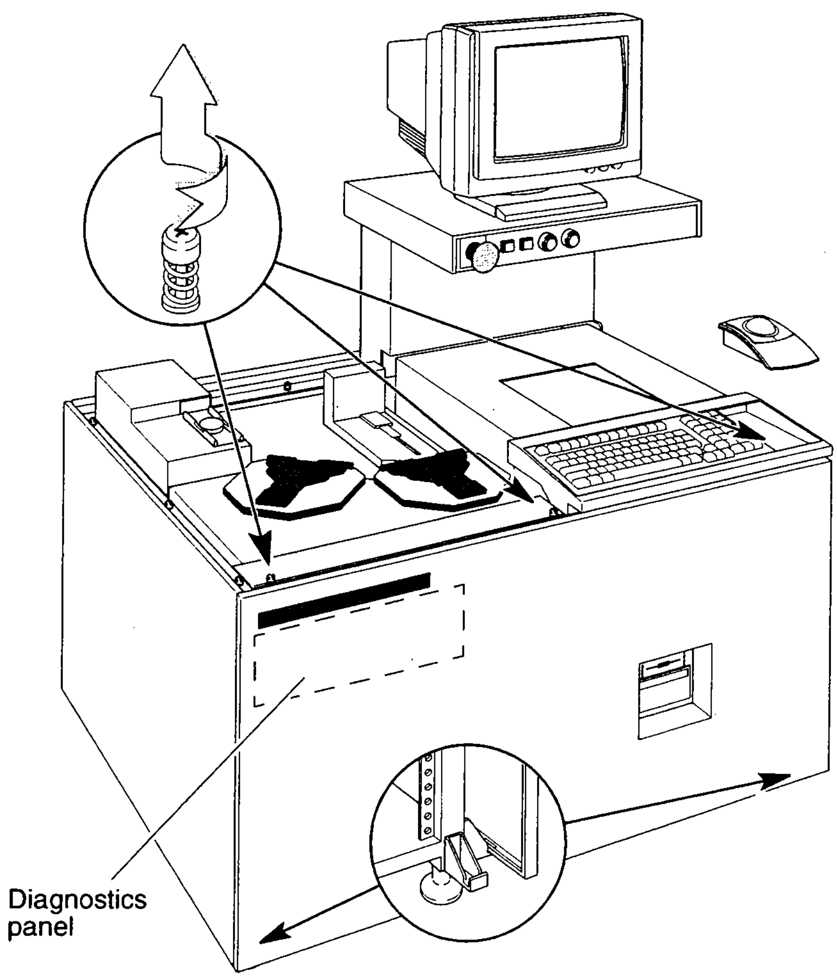

Figure C-1: Accessing the Diagnostics Panel

The Diagnostics Panel

The following sections are intended to help users or maintenance personnel identify and correct system problems. If your tester is not working properly, try to diagnose and correct the problem using the information in these sections. If you are still having trouble with the system, contact Tencor Field Service for assistance.

This section provides a functional overview of the Diagnostics Panel. The Diagnostics Panel (Figure C-2) enables you to manually control the tester and to test and monitor all tester functions. Sections in the Diagnostics Panel are explained inTable C-1.

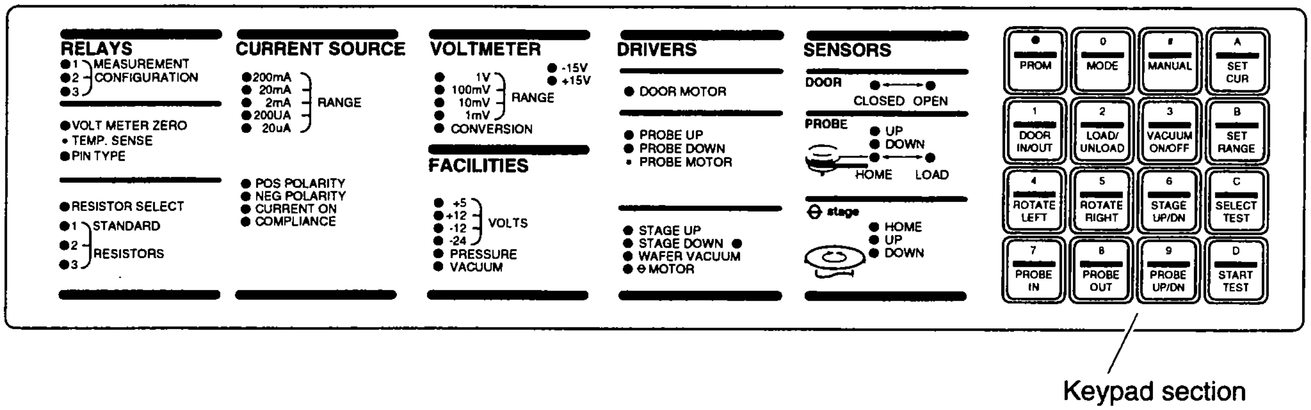

Figure C-2: Diagnostics Panel

Table C-1: Diagnostics Panel Sections

Section	Label	Function
RELAYS	MEASUREMENT CONFIGURATION	Indicate the relay states as they change the current path through the probe pins.
	VOLT METER ZERO	Indicates when the voltmeter is being *zeroed*. (used for single polarity measurements in which the resulting reading is subtracted as an offset)
	TEMP SENSE P/N TYPE RESISTOR SELECT STANDARD RESISTORS	Theses indicators are not used.

Table C-1: Diagnostics Panel Sections (Continued)

Section	Label	Function
CURRENT SOURCE	RANGE	Five current ranges are available: 1-20 µA, 20-200 µA, 200 µA-2 mA, 2-20 mA and 20-200mA. The values on the panel are the maxima of each range.
	POS POLARITY	Indicates that current is flowing in the positive direction during measurement.
	NEG POLARITY	Indicates that current is flowing in the negative direction during measurement.
	CURRENT ON	Indicates that the current source is on.
	COMPLIANCE	Indicates an overvoltage condition in the current supply PCA. Refer to the later section "Error Messages That Might Occur During Measurement."
VOLTMETER	RANGE	Four voltage ranges are available: 1 µV-1 mV, 1-10 mV, 10-100 mV and 100 mV-1 V. The values on the panel are the maxima of each range.
	CONVERSION	Indicates that the electrical impulse is being calculated to give the corresponding resistivity value.
	15V	This LED monitors the 15V from the analog power supply PCA to the DVM. It remains lit as long as ±15V is supplied.
FACILITIES	VOLTS	The power LEDs (+5, +12, -12, +24V) indicate the presence of DC power. All power facilities are wired directly to the power supply outputs. These LEDs are not affected by the LED test.
	PRESSURE/VACUUM	These LEDs monitor the small air pressure and vacuum switch/ detectors on the pneumatics board.
	LED Test	The LED TEST key lights all LEDs except the power LEDs, to ensure that they are functioning.
DRIVERS	DOOR MOTOR	When lit, this LED indicates that the driver chip on the tester's interface board is driving the door motor. The door motor requires ±24Vdc.

***Table C-1**: Diagnostics Panel Sections (Continued)*

Section	Label	Function
	PROBE UP	When lit, this LED indicates that the probe arm and fitted probe should be up and not contacting the wafer.
	PROBE DOWN	When lit, this LED indicates that the probe arm and fitted probe should be down.
	PROBE MOTOR	When lit, this LED indicates that the probe motor should be on and moving the probe arm in or out.
	STAGE UP	When lit, this LED indicates that the stage should be up.
	STAGE DOWN	When lit, this LED indicates that the stage should be down.
	WAFER VACUUM	This LED indicates that the pneumatics board should be providing full vacuum to the wafer stage. When off, a slight bleed vacuum is present to assist wafer positioning.
DRIVERS (continued)	MOTOR	When lit, this LED indicates that the rotary-stage motor should be on and rotating the stage.
SENSORS	DOOR CLOSED/ OPEN PROBE UP/DOWN HOME/LOAD STAGE HOME/UP/ DOWN	These LEDs indicate that the particular mechanical device has reached the end of travel. The stage up and stage down sensors do not operate when the stage is not in the home position.
Keypad	Each key is labeled	The Diagnostics Panel keypad is used to control the tester manually, or to enter values into the system. It is a valuable tool for diagnostic testing. Refer to the section, "Using Manual Mode," for additional information.

Performing a Facilities Test

To perform a facilities test

1. Check the **FACILITY** LEDs on the Diagnostics Panel. See Figure C-2 for the location of LEDs on the Diagnostics Panel. All facilities should be present.

    - If air or vacuum is not present, check the connections at the rear of the tester. Refer to the maintenance manual for the facilities requirements of the tester.
    - If power is not present at the tester, check all power connections. Refer to the maintenance manual if you suspect a failing power supply or a short.
    - Check the air dryer at the rear of the tester for water accumulation. If necessary, drain the air dryer by pressing the small pin below the retainer bulb.

Performing a Reset Test

To perform the reset test

1. Start the reset by pressing **MANUAL**, and then **PGRM** on the Diagnostics Panel.

2. Monitor the LEDs as the tester resets. Refer to Table C-2 for the expected state of these items. If the tester does not complete the tester reset sequence, contact your Tencor Field Service representative.

Table C-2: *Tester Reset Sequence*

Phase of Tester Reset	Diagnostics Panel
Reset begins.	
Rotary stage searches for home position (it will lower, if up).	Stage Home and Stage Down sensor LEDs light. Rotary stage driver LED is on while stage rotates.
Door will close, if open.	Door Motor driver LED is on while door is moving. (Door) Closed sensor LED lights and remains on after door is closed.
Radial stage moves fully in to home position, then out to load position.	Radial (θ) Motor driver LED is on while stage is moving. Home sensor LED lights when probe arm is at stage center. Load sensor LED lights when probe is fully retracted.
Reset ends	

Using Manual Mode

Manual Mode enables you to manipulate the tester's mechanical hardware and change probe heads.

- To enable Manual Mode, press **MANUAL** on the Diagnostics Panel.
- To exit Manual Mode, press **PGRM** on the Diagnostics Panel.

The tester must successfully complete a reset or powerup reset before it can enter Manual Mode. The function of keys that can be used in Manual Mode are described in Table C-3.

Table C-3: Keypad Functions

Key	Function
MANUAL	This key puts the tester in Manual Mode and enables all other keys on the keypad with the exception of **SET CUR**, **SET RANGE**, and **SELECT TEST**.
DOOR IN/OUT	This key moves the door to the opposite end of travel (from open to closed, or closed to open). If the door is not fully opened or closed, it will move to the fully open position. Door motion is inhibited until the stage is down.
LOAD/UNLOAD	This key moves the rotary and radial stages between the wafer load/unload state and the test state. In the load/unload state, the probe arm (radial stage) is retracted, the probe is up, the door is open and the rotary stage is raised and in the home position. In the test state the rotary stage is lowered and in the home position, the door is closed, and the probe is positioned at the center of the stage (home).
VACUUM ON/OFF	This key activates the stage *hold-down* vacuum. When off, there will be a slight vacuum present to assist in wafer positioning. This key is operational both in and out of Manual Mode.
ROTATE LEFT/ RIGHT	Use these keys to rotate the rotary stage. The stage will automatically stop when it reaches the home position (slot forward). You may stop the stage at any *theta* position by releasing either key. The stage will not rotate unless the stage is lowered.
STAGE UP/DN	This key moves the rotary stage up or down to its end of travel. The stage cannot stop anywhere between the fully up or fully down positions. The stage will not rise unless the **DOOR OPEN** and **PROBE LOAD** sensors are on.
SELECT TEST	This key has no function in Manual Mode at this time.
PROBE IN/PROBE OUT	Use these keys to move the probe arm (they must be held down for continuous motion). The arm will automatically stop at the end of travel when the sensor LED lights. You may stop the probe anywhere between the home and load positions by releasing either key. The probe will not move unless the rotary stage is lowered and the probe is raised.
PROBE UP/DN	This is a toggle switch that moves the probe arm to the *up* or *down* position.

Conducting Manual Performance Tests

Manual performance tests are conducted in Manual Mode:

- To enable Manual Mode, press **MANUAL** on the Diagnostics Panel's keypad.
- To exit Manual Mode, press **PGRM**, located on the tester's front assembly.

Checking the Rotation of the Rotary Stage

1. Open the lightbox door by pressing **DOOR IN/OUT** on the keypad.
2. Rotate the stage several times in both directions by alternately pressing **ROTATE RIGHT** and **ROTATE LEFT**.

   The stage should rotate smoothly at a constant speed. If it slips or exhibits severe backlash, the drive belt might be worn. To check the condition of the belt, refer to the drive belt replacement procedure in the maintenance manual. If the belt does not appear worn, you may need to adjust the belt tension as described in the maintenance manual.

Checking the Up/Down Movement of the Rotary Stage

1. Open the lightbox door by pressing **DOOR IN/OUT**.
2. Move the stage up and down by pressing **STAGE UP/DN**.

   The stage will move faster up than down and might hesitate slightly while lowering. *Up* time should take no longer than three seconds. *Down* time should take no longer than eight seconds. If the times you record are greater, or if stage motion is irregular or appears inhibited, perform a lubrication test for the rotary stage (refer to your system's maintenance manual).

Checking the In/Out Movement of the Radial Stage

1. Open the lightbox door by pressing **DOOR IN/OUT**.
2. Ensure that all radial stage cables are securely connected.
   - If the sensor cable is not connected to the radial sensor board, the probe arm will not move.
   - If the sensor cable connection is intermittent, the probe arm will make a loud, chattering noise as you try to extend it to the home (Probe In) position.
3. Alternately press **PROBE IN** and **PROBE OUT** to move the probe in and out.

   The probe should move smoothly in both directions at a constant velocity. If the motion seems rough or sounds dry, refer to the maintenance manual to lubricate the radial stage.

Note *Tencor recommends that you lubricate the radial stage lead screw every six months. Refer to the maintenance manual for a schedule of maintenance procedures.*

Checking the In/Out Movement of the Lightbox Door

Move the lightbox door in and out by pressing **DOOR IN/OUT**. The door should move smoothly in both directions. If the door bounces at the stops (sensor LED extinguishes) or slips, refer to the maintenance manual to adjust the door cable tension. ***Do not*** lubricate the door.

Troubleshooting at the System-Level

For more detailed troubleshooting information at the system-level, refer to your system's maintenance manual.

Strange Measurement Readings

- Check Probe Qual.
- Check the all cables are connected properly.
- Be sure that the lightbox door is closed during testing.
- Measure a standard or known good wafer. The problem could be caused by the wafer you are measuring.
- Ensure that the scale factor is set to 1.000. (Correlation equation = NONE.) Ensure that the correct current level is selected.
- Check the tester calibration using the resistor networks.
- Run the probe qualification routine.
- Are the measurement readings approximately *half* the correct value? The polarity relay may be defective. Refer to your system's maintenance manual.
- Refer to the later section "Error Messages That Occur During Measurement."

Unacceptable Current or Voltage Values

1. Check Probe Qual.
2. Ensure that the probe is contacting the wafer surface.
3. Ensure that the probe head is connected to the probe head cable and is securely mounted in the probe arm.
4. Using a known measurable wafer, perform an operational check on the measurement electronics. There may be a nonconductive layer on the surface of the problem wafer.
5. Use the standard resistor packs to check the operation of the measurement electronics. If the system functions properly at this stage, then the probe head is suspect and should be checked using the Probe Qualification test. If the results from the test are not within specification, condition or replace the probe head as appropriate.

Tester or System Power Failure

- Check the AC line from the line conditioner into the tester.
- Check the tester's fuses. Refer to your system's maintenance manual for further instruction.
- Power off the system for five minutes, then on again. The main power supply could have experienced a thermal shutdown failure. Contact Tencor Field Service if the problem persists.

Tester Does Not Complete a Reset Sequence

Refer to Table C-2 for the correct reset sequence. If the tester does not complete the tester reset sequence, contact your Tencor Field Service representative.

Wafer Does Not Remain on Stage During Data Collection

- Make sure there is sufficient vacuum to the tester.
- Make sure the vacuum key is turned to allow vacuum to the proper vacuum ring on the stage. Refer to your system's maintenance manual.
- Check the tester's internal vacuum lines for blockage and leaks by testing the seals of the rotary stage. Refer to your system's maintenance manual.
- Inspect the test wafer for warpage (this can introduce leaks between the wafer and the stage).
- Adjust the *hold-down* vacuum valve (refer to your system's maintenance manual).

No Wafer Vacuum or Poor Wafer Vacuum on the Stage

- Check the Diagnostics Panel vacuum facility LED.
- Check the vacuum facilities at the rear of the tester.
- Check that the stage vacuum adjuster is set to match the wafer diameter.
- Adjust the wafer vacuum bleed as described in the maintenance manual.
- Test the seals of the rotary stage. Refer to your system's maintenance manual.

Radial Stage Chatters as the Probe Goes to the Load *or* Home *Position*

- The probe up sensor is not properly centered on the slit in the probe up flag. Adjust the probe up sensor board.
- Check the Panduit connector at the stepper motor cable.
- Replace the radial sensor cable.

Probe Arm Motion is Rough

- The stage might need lubrication. It should be lubricated every 6 months. Refer to the system's maintenance manual for details.

Probe Arm Does Not Move

- Check the status of the rotary stage. The rotary stage must be down before the probe arm can move.
- Perform the reset test described earlier in this appendix.
- Is the probe up (PU) LED lit? Check the radial sensor cable (refer to the maintenance manual).

Probe Arm Grinds At the End of Its Travel

- Does the end-of-travel sensor (HOME or LOAD) light? If not, check the sensor cable from the interface board to the radial sensor (refer to your system's maintenance manual).

CAUTION *Do not adjust the sensor without first consulting Tencor Field Service.*

Probe Up/Down Sensor Error Appears

- There could be insufficient air pressure to compress the spring on the probe up/down cylinder. Ensure that the tester is supplied with 40-60 psi of air pressure.
- Check that the probe up/down driver LED (Diagnostics Panel) lights.
- The probe down or probe up sensor is blocked, out of adjustment, or defective. Clear the obstruction; or adjust or replace the sensor. If adjustment is required, refer to your system's maintenance manual.

Rotary Stage Does Not Go Up or Down

- The probe arm must be at the load position and the lightbox door must be open. Verify these states by checking the appropriate LED indicators on the Diagnostics Panel.
- Check the Diagnostics Panel vacuum and pressure facilities LEDs.
- Check if the air and vacuum facilities are connected properly at the rear of the tester.
- Check for a vacuum seal leak of the rotary stage as described in the maintenance manual.
- Perform the lubrication test of the rotary stage described in the maintenance manual.
- Check if the STAGE UP/STAGE DOWN driver LEDs on the Diagnostics Panel are on.
- Check that the stage up and stage down sensors reflect the proper position of the stage. If they do not, check the sensors as described in the maintenance manual.

Rotary Stage Up and Down Movement Is Rough or Slow

- Are the vacuum and air facilities sufficient? Air pressure should be 40-60 psi and the vacuum level at least 300-mm Hg.
- Does the top cover rub the stage as it drops? Check that the top cover is properly installed. The tabs on the rear of the top cover should fit into slots in the tester's rear panel.
- Perform the lubrication test of the rotary stage described in the maintenance manual.

Rotary Stage Rotation Is Rough/Rotary Stage Slips or Stops

- Check the drive belt. (The belt could be worn.) If the belt is loose, tighten it using the procedure described in the maintenance manual. If the belt needs replacing, follow the replacement procedure in the maintenance manual.

Lightbox Door Does Not Go to Fully Open or Closed Position/ Lightbox Door Slips

- If the door motor is not spinning, check the driver/sensor cable. (The motor might be burned out.)
- If the door appears to slip or bounce excessively, adjust the door cable tension as described in the maintenance manual.
- If sensors appear misaligned, adjust the door sensors. Refer to the system's maintenance manual.
- The door driver IC (U12) on the interface board may be defective.

Keypad Does Not Function Properly

- Is the tester in Manual Mode? Refer to the earlier sections "Using Manual Mode."
- Check that the cables labeled DIAGNOSTICS (ANALOG and MECHANICAL) and DISPLAY at the bottom of the interior front panel are securely connected.
- A failing keypad will work intermittently or might affect only a few keys. If this is the case, replace the keypad.
- The keypad encoder IC might be defective. If so, replace it.

Printer Does Not Respond to Print Commands

- Is the printer out of paper?
- Are all cables securely connected to the correct locations? Refer to the maintenance manual?
- Power off the printer, then on again. Try to print again.
- Is the correct printer type and baud rate selected in the General System Data Screen?

Error Messages That Might Occur During Measurement

Table C-4 describes error messages that might occur during measurement.

Note *Any of these errors will cause the test site to be excluded from the results.*

***Table C-4:** Keypad Functions*

Error Message	Description
Ratio Error	The dual configuration technique allows the calculation of the geometric correction factor Cf based on the ratio Va/Vb (or Ra/Rb). This correction factor can be calculated when the ratio is within a specific range (1.14 to 1.40). If the ratio falls outside this range, an error message will result. In practice, a ratio error is usually indicative of poor contact between the probe tips and the wafer surface (high contact resistance). Perform a Probe Qualification test, and condition the probe as indicated. Ratio errors can also occur when measuring too close to the edge of the film.
Voltage Overrange Error	A voltage overrange error occurs when the voltage input to the tester's DVM exceeds the maximum scale of the DVM (1V). Typically, this can occur when measuring very high resistance wafers. It could be that the measurement current is too high for the resistance being measured. Reduce the measurement current, if possible.
Current Compliance Error	A current compliance error occurs when the requested current is not reached during a measurement. The maximum available current is limited by the compliance voltage of the current source. The COMPLIANCE LED on the Diagnostics Panel will light if the compliance limit is reached. This error occurs if the probe head is installed incorrectly or not installed at all, or if probe-to-surface contact is poor (no current flow).

Software Error Messages, Descriptions, and Responses That Might Occur While Using the Temperature Compensation Feature

If the screen displays an error message while you are generating a TCR curve or running a temperature compensation test, use Table C-5 to determine what the message means, and the proper response to the error.

Table C-5: Software Error Messages, Descriptions, and Responses

FATAL RESPONSE ERROR IN THE ART SYSTEM XXXX! followed by: • Temperature Compensation equipment malfunctioning • Disabling the Temperature Compensation feature	**Description:** Temperature compensation hardware is broken or disconnected. **Response:** Reboot the system (press Crtl, Alt, and Del simultaneously). If problem still exists, contact a Tencor Field Service Representative.
Measured temperature wouldn't stabilize. System error	**Description:** Occurs before a measurement if the temperature compensation reading is not stable. **Response:** Check to see if ambient temperature for the tester is fluctuating rapidly. Stabilize ambient temperature for the tester. Restart test if message persists.
WARNING! UNABLE TO AUTORANGE TO TARGET VOLTAGE!	**Description:** This is only a warning message. It can occur, for example, when you are measuring metal films. **Response:** No response necessary. The test continues using the highest measurement current (200 mA).

Troubleshooting Measurement Problems

Use the following flowchart (Figure C-3) to troubleshoot the *Auto* RS55/tc system if it is exhibiting measurement problems.

Perform the calibration check given in Appendix D of this manual to check the following:

- Check that the measured value of each of the three resistor networks agrees with the true value to within the tolerances.
- Perform a Probe Qual and check that the standard deviation of the R_S values is sufficiently low (below .2%).

Do the standard wafers measure correctly?

Yes

Retry the test. If the results do not seem correct, determine whether temperature measurement and compensation are adversely affecting measurements. Do this by

- Checking that the room temperature sensor is accurate to within ± ½° of the wafer temperature displayed onscreen
- Checking that you are using the correct temperature curve
- Checking that the wafer is at ambient temperature before measuring

Do the standard wafers measure correctly?

No

- Check the analog section to determine which PCA needs replacement. Refer to the maintenance manual.
- Check ***tc*** connection points on the underside of the stage for oxidation.

Call your local Tencor Field Service Representative.

Yes

Retry the test. If the results do not seem correct, perform the Probe Qualification procedure.

Does the Probe Qualification procedure yield acceptable results?

No

Condition the probe, perform the Probe Qualification procedure again, and retest.

Yes

Retry the test. If the results do not seem correct, check stage alignment.

Is the stage misaligned?

No

Call your local Tencor Field Service Representative.

Yes

Perform the rotary (theta) and radial stage alignment procedure. Refer to the maintenance manual.

No

Call your local Tencor Field Service Representative.

Figure C-3: Troubleshooting Measurement Problems

D PROBE HEAD REPEATABILITY AND CALIBRATION TESTS

Appendix D
Selecting and Testing Probe Heads

Read This First

The quality of the data obtained from a four-point probe is highly dependent on its measurement repeatability. For this reason, Tencor includes a probe qualification (Probe Qual) procedure as part of your system's firmware. This procedure enables you to objectively determine the performance of the four-point probe. In addition, choosing the right probe head for the kind of wafer you are measuring is important. For help in choosing a probe head, refer to "Choosing the Right Probe Head" in this chapter.

Appendix D
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Short-Term System Repeatability and the Effects of the Probe Head

One of the main sources of noise in the sheet resistance measurement is the probe itself. To obtain accurate and repeatable results, the probe head pins must make good electrical contact each time they touch the surface of the wafer.

The OmniMap probe qualification procedure checks the short-term repeatability of the probe head. For example, if a probe that is used to measure a process with a uniformity spec of 0.75% has a repeatability (noise) of 0.5%, and the true wafer uniformity is 0.65%, the net result is

$$\begin{aligned} S &= \sqrt{S_{wfr}^{2} + S_{probe}^{2}} \\ &= \sqrt{0.65^{2} + 0.5^{2}} \\ &= 0.82\% \end{aligned}$$

where

S = resulting standard deviation,

S_{wfr} = real standard deviation of the wafer,

S_{probe} = probe qualification standard deviation.

The monitor standard deviation of 0.82% is larger than the uniformity spec and therefore out of specification. From this example we may conclude that the tighter the process monitor specification, the smaller should be the allowable noise induced by the probe head.

As probe repeatability degrades, the following parameters degrade (in order):

- The quality of the maps
- The standard deviation
- The average sheet resistance

To ensure the continued quality of the measurements and maps we recommend that you check probe repeatability routinely—at least once a day, depending on the probe use and the wafers being run. If your fab runs three shifts and the OmniMap is in constant use, then you should check probe repeatability at the beginning of each shift.

Probe repeatability is best checked on monitor wafers specially designated for this purpose. If you are checking for repeatability on ion-implanted wafers, use a wafer with a resistivity greater than or equal to that of the wafers you typically measure. Depending on the process being monitored, it is essential to keep a select few monitor wafers aside. These monitor wafers should be changed every three months or in accordance with their use, depending on the type of probe head and the monitor wafers being used.

The probe qualification takes five measurements, each ¼° apart, at each of the four sites Figure D-1. You should try to maintain the standard deviation (STDV) of the R_s measurements within each site at ±0.2%. Of course, this is highly application-sensitive and may not be possible for difficult layers or for cases in which the probe head is not the proper type for the layers being measured.

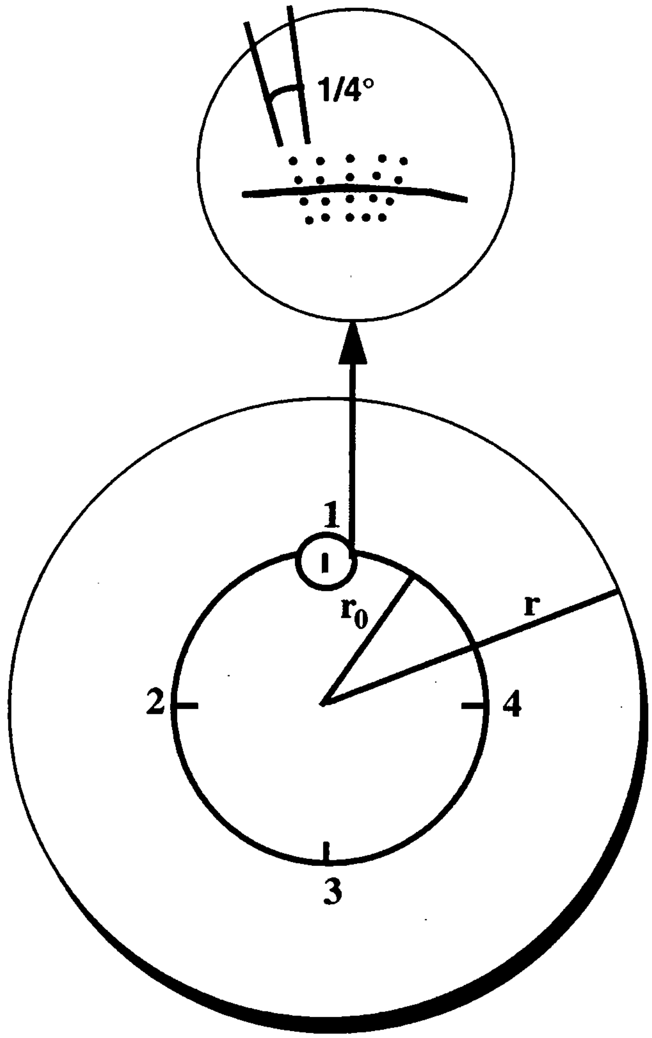


Figure D-1: Test Site Distribution for Probe Qualification

Figure D-2 shows the printout for a probe with excellent repeatability. Standard deviations are underlined.

Tencor OmniMap RS55/tc

Tuesday Mar 12, 1996 19:40

TEST SYSTEMS	PROMETRIX	RS55/tc SYSTEM #1
DISK ID: DEFAULT CONFIG.		PROBE ID: 8298

PROBE QUALIFICATION

	VALUE	R_a	R_b	Cf
SITE #1	7.437 ohms/sq	1.640 ohms	1.299 ohms	4.535
	7.444 ohms/sq	1.641 ohms	1.301 ohms	4.535
	7.448 ohms/sq	1.641 ohms	1.299 ohms	4.540
	7.451 ohms/sq	1.641 ohms	1.300 ohms	4.540
	7.453 ohms/sq	1.642 ohms	1.300 ohms	4.540
MEAN:	7.447 ohms/sq	1.641 ohms	1.300 ohms	4.538
STDV:	0.085%	0.043%	0.064%	0.060%
SITE #2	7.491 ohms/sq	1.650 ohms	1.307 ohms	4.540
	7.486 ohms/sq	1.647 ohms	1.303 ohms	4.546
	7.491 ohms/sq	1.646 ohms	1.301 ohms	4.551
	7.497 ohms/sq	1.649 ohms	1.305 ohms	4.546
	7.499 ohms/sq	1.648 ohms	1.303 ohms	4.551
MEAN:	7.447 ohms/sq	1.648 ohms	1.304 ohms	4.547
STDV:	0.069%	0.095%	0.174%	0.100%
SITE #3	7.486 ohms/sq	1.647 ohms	1.303 ohms	4.546
	7.487 ohms/sq	1.651 ohms	1.308 ohms	4.535
	7.487 ohms/sq	1.651 ohms	1.309 ohms	4.535
	7.448 ohms/sq	1.649 ohms	1.306 ohms	4.540
	7.449 ohms/sq	1.647 ohms	1.303 ohms	4.546
MEAN:	7.487 ohms/sq	1.649 ohms	1.306 ohms	4.540
STDV:	0.015%	0.121%	0.212%	0.121%
SITE #4	7.450 ohms/sq	1.643 ohms	1.301 ohms	4.535
	7.453 ohms/sq	1.642 ohms	1.299 ohms	4.540
	7.453 ohms/sq	1.642 ohms	1.300 ohms	4.540
	7.463 ohms/sq	1.646 ohms	1.304 ohms	4.535
	7.448 ohms/sq	1.644 ohms	1.304 ohms	4.530
MEAN:	7.453 ohms/sq	1.643 ohms	1.302 ohms	4.536
STDV:	0.077%	0.101%	0.176%	0.092%

Figure D-2: Printout of OmniMap Auto RS55/tc Probe Qualification Results

Using the Probe Qualification Results to Estimate Probe Head Measurement Errors

The OmniMap uses the probe qualification to make four separate estimates of the measurement errors $\sigma(R_a)$, $\sigma(R_b)$, and $\sigma(R_s)$ associated with the probe head.* As shown in "Short-Term System Repeatability and the Effects of the Probe Head," each measurement consists of a group of 5 readings obtained by increasing the angle θ by ¼° increments for each successive probing. (The user designates r_O, the radius of the circle.) The measurement error $\sigma(R_a)$ is calculated using the formula

$$\sigma(R_a) = \sqrt{\frac{1}{4}\sum_{i=1}^{5}\left(R_{a_i} - \bar{R}_a\right)^2}$$

where

$$\bar{R}_a = \frac{1}{5}\sum_{i=1}^{5} R_{a_i}$$

A similar relationship holds for $\sigma(R_b)$. The value $\sigma(R_s)$, is calculated in the same way from the individual sheet-resistance values:

$$\sigma(R_s) = \sqrt{\frac{1}{4}\sum_{i=1}^{5}\left(R_{s_i} - \bar{R}_s\right)^2}$$

where

$$\bar{R}s = \frac{1}{5}\sum_{i=1}^{5} R_{s_i}$$

Finally, $\sigma(R_a)$, $\sigma(R_b)$, and $\sigma(R_s)$ are normalized and expressed as a percent standard deviation for each group of 5 readings:

$$\sigma'(R_a) = 100\left[\frac{\sigma(R_a)}{\bar{R}_a}\right]$$

$$\sigma'(R_b) = 100\left[\frac{\sigma(R_b)}{\bar{R}_b}\right]$$

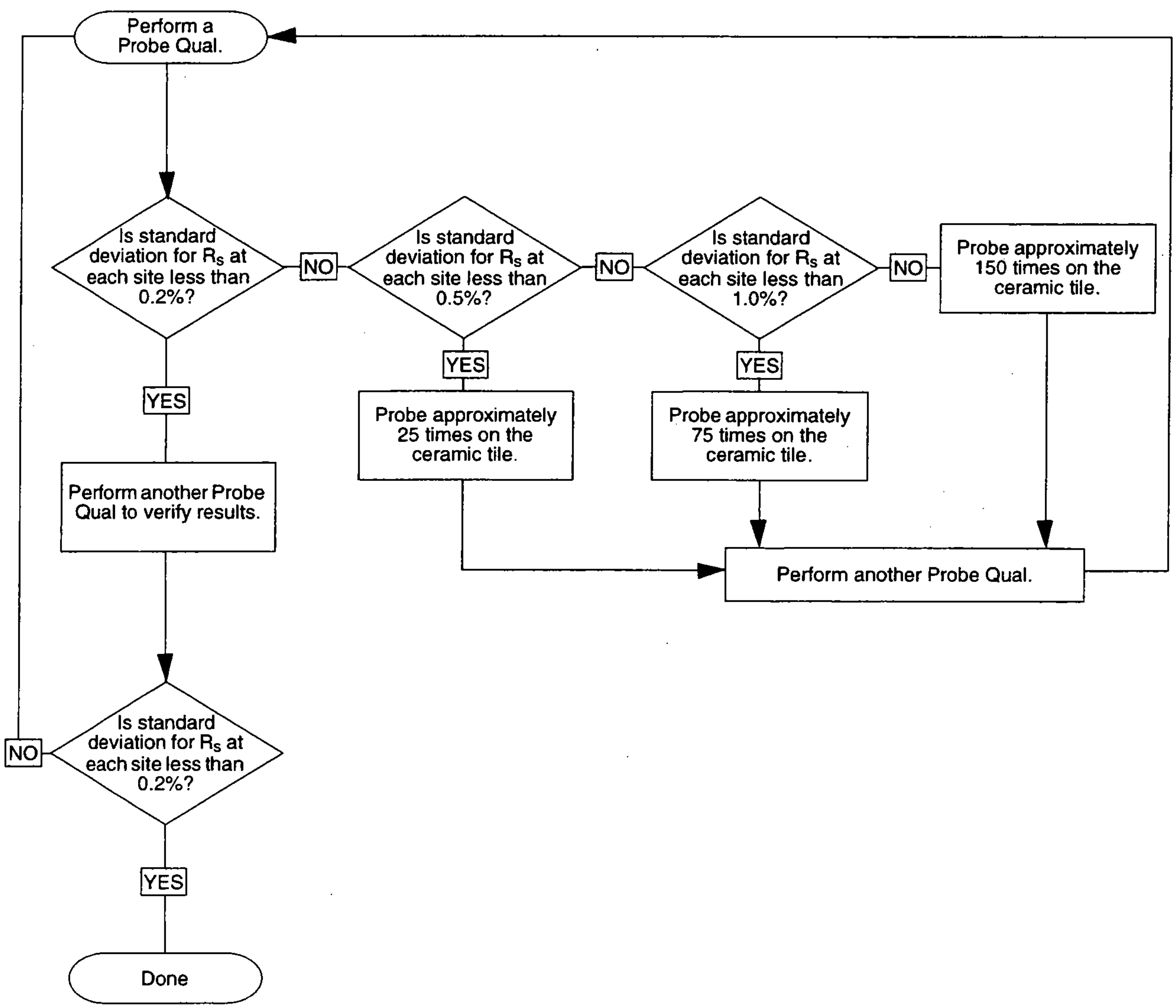
$$\sigma'(R_s) = 100\left[\frac{\sigma(R_s)}{\bar{R}_s}\right]$$

* For additional information on measurement theory and associated calculations, refer to Appendix A of this manual, or ask your local Tencor representative for a copy of Technical Brief #04, "Common Units Used in Four-Point Probe Measurements."

Using Probe Qual Data to Determine the Conditioning Count

Perform the following procedure at the beginning of each shift to check the probe's measurement accuracy, or any time you suspect that the probe is defective.

Note *The number of conditioning counts required to condition a probe head depends on the type of probe head and the monitor wafer. Use the following conditioning counts and standard deviations only as general guidelines when evaluating your own probe heads.*



Choosing The Right Probe Head

Contact between the probe tips and the wafer surface is a critical issue when making sheet resistance measurements using a four-point probe. Many people use the same probe head to measure a variety of wafers. Sometimes, this will produce erroneous readings or cause electrically-noisy measurements. Table D-1 describes which probe head types are best for specific applications.

***Table D-1**: Proper Probe Head Type for Specific Application*

Probe Type	Part Number	Description				Application	Minimum Edge Exclusion*
		radius	loading	material	spacing		
A	50-0002-01	1.6 mil	100 gm	Tungsten Carbide	40 mil	For measuring metals	Auto: 5 mm Manual: 6 mm
F	50-0002-10	1.6 mil	100 gm	Tungsten Carbide	25 mil		Auto: 3 mm Manual: 5 mm
B	50-0002-02	4.0 mil	100gm	Tungsten Carbide	40 mil	General purpose head for implantation, doped poly, silicides, epitaxy, and diffusion	Auto: 5 mm Manual: 6 mm
G	50-0002-11	4.0 mil	100gm	Tungsten Carbide	25 mil		Auto: 3 mm Manual: 5 mm
C	50-0002-03	8.0 mil	100gm	Tungsten Carbide	40 mil	Specifically designed for high impedance surfaces such as low implant dose, shallow junctions, doped poly	Auto: 5 mm Manual: 6 mm
H	50-0002-12	8.0 mil	100gm	Tungsten Carbide	25 mil		Auto: 3 mm Manual: 5 mm
D	50-0002-05	20.0 mil	100 gm	Tungsten Carbide	40 mil	For very difficult implant and high impedance surfaces beyond 8.0 mil	Auto: 5 mm Manual: 6 mm
E	50-0002-06	1.6 mil	200gm	Tungsten Carbide	62.5 mil	Probe head specific to substrate measurements, i.e. bulk	Auto: 6 mm Manual: 7 mm

* These specifications are from edge of film, not from edge of wafer (unless measuring a bare substrate).

Note *The system is supplied with Type B and Type C probe heads. However, because their pins are closer together, probes with 25-mil spacing (types F, G, and H) are particularly suited to measuring close to the film's edge. Call Tencor for additional information about probe heads.*

When choosing probe heads to make sheet resistance measurements, remember to *use different probes to measure metal films and silicon wafers*. For example, use a different probe head when measuring an aluminum film, because aluminum is a soft metal and oxidizes easily. As the probe repeatedly contacts the wafer's aluminum film, some of the aluminum collects on the probe tips. The excess aluminum smooths, and sometimes oxidizes, the surface of the probe tips. If you were to use the aluminum-coated probe head to measure a highly polished and oxidized silicon wafer, there would be very little penetration or electrical contact by the probe tips (See Figure D-3). Although the metal buildup on the surface of the probe tips can literally be scraped off, this is not a recommended practice, as you might degrade the quality of the probe tip.

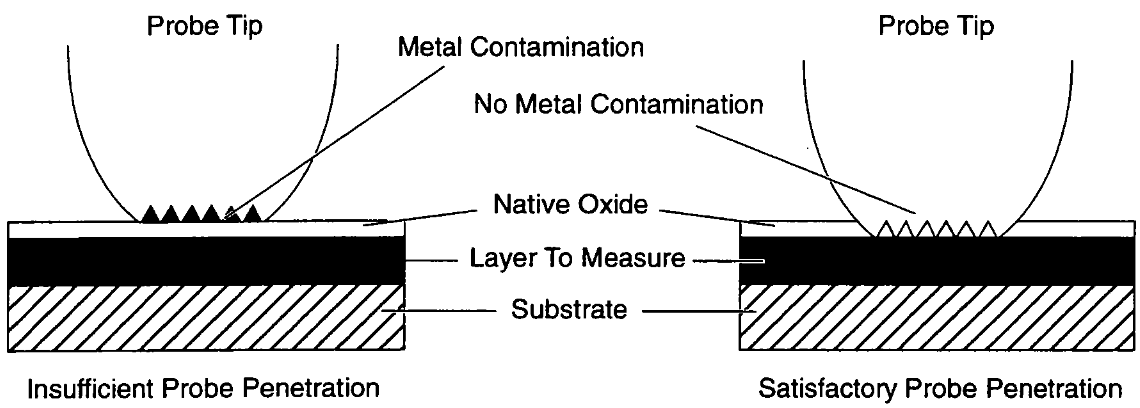


Figure D-3: Insufficient and Satisfactory Probe Penetration

Changing the Probe Head

Certain layers/films require different types of probe heads. You can change the probe head either manually or automatically.

To change the probe head manually

1. Make sure the tester stage is down, the lightbox door is open and the probe is positioned at the center of the stage (the *home* position). If these conditions are not present
   - If the stage is up, first press STAGE UP/DN to lower the stage.
   - Press PROBE IN until the probe arm is fully extended.
2. Press MANUAL to enable Manual Mode.
3. Loosen the $^5\!/_{32}$-inch Allen-head screw which secures the head to the probe arm, and remove the probe head.
4. Install the replacement probe head, and tighten the Allen-head screw (to 10 in-lbs.).
5. Press PRGM to reset the tester.

To change the probe head automatically

1. From the Introduction Screen, press F1 (FOLDER SELECT).
2. Press F3 (CHANGE PROBE).

   The door opens, the stage lowers, and the probe moves toward the center of the stage.
3. Loosen the $^5\!/_{32}$-inch Allen-head screw which secures the head to the probe arm, then remove the probe head.
4. Note the probe tip data written on the new probe head.
5. Install the replacement probe head and tighten the Allen-head screw.
6. Enter the new probe I.D. (serial number of the probe). Refer to "Editing Probe Data in Engineering and Operations Modes" in Chapter 3.
7. Enter the new probe-tip spacing.

   Refer to the label on the probe; the spacing value is identified as ***Pitch***. (This value is used for thickness/probe spacing corrections).
8. Press F5 (UPDATE).

   Pressing UPDATE updates the new probe-head information throughout the entire data base.
9. Press F8 (MAIN MENU). The Folder Select Screen appears.

   The door closes, and the stage raises. At this point, you have completed changing the probe head automatically.

Checking Tester Calibration

The OmniMap tester requires no calibration on the part of the user. However, you should periodically check the tester to ensure that it continues to provide accurate measurements. For this purpose you are provided with three precision resistor networks having nominal values of 2.794 Ω /sq., 279.4 Ω/sq., and 27.94 kΩ/sq.

To check the calibration

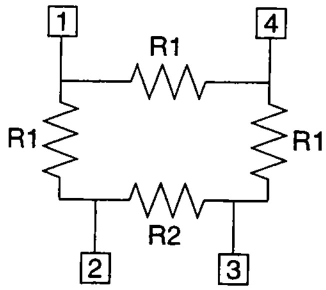
1. Remove the probe head.
2. Plug in a resistor network, with the connector facing the rear of the tester.
3. Select a current manually, or use one of the Auto Range modes. (Refer to the specification sheet that ships with the resistor network.)
4. Take a measurement.
5. Repeat with other resistor networks as desired.

CAUTION *The measured value of each network should agree with the true value to within the tolerances given in Table D-2. If the measured values fall outside the specified tolerance for a given current range, contact Tencor Field Service. External calibration of the meter circuitry requires special test equipment and cannot be performed on site.*

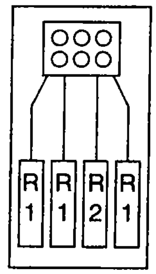
Table D-2: *Measurement Accuracy Using Resistor Networks*

Network	Current	Accuracy (%)	Std Dev (%)
2.794 Ω/sq	0.1 mA	±1	≤ 0.74
	10 mA	±1	≤ 0.06
	200 mA	±1	≤ 0.1
279.4 Ω/sq	0.1mA	±1	≤ 0.06
	1mA	±1	≤ 0.06
	10 mA	±1	≤ 0.06
27.94 kΩ/sq	0.001 mA	±1	≤ 0.06
	0.01 mA	±1	≤ 0.06
	0.02 mA	±1	≤ 0.06

Figure D-4 shows a schematic representation of the precision resistor network and the derivation of the correction factor using the dual-configuration method.

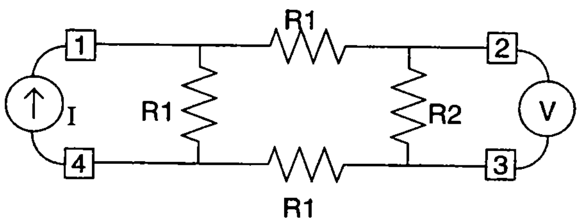


$R2 = 5R1$



Resistor network PC board

Configuration A

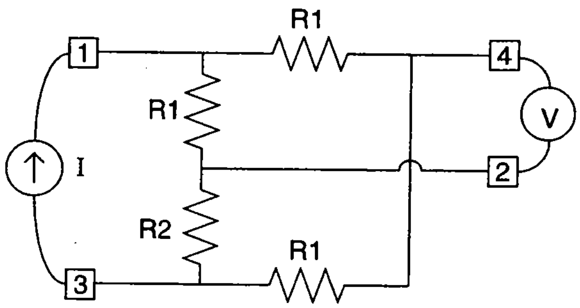


$$V = \frac{I(R1 \parallel (2R1 + R2))}{2R1 + R2} \times R2 = \frac{I(R1 \parallel 7R1)}{7R1} \times 5R1$$

$$= IR1\left(\frac{7}{1+7}\right)\frac{5}{7}$$

$$\boxed{V_A = (5/8) IR1}$$

Configuration B



$$V1 = I(R1 + R2) \parallel (2R1) = I(6R1 \parallel 2R1) = IR1\frac{2 \times 6}{2 + 6}$$

$$= (3/2)\, IR1$$

$$V2 = V1\frac{R2}{R1 + R2} = V1\frac{5R1}{6R1} = (5/6)\, V1$$

$$V4 = V1\frac{R1}{2R1} = V1\frac{1}{2} = (1/2)\, V1$$

$$V24 = V2 - V4 = V1\left(\frac{5}{6} - \frac{1}{2}\right) = \frac{1}{3}V1 = \frac{1}{3}\left(\frac{3}{2}\right)IR1$$

$$= (1/2)\, IR1$$

$$\boxed{V_B = (1/2) IR1}$$

CORRECTION FACTOR:

$R_A = V_A/I = (5/8)\, R1$

$R_B = V_B/I = (1/2)\, R1$

$R_A/R_B = (5/8)\,(2/1) = 5/4$

$kA = -14.696 + 25.173\,(R_A/R_B) - 7.872\,(R_A/R_B)^2 = 4.470$

$Rs = kA \times R_A = (4.470)\,(5/8)\, R1 = 2.794R1$

$$\boxed{R_S = (2.794) R1}$$

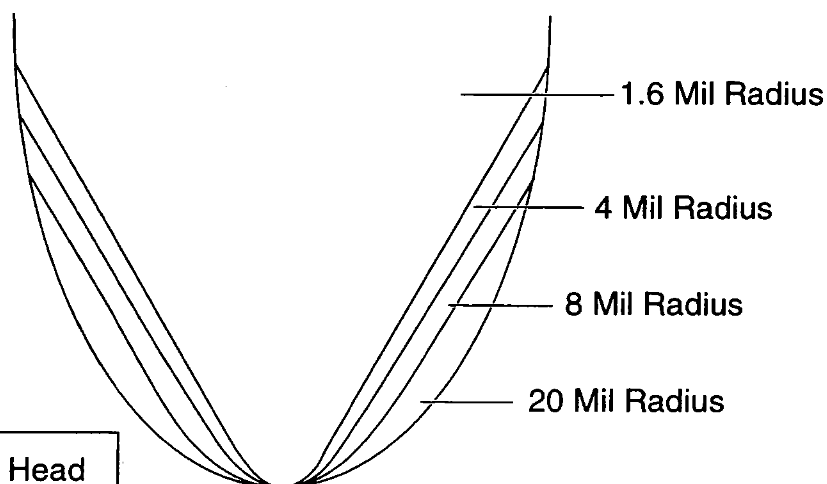
Figure D-4: *Resistor Networks—Simulating the Four-Point Probe*

Contact Resistance and Probe Tip Diameter

A sharp probe, such as a 1.6-mil radius tip, works very well for metal layers where contact resistance and probe penetration are not a problem. Figure D-5 shows the different probe tip types and their diameters. Silicon wafers and wafers with implanted layers can have high contact resistance. The effective resistance is a function of the resistance of all the contact points.

Since each probe is not a single contact point but has multiple contact points due to the rough surface of the tungsten carbide, there are multiple resistances all in parallel. Therefore, we will decrease the effective resistance by increasing the number of contact points. This can be done by increasing the area of contact (i.e. the tip radius). For high dose implants (>1E14 ions/cm2) or low-resistivity silicon (lower than 10 Ω-cm), a 4-mil radius tip is recommended. For medium-dose implants (1E14–5E12 ions/cm2) and medium-resistivity substrates (1–100 Ω-cm), an 8-mil tip is more appropriate. For low-dose implants (5E12 ions/cm2) or high resistivity materials (>100 Ω-cm), a 20-mil probe tip will work best.

When trying to measure a sawed or lapped surface, measurement problems are often experienced because this is a non-continuous surface and will reduce the number of contact points. In this case a higher probe loading or spring pressure is needed to make a positive contact to the surface. An increase to 200-gram loading from the usual 100-gm will usually solve contact problems on rough surfaces. Some bare silicon wafers may have a depletion region caused by the polishing process and may require a 10-minute bake at 200 °C on a hot plate, to replenish the surface, or a 1.6-mil, 200-gm probe to penetrate the layer. Table D-3 shows a chart of preferred and alternate probe-tip radii for different wafers.



Probe Tip Radii

Probe Tip Radius	Probe Head Type
1.6 Mil Radius	A, E & F
4 Mil Radius	B & G
8 mil Radius	C & H
20 Mil Radius	D

Figure D-5: Probe Tip Radii

Table D-3: Preferred and Alternate Probe Tip Radii

	Probe Type	**Metals**	**High Dose Low R_s**	**Medium Dose Medium R_s**	**Low Dose High R_s**	**Buried Layers or Bulk Substrate**
1.6 mil 100-gm loading	A and F	Preferred	Alternate			Alternate
4.0 mil 100-gm loading	B and G	Alternate	Preferred	Alternate		
8.0 mil 100-gm loading	C and H		Alternate	Preferred	Alternate	
20 mil 100-gm loading	D			Alternate	Preferred	
1.6–20 mil 200-gm loading	E					Preferred

E DEFAULT TEST CONFIGURATIONS

Appendix E
Default Test Configurations

Read This First

Figure E-1 lists the default parameters for all the index cards associated with setting up a Contour Map test. The default parameters of the index cards for each test type (Diameter Scan, Qual Procedure, Quick Test, Pattern Test) are identical, with the exception of the parameters for the Test Type and the Maps & Graphs Index Cards. Therefore, this appendix lists only the default parameters for the Test Type Index Card and, where appropriate, the default parameters for the Maps & Graphs Index Card for each test other than Contour Map. The words, *MAY CHANGE* are not literally displayed on the index cards; rather, MAY CHANGE represents that the parameter for the field is changeable.

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Figure E-1 lists the default parameters for all the index cards associated with setting up a Contour Map test. The default parameters of the index cards for each test type (Diameter Scan, Qual Procedure, Quick Test, Pattern Test) are identical, with the exception of the parameters for the Test Type and the Maps & Graphs Index Cards. Therefore, this appendix lists only the default parameters for the Test Type Index Card and, where appropriate, the default parameters for the Maps & Graphs Index Card for each test other than Contour Map. The words, *MAY CHANGE* are not literally displayed on the index cards; rather, MAY CHANGE represents that the parameter for the field is changeable.

Defaults for Setting Up a Contour Map Test

Figure E-1 shows the default parameters and values of the index cards for setting up a Contour Map test.

	TENCOR OmniMap RS55/tc		
	Tues. March 12, 1996 15:46		
Folder ID: 21	Account ID: RS55 DEMO:		
	(Drawer Name) : (Folder Name)		
Wafer Facts	WAFER ID		MAY CHANGE
	LOT ID		MAY CHANGE
	PROCESS DATE		MAY CHANGE
	PROCESS TIME		MAY CHANGE
	OPERATOR		MAY CHANGE
	PROCESS		MAY CHANGE
	EQUIPMENT		MAY CHANGE
	SHIFT		MAY CHANGE
	STATUS 1		MAY CHANGE
	STATUS 2		MAY CHANGE
Memos & Notes	TO OPERATOR		MAY CHANGE
			MAY CHANGE
			MAY CHANGE
			MAY CHANGE
			MAY CHANGE
	TO SUPERVISOR.......		MAY CHANGE
			MAY CHANGE
			MAY CHANGE
			MAY CHANGE
			MAY CHANGE
Wafer Handler	CASSETTE SLOT EDITOR	WAFER COUNT: 25	MAY CHANGE
	C2C SOURCE CASSETTE	RIGHT CASSETTE	MAY CHANGE
	C2C DESTINATION	ALL WAFERS TO RIGHT	MAY CHANGE
	LOT ID		MAY CHANGE
	WAFER DIAMETER	100.00 mm / 3.94 in	MAY CHANGE
	CSST. SIZE OFFSET	0.572 inches	MAY CHANGE
	WAFER FLAT ALIGNER	YES. ALIGN WAFER.	MAY CHANGE
	AUTO SAVE	AUTO SAVE, NO UPLOAD.	MAY CHANGE
	AUTO SLOT	ON: SRCH SLCT WAFERS	MAY CHANGE
	SAMPLE TYPE	AUTO RANGE-AUTO RUN	MAY CHANGE

Figure E-1: Default Parameters and Values for Setting Up a Contour Map Test

Test Type	TEST TYPE	CONTOUR MAPPING		MAY CHANGE
	TEST SITES	49		MAY CHANGE
	WAFER DIAM	100.00 mm / 3.94 in		MAY CHANGE
	TEST DIAM	88.00 mm / 3.46 in		MAY CHANGE
	SORTING SIGMA	3.0		MAY CHANGE
	MAP PATTERN	49 SITE TEMPLATE		MAY CHANGE
	TEMPLATE MAP	49 SITE		MAY CHANGE
	AUTO SAVE	AUTO SAVE, NO UPLOAD		MAY CHANGE
	CORRELATION	NONE		MAY CHANGE
	UNITS	OHMS/SQ		LOCKED
Measure Type	SAMPLE TYPE	AUTO RANGE-AUTO RUN		MAY CHANGE
	AMPERAGE	0.0100 mA		MAY CHANGE
	VOLTAGE	7.500 mV		MAY CHANGE
	PROBE ID			LOCKED
	PROBE SPACING	1.016 mm/0.040 in		LOCKED
	CONFIGURATION	DUAL		MAY CHANGE
	TEMP. COP. CURVE	NONE		
Maps & Graphs	CONTOUR DISPLAY	STANDARD		LOCKED
	- INTERVAL	1.000%		MAY CHANGE
	3D DISPLAY	FULL SCALE DISPLAY		MAY CHANGE
	- INTERVAL	1.000%		MAY CHANGE
	- ABS MINIMUM	0.0000	0.000%	MAY CHANGE
	- ABS MEAN	0.0000	OHMS/SQ	MAY CHANGE
	- ABS MAXIMUM	0.0000	0.000%	MAY CHANGE
	ROT ANGLE	0 degrees		MAY CHANGE
	TILT ANGLE	30 degrees		MAY CHANGE
Trend Setup	PLOT	MEAN - STD DEV		MAY CHANGE
	SIGMA BRACKET	3.0		MAY CHANGE
	SEQUENCED BY	PROCESS DATES		MAY CHANGE
	USING	PRECEDING n WAFERS		MAY CHANGE
	- n EQUALS	999	(n = 1 to	MAY CHANGE
	- END DATE			MAY CHANGE
	DATA PTS. ARE	INDIVIDUAL WAFERS		MAY CHANGE
Trend Scaling	PLOT LIMITS	FULL SCALE		MAY CHANGE
	- MIN	0.00000		MAY CHANGE
	- MAX	0.00000		MAY CHANGE
	MEAN-TARGET	0.00000		MAY CHANGE
	- WARNING	0.0000	0.000%	MAY CHANGE
	- SPEC	0.0000	0.000%	MAY CHANGE
	STDV-WARNING	0.0000		MAY CHANGE
	- SPEC	0.0000		MAY CHANGE

Figure E-1: *Default Parameters and Values for Setting Up a Contour Map Test (Continued)*

SQC Setup	PLOT	MEAN VALUE		MAY CHANGE
	IN GROUPS OF	WAFER POINT GROUP		MAY CHANGE
	SEQUENCED BY	PROCESS DATES		MAY CHANGE
	USING	PRECEDING N DAYS		MAY CHANGE
	–n EQUALS	999		MAY CHANGE
	–END DATE			MAY CHANGE
	LIMITS ARE	SAME DATE RANGE		MAY CHANGE
	–START DATE			MAY CHANGE
	–END DATE			MAY CHANGE
SQC Scaling	PLOT LIMITS	3 SIGMA SCALE		MAY CHANGE
	XBAR – TARGET	0.0000 OHMS/SQ.		MAY CHANGE
	– ± CONTROL	0.0000	0.000%	MAY CHANGE
	RANGE – TARGET	0.0000 OHMS/SQ		MAY CHANGE
	– ± CONTROL	0.0000	0.000%	MAY CHANGE
RS55/tc	ST-6.3	PROBE: PROBE ID: #0000		

Figure E-1: *Default Parameters and Values for Setting Up a Contour Map Test (Continued)*

Defaults for Setting Up a Diameter Scan

Figure E-2 shows the default parameters and values of the index cards for setting up a Diameter Scan test.

Test Type	TEST TYPE	DIAMETER SCAN		MAY CHANGE
	TEST SITES	49		MAY CHANGE
	WAFER DIAM	100.00 mm / 3.94 in		MAY CHANGE
	TEST DIAM	88.00 mm / 3.46 in		MAY CHANGE
	SORTING SIGMA	3.0		MAY CHANGE
	ROTATION	0 dg TOP TO BTTM		MAY CHANGE
	AUTO SAVE	AUTO SAVE, NO UPLOAD		MAY CHANGE
	CORRELATION	NONE		MAY CHANGE
	UNITS	OHMS/SQ		LOCKED
Maps & Graphs	SCAN DISPLAY	FULL SCALE DISPLAY		MAY CHANGE
	- INTERVAL	1.000%		MAY CHANGE
	- ABS MINIMUM	0.0000	0.000%	MAY CHANGE
	- ABS MEAN	0.0000	OMS/SQ	MAY CHANGE
	- ABS MAXIMUM	0.0000	0.000%	MAY CHANGE

Figure E-2: *Default Parameters and Values for Setting Up a Diameter Scan Test*

Defaults for Setting Up a Quick Test

Figure E-3 shows the default parameters and values of the index cards for setting up a Quick Test. (The Quick Test setup does not include a Maps & Graphs Index Card.)

Test Type	TEST TYPE	QUICK TEST	MAY CHANGE
	TEST SITES	5	MAY CHANGE
	WAFER DIAM	100.00 mm / 3.94 in	MAY CHANGE
	TEST DIAM	88.00 mm / 3.46 in	MAY CHANGE
	SORTING SIGMA	3.0	MAY CHANGE
	QUICK TEST	PROMETRIX 5	MAY CHANGE
	ROTATION	0 degrees	MAY CHANGE
	AUTO SAVE	AUTO SAVE, NO UPLOAD.	MAY CHANGE
	CORRELATION	NONE	MAY CHANGE
	UNITS	OHMS/SQ	LOCKED

Figure E-3: *Default Parameters and Values for Setting Up a Quick Test*

Defaults for Setting Up a Qual Procedure

Figure E-4 shows the default parameters and values of the index cards for a Qual Procedure. (The Qual Procedure setup does not include a Maps & Graphs Index Card.)

Test Type	TEST TYPE	QUAL PROCEDURE	MAY CHANGE
	TEST SITES	20	MAY CHANGE
	WAFER DIAM	100.00 mm / 3.94 in	MAY CHANGE
	TEST DIAM	88.00 mm / 3.46 in	MAY CHANGE
	SORTING SIGMA	3.0	MAY CHANGE
	AUTO SAVE	AUTO SAVE, NO UPLOAD	MAY CHANGE
	CORRELATION	NONE	MAY CHANGE
	UNITS	OHMS/SQ	LOCKED

Figure E-4: Default Parameters and Values for Setting Up a Qual Procedure

Defaults for Setting Up a Pattern Test

Figure E-5 shows the default parameters and values of the index cards for setting up a Pattern test. (The Maps & Graphs Index Card for setting up a Pattern test is the same as for a Contour Map test.)

Test Type	TEST TYPE	PATTERN TESTING	MAY CHANGE
	MODE	AUTOMATIC	MAY CHANGE
	WAFER DIAMETER	100.00 mm / 3.94 in	MAY CHANGE
	STEP SIZE	x: 5.000 y: 5.000	MAY CHANGE
	PATTERN	0 Sites	MAY CHANGE
	FLAT ORIENTATION	0 degrees	MAY CHANGE
	SORTING SIGMA	3.0	MAY CHANGE
	AUTO SAVE	AUTO SAVE, NO UPLOAD	MAY CHANGE
	CORRELATION	NONE	MAY CHANGE
	UNITS	OHMS/SQ	LOCKED

Figure E-5: Default Parameters and Values for Setting Up a Pattern Test

F SIGNAL TOWER
OPTION

Appendix F
The Signal Tower Option

StatTrax software version 6.3 supports the Signal Tower option. The option functions in both host and remote modes. This option provides the system with a visual system-status indicator. Four indicator lights are available on the tower. These lights are configurable to display a set of defined equipment states. (Contact your Tencor representative if you need to reconfigure the lights.)

Using the Signal Tower Option

Signal Tower operation requires the option hardware and configuration file. This file enables operation and configures the indicators with their associated equipment states. Upon installation of 6.3 software, a template of this file is installed in C:RUNFILES\SIGTOWER.IN_. This file must be copied to enable the Signal Tower feature.

At the DOS prompt, type

```
copy c:\runfiles\sigtower.in_ c:\runfiles\sigtower.ini
```

Signal Tower Equipment States

The following states are identified by the Signal Tower (see Table F-1 for a description of each state).

- Power states: Off/On
- Maintenance states: On/Off
- Alarm states: Alarm/Alarm Reset
- Operating states: Loading and Unloading Cassette/Processing/Idle
- Control States: Host mode/Local mode

The Alarm, Operating, and Control states are indicated via the software only while StatTrax is running and are overridden by the Power and Maintenance states.

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***Table F-1** : Signal Tower Equipment States and Indicator Defaults*

State	Condition	Description
POWER	ON	When the system is powered on, the indicators show the configured states.
	OFF	When the system is powered down, all indicators are off.
MAINTENANCE	ON	Prior to maintenance, the service engineer must take the system offline and place the system in maintenance mode. This is accomplished by a Maintenance switch on the tower controller. Activation of this switch turns on indicator 4 (red)and turns off all other indicators.
	OFF	Maintenance switch is turned off. Indicators return to configured operation.
ALARM	ALARM	When an Alarm condition occur, indicator 4 (red) blinks. The Alarm state may be active with any combination of operating and control states. It is active at any time the system encounters an error condition requiring operator intervention. An error message will appear on the screen.
	ALARM RESET	The error message on the screen will be reset when the operator presses a key. This will also turn the Alarm to the ALARM RESET state.
OPERATING	LOAD	Indicator 2 (green) blinks when a LOAD condition exists. Active during SECS-II Stream 4 cassette loading/unloading sequence. Manual material transfer operations will not activate this state.
	PROCESS	Indicator 3 (yellow) is on when a PROCESS condition exists. Active when wafer measurement starts and until the last wafer in the cassette is completed.
	IDLE	Indicator 2 (green) is on when an IDLE condition exists. Equipment is not in either PROCESS or LOAD state.

***Table F-1**: Signal Tower Equipment States (Continued)and Indicator Defaults*

State	Condition	Description
CONTROL	HOST	Indicator 1 (blue) is on when a Host condition exists. Equipment is logged on to remote Host.
	LOCAL	Equipment is not logged on to remote Host.

Note

The indicator lights are numbered 1 through 4 from bottom to top:

- *Indicator 1 is blue*
- *Indicator 2 is green*
- *Indicator 3 is yellow*
- *Indicator 4 is red*

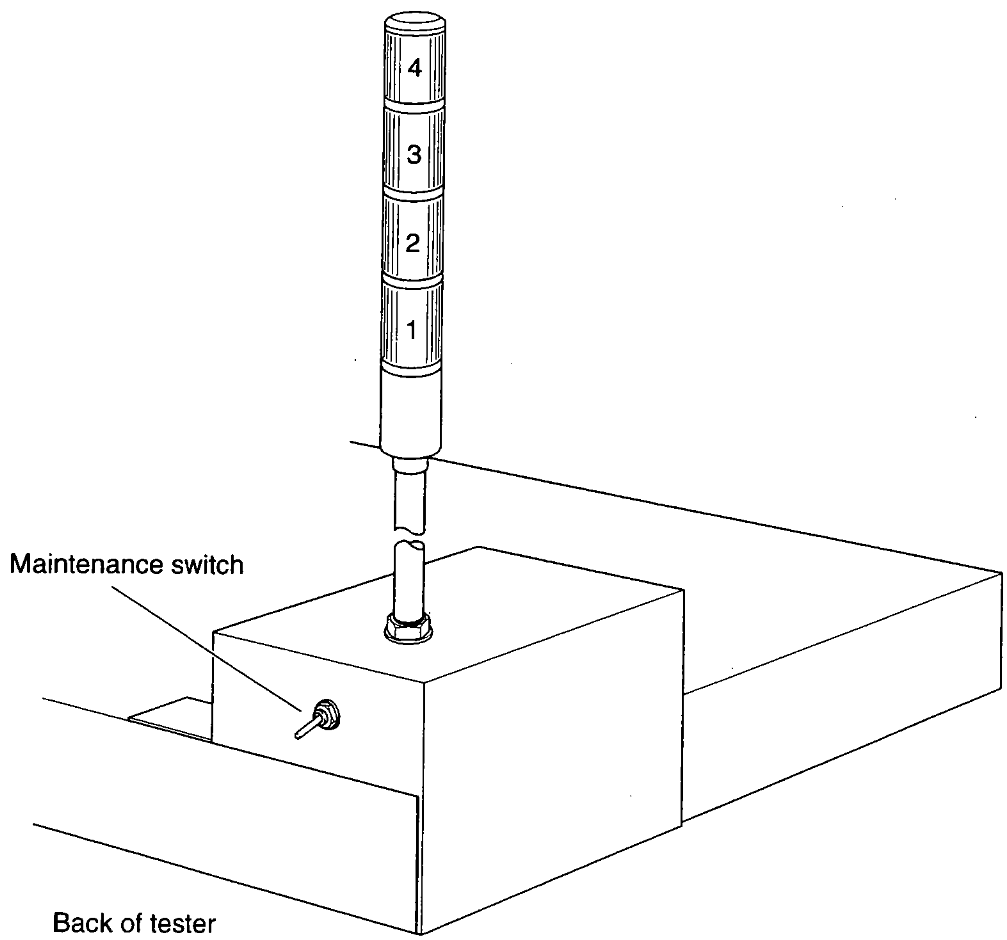

***Figure F-1:** Signal Tower, Rear View*

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