Section 4 - SMARTSET Menu Explanations

Overview of SMARTSET

SMARTSET is a menu-driven software package that characterizes the wafer stepper system to optimize system performance. SMARTSET uses the local alignment system to perform system characterization.

SMARTSET performs two types of analysis:

- <u>Image placement within a die</u>, used to determine lens characteristics and setup of the optical column of the wafer stepper system. This is referred to as *Intrafield Analysis*.

- <u>Image placement on the wafer</u>, used to determine the stepping characteristics of the wafer stepper system. This is referred to as *Grid Analysis*.

Both intrafield and grid analysis can be used to characterize a single system, or to match several systems against a reference system. For both these types of analysis, SMARTSET determines the wafer stepper system characteristics by automatically retrieving the data from the wafer stepper system, analyzing the data, providing models and plots of stepping and lens characteristics, and using this data to suggest corrective actions for optimizing wafer stepper system performance.

SMARTSET Menus

SMARTSET Main Menu

Refer to Figure 4-1 for a flowchart of the complete SMARTSET software package.

TP-6148

MANUAL DATA ENTRY
Test Pattern Layout
1. Default Grid Layout
2. Existing Layout
3. Create New Layout
4. Previous Menu

→ Output Filename → Files → Test Pattern Layout
→ Manual Data Entry Display

GRID ANALYSIS
1. Capture SXS File
2. Capture ETP File
3. Manual Data Entry
4. Average Data Files
5. Edit Data File
6. Difference of Data Files
7. Overlay Data Files
8. Model/Plot Vectors
9. Mode Corrections
10. Previous Menu

SMARTSET Files → Output Filename → Grid Analysis Main Menu
SMARTSET Files → Output Filename → Edit Data Display
SMARTSET Files → Output Filename → Grid Analysis Display

Source of Mode Parameters
1. Use Default File
2. Use Existing File
3. Create New File
4. Edit Existing File
5. Previous Menu

File Names
Grid Mode Parameters → File Names

GRID ANALYSIS
1. Measured
2. Translation
3. Rotation
4. Scale
5. Orthogonality
6. Residual
7. Previous Menu

F1 Key for Bar Chart
F2 Key to Change Scale
F9 Key to Print Screen

MODE CORRECTIONS
1. System to System
2. System Setup (90° Rotation)
3. Previous Menu

SMARTSET Files → Grid Mode Corrections Display
Output Filename → Manual Data Entry Display

Test Pattern Layout
1. Default 5X IFD
2. Default 10X IFD
3. Existing Layout
4. Create New Layout
5. Previous Menu

INTRAFIELD ANALYSIS
1. Capture SXS File
2. Capture ETP File
3. Manual Data Entry
4. Average Data Files
5. Difference of Data Files
6. Edit Data File
7. Spec Field Size
8. Model/Plot Vectors
9. Platen Adjustments
10. Tabulate Results
11. Plot Distortion Data
12. Previous Menu

SMARTSET Files → Output Filename → Intrafield Analysis Main Menu
SMARTSET Files → Output Filename → Edit Data Display
SMARTSET Files → Output Filename

Enter Field Size (mm)
Enter Field Height (mm)
Enter Field Width (mm)

TYPE OF FIELD
1. Circular
2. Rectangular
3. Previous Menu

F1 Key for Bar Chart
F2 Key to Change Scale
F9 Key to Print Screen

INTRAFIELD ANALYSIS
A. Measured
B. Correctable
1. Translation
2. Rotation
3. Reduction
4. Trapezoid
C. Anamorphism
D. Lens Distortion
E. Residual
F. Previous Menu

SMARTSET Files → Platen Corrections Display

TABULATE RESULTS
1. Radial Coordinates
2. Field Coordinates
3. Previous Menu

RADIAL FIELD SIZE
Enter Radial Distance (mm)
→ Tabulate Results Display

FIELD COORDINATES
Enter X (mm)
Enter Y (mm)

DISTORTION PLOT
1. Single File
2. Overlay Files
3. Previous Menu

SMARTSET Files → Enter Title → Enter Field Size (1-15mm)

Enter Maximum Range of Distortion in Microns (0.1-0.5)
→ Distortion Plot Display

UNIFORMITY ANALYSIS
1. Average Data Files
2. Difference of Data Files
3. Edit Data File
4. Analyze Data File
5. Previous Menu

SMARTSET Files → Output Filename → Uniformity Analysis Main Menu
SMARTSET Files → Output Filename → Edit Data Display
SMARTSET Files → Intensity Analysis Display

F1 to Enter a Title
F3 to Change Size of Display (Rows & Cols)
F4 to Smooth Plot Display
F9 to Print Uniformity Analysis Display
F10 Enter Data Cutoff Value

SYSTEM ANALYSIS
1. Grid
2. Intrafield
3. Uniformity
4. Previous Menu

SETUP DEFINITION
1. Create New Entry
2. Revise Current Entry
3. Delete Stepper Entry
4. Define ETP Baud Rate
5. Previous Menu

STEPPER DIRECTORY → Setup Definition Display
Enter Stepper Label → Setup Definition Display

FILE HOUSEKEEPING
1. Transfer Files Between Directories
2. Back Up Files to Floppy Drive A
3. Load Files from Floppy Drive A
4. Delete Files in a Directory
5. Previous Menu

STEPPER DIRECTORY

FILE HOUSEKEEPING
1. Grid Data Files
2. Intrafield Data Files
3. Uniformity Data Files
4. Grid Mode Parameters
5. Grid Test Pattern Layouts
6. Intrafield Test Pattern Layouts
7. Previous Menu

FILE DIRECTORIES

STEPPER DIRECTORY

SMARTSET MAIN MENU
Version 7.1
1. System Analysis
2. Setup Definition
3. File Housekeeping
4. Exit from SMARTSET

SMARTSET Menu Flowchart

SYSTEM PROGRAM MENU

Figure 4-1
SMARTSET Software Menu Flowchart

From the SMARTSET Main menu the user can select from 4 options. The SMARTSET Main menu is displayed as in Figure 4-2.

SMARTSET MAIN MENU
Version 7.1

1. System Analysis
2. Set-up Definition
3. File Housekeeping
4. Exit from SMARTSET

Figure 4-2
SMARTSET Main Menu

Option 1: This option allows the user to analyze SMARTSET data files for grid, intrafield, and uniformity.

Option 2: This option allows the user to set up the SMARTSET configuration file so the SMARTSET displays will be for the correct system configuration.

Option 3: This option allows the user to copy or transfer files between directories on the metrology computer. The user can also copy files to or from floppy drive A. This option also allows the user to delete SMARTSET files from any of the SMARTSET directories. Files have to be deleted periodically since the SMARTSET directories can only display 99 files at once of each file type (grid, intrafield, and uniformity).

Option 4: This option returns the user to the System Program menu of the metrology software.

System Analysis Menu

The System Analysis menu is displayed when option 1 is selected from the SMARTSET Main Menu. The 3 options displayed are the 3 functions of the SMARTSET software package: grid, intrafield, and uniformity analysis (Figure 4-3).

SYSTEM ANALYSIS
Version 7.1

1. Grid
2. Intrafield
3. Uniformity
4. Previous Menu

Figure 4-3
System Analysis Menu

Option 1: This option allows the user to analyze the wafer stepper grid overlay performance. When this option is selected, the grid analysis menu is displayed.

Option 2: This option allows the user to analyze the wafer stepper intrafield performance. When this option is selected, the intrafield analysis menu is displayed.

Option 3: This option allows the user to analyze the wafer stepper MAXIMUS uniformity performance using the IQ system (Illumination Qualifier). When this option is selected, the uniformity analysis menu is displayed.

Option 4: This option returns the user to the SMARTSET Main menu.

Setup Definition Menu

This menu (Figure 4-4) is displayed when the user selects option 3 from the SMARTSET Main Menu. The user must enter information about the wafer stepper configuration so the SMARTSET can perform the correct calculations. For example, the user must enter the type of platen the system is equipped with so that the platen adjustments display will show the correct type of adjustment (MMP vs. PPC and manual rotation vs. RMS).

SETUP DEFINITION
Version 7.1

1. Create New Entry
2. Revise Current Entry
3. Delete Stepper Entry
4. Define ETP Baud Rate
5. Previous Menu

Figure 4-4
Setup Definition Menu

Option 1: This option allows the user to define the wafer stepper system configuration (Figure 4-5). As the user moves through the menu, submenus of the various options are displayed. Press RETURN to move through the menu.

Option 2: This option allows the user to update the wafer stepper system configuration that was created from option 1.

Option 3: This option allows the user to delete a wafer stepper configuration listing that was created earlier with option 1.

Option 4: This option allows the user to set the baud rate of the incoming ETP data.

Option 5: This option returns the user to the SMARTSET Main menu.

SETUP DEFINITION

Stepper Label:

1.	10-77-58	2.	10-77-61	3.	10-78-06	4.	10-78-34	5.	10-78-37
6.	10-78-45	7.	10-78-46	8.	10-78-47	9.	10-78-48	10.	10-78-52
11.	5-1635	12.	5-2035	13.	5-2142-g	14.	5-2145-i	15.	5-2232
16.	5-2235	17.	5-2529-g	18.	5-2923	19.	5-2040	20.	2035krf
21.	Orion								

Lens Model:

1. Wedge Adjustable
2. Washer Adjustable
3. Micrometer Adjustable
4. Piezo Electric UCI
5. Piezo Electric UCII
6. RPC

Platen Type:

1. 300   2. 1200   3. 2400   4. 4800   5. 9600

Baud Rate:

1. 63.5 (2.5in.)   2. 76.2 (3.0in.)   3. 101.6 (4.0in.)

Microscope Objective Spacing:

1. 76.2 (3in.)   2. 100 (4in.)   3. 125 (5in.)   4. 150 (6in.)   5. 200 (8in.)

Wafer Size:

TP-6447

Figure 4-5
Setup Definition Display

File Housekeeping Menu

This menu allows the user to transfer files to other directories or disks. It also allows the user to delete files in the grid, intrafield, and uniformity analysis menus. Since these menus can display only 99 files at once of each file type (grid, intrafield, and uniformity), file housekeeping is required to delete old files so that new files can be saved (Figure 4-6).

FILE HOUSEKEEPING
Version 7.1

1.   Transfer Files Between Directories
2.   Backup Files to Floppy Drive A
3.   Load Files from Floppy Drive A
4.   Delete Files in a Directory
5.   Previous Menu

Figure 4-6
File Housekeeping Menu

Option 1:   This option allows the user to transfer files between different directories on the same hard drive.

Option 2:   This option allows the user to copy files from any of the SMARTSET directories to floppy drive A.

Option 3:   This option allows the user to copy files from floppy drive A to any of the SMARTSET directories.

Option 4:   This option allows the user to delete SMARTSET files in any of the SMARTSET directories. The maximum number of files in a directory is 99 of each file type (grid, intrafield, and uniformity). If there are more than 99 files, the files at the end of the display are not accessible.

Option 5:   This option returns the user to the SMARTSET Main menu.

Deleting Files in Directories

This menu is displayed when the user selects option 4 from the File Housekeeping menu. This menu allows the user to delete files from specific directories (Figure 4-7).

FILE HOUSEKEEPING
Version 7.1

Type of File

1. Grid Data Files
2. Intrafield Data Files
3. Uniformity Data Files
4. Grid Mode Parameters
5. Grid Test Pattern Layouts
6. Intrafield Test Pattern Layouts
7. Previous Menu

Figure 4-7
Delete Files Menu

Option 1: This option allows the user to delete files from the grid data files directory.

Option 2: This option allows the user to delete files from the intrafield data files directory.

Option 3: This option allows the user to delete files from the uniformity data files directory.

Option 4: This option allows the user to delete files from the grid mode parameter files.

Option 5: This option allows the user to delete files from the grid test pattern layout directory.

Option 6: This option allows the user to delete files from the intrafield test pattern layout directory.

Option 7: This option returns the user to the SMARTSET Main menu.

Grid Analysis Menu Selections

Grid Analysis Menu

This menu is displayed when the user selects option 1 from the System Analysis menu. These options allow the user to receive and manipulate grid alignment data. If the user wants to receive and manipulate intrafield alignment data, the Intrafield Analysis menu must be used (Figure 4-8).

GRID ANALYSIS
Version 7.1

1. Capture SXS File
2. Capture ETP File
3. Manual Data Entry
4. Average Data Files
5. Difference of Data Files
6. Edit Data File
7. Overlay Data Files
8. Model/Plot Vectors
9. Mode Corrections
10. Previous Menu

Figure 4-8
Grid Analysis Menu

Option 1: This option prepares the system to receive data from the SXS alignment system.

Option 2: This option prepares the system to receive and format data from the electrical test pattern (ETP) system through the RS-232 communications port.

Option 3: This option allows the user to manually enter optical vernier readings so the data can be modeled and plotted using SMARTSET. When this option is selected, a test pattern must be selected (a submenu is displayed, Figure 4-9). Then a picture of a wafer is displayed to allow the user to enter the vernier readings in the area of the original readings (Figure 4-10).

Option 4: This option allows the user to take 2 or more alignment data files and average the results of those files to create a new file. The original files are not changed.

Option 5: This option allows the user to take 2 alignment data files and subtract the second file selected from the first. The results are used to create a new file which is then modeled and plotted to view the matching difference between systems. The original files are not changed.

Option 6: This option allows the user to modify, examine, or delete vector readings. When this option is selected, a picture of the original wafer readings is displayed. Use the cursor keys to move around the wafer plot, the DEL key to delete data points and the INS key to replace any deleted data points.

Option 7: This option allows the user to overlay 2 or more alignment data files. The files are superimposed for grid analysis. This displays the vector plots of each file. Allows the user to compare wafer readings easily by viewing the vectors.

Option 8: This option allows the user to graphically display the individual vector components such as translation, microscope rotation, X and Y scaling, orthogonality, and residual errors. When this option is selected, a submenu is displayed asking what template to compare the SMARTSET data to (the default file is typically used). After the user selects the template file, another submenu of the available options is displayed to model and plot the data.

Option 9: This option displays the suggested corrections to be added to or subtracted from the current wafer stepper mode settings.

Option 10: Returns the user to the System Analysis menu.

Manual Data Entry Option

When this option is selected, a Test Pattern Layout submenu is displayed (Figure 4-9). This menu prepares the SMARTSET to analyze incoming data in a specific pattern. If the user selects option 3, Figure 4-11 is displayed requiring the user to enter array data for a custom test pattern.

MANUAL DATA ENTRY
Test Pattern Layout

1. **Default Grid Layout**
2. **Existing Layout**
3. **Create New Layout**
4. **Previous Menu**

Figure 4-9
Grid Test Pattern Layout Selection Menu

Option 1: Uses the default layout for displaying the SMARTSET data.

Option 2: Allows the user to select the layout file to use for the display.

Option 3: This option displays a list of array parameters that the user must set when creating layouts (Figure 4-11). The layouts created can be selected from option 2 to be used in displaying the SMARTSET data.

Option 4:   This option returns the user to the Grid Analysis menu.

Data File Editor
File:
Data Type:
Statistics
X = 0.02µm
Y = -0.05µm
R = 0.05µm
Total = 45 Points
Editing Keys:

↑   Move Up

↓   Move Down

→   Move Right

←   Move Left
DEL   Delete Point
INS   Restore Point
E   Edit/Add
Q   Quit/No Save
ESC   Exit/Save

GRID ANALYSIS
Manual Data Entry

TP-6433
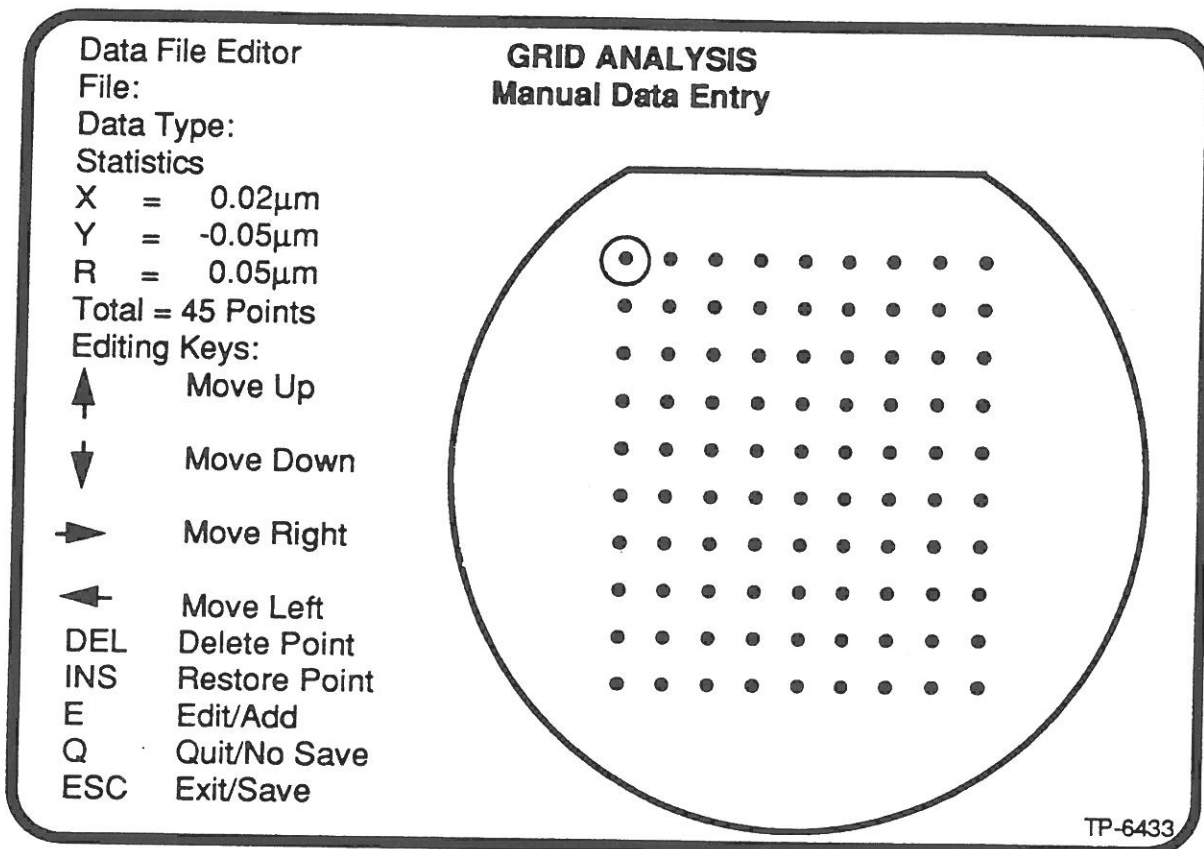
Figure 4-10
Manual Grid Data Entry Display

GRID ANALYSIS
Test Pattern Layout

Filename:
Number of Rows:
Number of Columns:

Step Size in X (mm):
Step Size in Y (mm):

Figure 4-11
Manual Grid Data Entry Test Pattern Layout Display

Model/Plot Vectors Option

When option **8** (Model/Plot Vectors) is selected from the Grid Analysis menu, an intermediate menu enables the source of the grid mode data to be used to calculate the model and vector plots. The menu options for the Source of Mode Parameters menu are (Figure 4-12):

GRID ANALYSIS
Source of Mode Parameters

1. **Use Default File**
2. **Use Existing File**
3. **Create New File**
4. **Edit Existing File**
5. **Previous Menu**

Figure 4-12
Source of Mode Parameters Menu

Option 1: This option uses the system default mode parameters to perform the SMARTSET calculations.

Option 2: This option allows the user to choose the mode parameter file. The user must create a mode parameter file before any files can be displayed with this option.

Option 3: This option allows the user to create a mode parameter file.

Option 4: This option allows the user to change the settings in the mode parameter file. SMARTSET recalculates the data after the user makes the changes.

Option 5: This option returns the user to the Grid Analysis menu.

Grid Analysis Source of Mode Parameters Display

This is the display when the user chooses Model/Plot Vectors from the Grid Analysis menu. It allows the user to choose the source of the mode parameters upon which the SMARTSET grid calculations are based (Figure 4-13).

GRID ANALYSIS
Source of Mode Parameters

Filename:
Current AWA Baseline Corrections (mm)
  X:
  Y:
Current SXS Baseline Corrections (mm)
  X:
  Y:
AWA Mark Offsets (mm)
  X:
  Y:
SXS Mark Offsets (mm)
  X:
  Y:
Right Alignment Die
  Row:
  Col:

Figure 4-13
Create or Edit Grid Source of Mode Parameters Display

The menu options for the Grid Analysis menu are as in Figure 4-14.

GRID ANALYSIS

1. **Measured**
2. **Translation**
3. **Rotation**
4. **Scale Factor**
5. **Orthogonality**
6. **Residual**
7. **Previous Menu**

Figure 4-14
Grid Analysis Menu

Option 1:   This option displays a plot of the captured grid alignment data (Figure 4-15).

Option 2:   This option allows the user to view the X and Y displacement of the data. The errors displayed include global baseline and manual alignment errors.

Option 3:   This option allows the user to view the microscope rotation error. Microscope rotation is the deviation of the X readings gradually increasing from the right side of the wafer to the left. This deviation is caused by the microscope objectives not being perfectly parallel to the X stage motion.

Option 4:   This option allows the user to view the X and Y scaling error. (Scaling is a deviation from the user-specified absolute stepping distance of the stages.)

Option 5:   This option allows the user to view the orthogonality error. (Orthogonality is a measure of the perpendicularity of the X stage motion with respect to the Y stage motion.) Only the angle of the Y motion is adjustable.

Option 6:   This option allows the user to view the residual error. (Residual errors are readings that do not fit any particular model.) The lower the residual errors, the better the system is operating and the more accurate the modeled data is.

GRID ANALYSIS
FILE:
  Rotation +

STATISTICS:
  MIN. = 0.000 µm
  AVE. = 0.071 µm
  MAX. = 0.124 µm
  S.D. = 0.030 µm
  TOTAL = 69 points

SCALE: 0.10 µm

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TP-6453
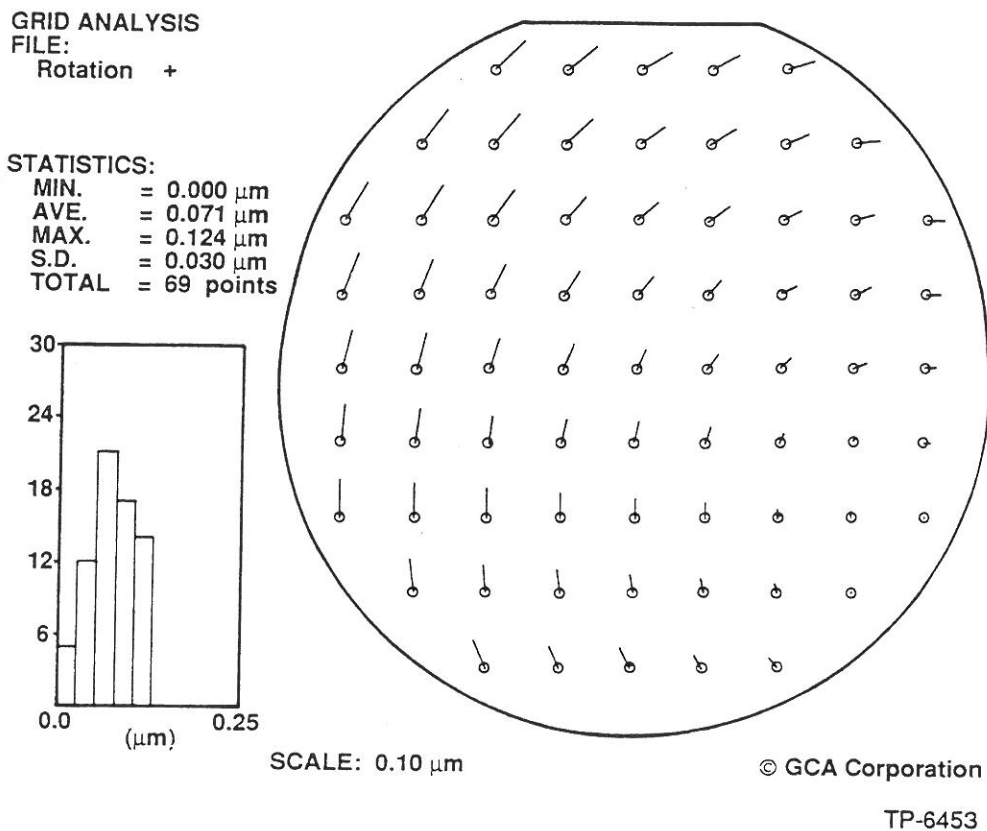
Figure 4-15
Typical Grid Analysis Display

Function Keys from within the Grid Analysis Menu

The following function keys can be used while displaying vector diagrams (Figure 4-16).

F1	Toggles between the vector diagram and the individual X and Y distribution bar charts.
F2	Enables the scale of the present vector plot to be changed.
F9	Outputs the vector diagram to the high-speed dot matrix printer.

SMARTSET
INTRAFIELD ANALYSIS
FILE:

X - statistics		+ Measured	Y - statistics	
MIN.	= -0.114 μm	- Translation	MIN.	= -0.115 μm
AVE.	= 0.000 μm	- Residual	AVE.	= 0.008 μm
MAX.	= 0.114 μm		MAX.	= 0.120 μm
S.D.	= 0.048 μm		S.D.	= 0.050 μm
TIR	= 0.228 μm		TIR	= 0.235 μm
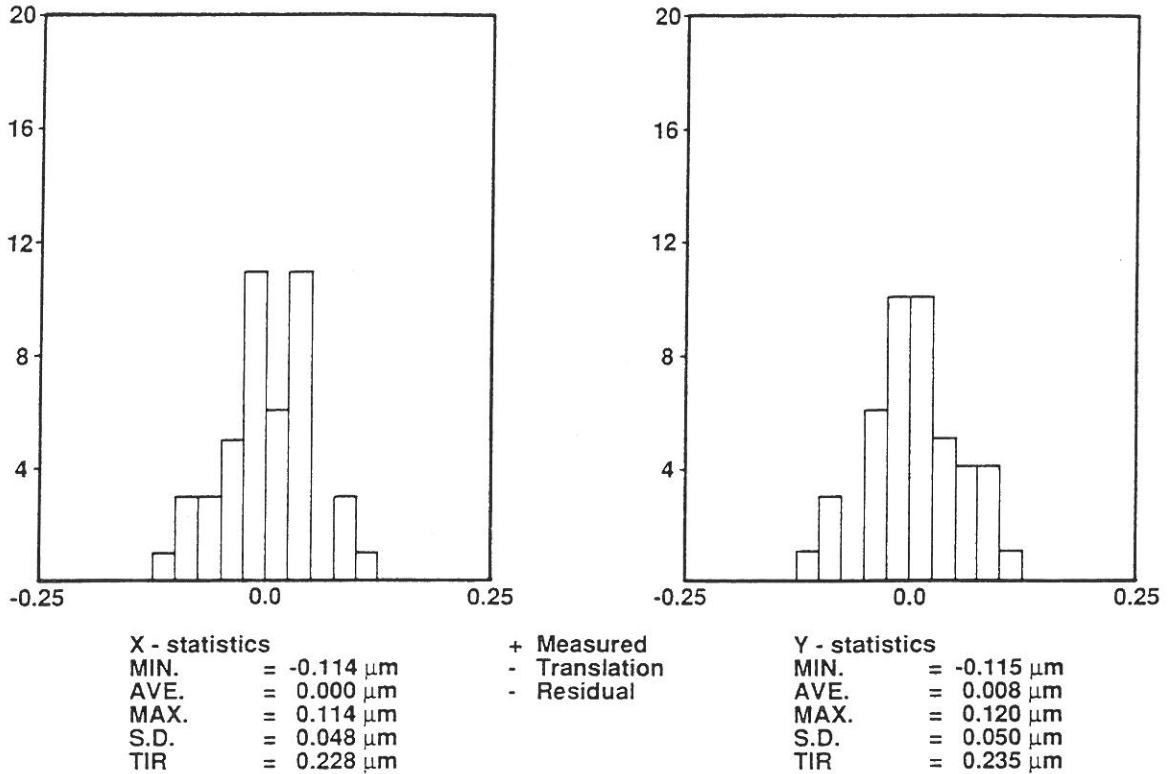
TP-6455

Figure 4-16
Typical Bar Chart Display

Grid Mode Corrections Menu

This menu prepares the SMARTSET to analyze the SMARTSET mode correction data as a single system or as a system being matched to another (Figure 4-17).

GRID ANALYSIS
Mode Corrections

1. **System to System**
2. **System Setup (90° Rotation)**
3. **Previous Menu**

Figure 4-17
Mode Corrections Menu

Option 1: This option is used when matching 2 or more systems to each other.

Option 2: This option is used when setting up a system to itself. This matches the X and Y stepping and the orthogonality.

Option 3: This option returns the user to the SMARTSET file directory.

Grid Mode Corrections Display

When option 1 or 2 is selected from the Mode Corrections menu, the wafer stepper mode corrections, required to correct the grid errors, are displayed (Figure 4-18).

GRID ANALYSIS
Mode Corrections

Baseline Correction
    X: 0.00016mm
    Y: 0.00025mm
Microscope Rotation
    Ø: 0.05µm/mm
Scale Factor
    X: 1.0ppm
    Y: 1.0ppm
Orthogonality
    -0.8ppm

Figure 4-18
Grid Analysis Mode Corrections Display

Intrafield Analysis Menu Selections

Intrafield Analysis Menu

This menu (Figure 4-19) is displayed when the user selects option 2 from the System Analysis menu. These options allow the user to receive and manipulate intrafield alignment data. If the user wants to receive and manipulate grid alignment data, the Grid Analysis menu must be used.

INTRAFIELD ANALYSIS
Version 7.1

1. Capture SXS File
2. Capture ETP File
3. Manual Data Entry
4. Average Data Files
5. Difference of Data Files
6. Edit Data File
7. Spec Field Size
8. Model/Plot Vectors
9. Platen Adjustments
10. Tabulate Results
11. Plot Distortion Data
12. Previous Menu

Figure 4-19
Intrafield Analysis Main Menu

Option 1: This option prepares the system to receive data from the SXS alignment system. When this option is selected, the prompt **WAITING FOR SXS DATA** is displayed and SXS alignment can start.

Option 2: This option prepares the system to receive data from the electrical test pattern system. When this option is selected, the prompt **WAITING FOR ETP DATA** is displayed and alignment can start.

Option 3: This option allows the user to manually enter vernier readings for SMARTSET analysis. When this option is selected, a picture of a wafer is displayed to allow the user to enter the vernier readings in the area of the original readings.

Option 4: This option allows the user to take 2 or more alignment data files and average the results of those files to create a new file. The original files are not changed.

Option 5: This option allows the user to take 2 alignment data files and subtract the second file selected from the first. The results are used to create a new file which is then modeled and plotted to view the matching difference between systems. The original files are not changed.

Option 6:   This option allows the user to modify, examine, or delete vector readings. When this option is selected, a picture of the original wafer readings is displayed. Use the cursor keys to move around the wafer plot, the DEL key to delete data points, and the INS key to replace any deleted data points.

Option 7:   This option allows the user to specify what field size is displayed in the Model/Plot Vectors option. If the user read a 15x15 array across a 20mm die and only 18mm of field was usable, the last 2mm of data could be dropped out by selecting this option and entering 9mm radial reading. The field size is always specified as a radial reading.

Option 8:   This option allows the user to graphically display the individual vector components such as platen rotation, reduction, trapezoid and residual errors. When this option is selected, a submenu of the available options is displayed.

Option 9:   This option displays a picture of a platen and the required adjustments to correct the reduction and trapezoid errors. The platen rotation correction is also displayed.

Option 10:   This option displays all the errors in column form and the corrections required.

Option 11:   This option displays the distortion data from multiple systems or wafers as a line graph. This allows the user to determine how easily the wafer stepper systems can be matched.

Option 12:   This option returns the user to the System Analysis menu.

Manual Data Entry Option

This option allows the user to enter optical vernier data into an intrafield plot manually for SMARTSET analysis. When this option is selected a test pattern layout menu (Figure 4-20) is displayed. After the user selects the layout, the manual intrafield data entry display appears (Figure 4-22).

MANUAL DATA ENTRY
Test Pattern Layout

1.   Default 5X IFD
2.   Default 10X IFD
3.   Existing Layout
4.   Create New Layout
5.   Previous Menu

Figure 4-20
Intrafield Test Pattern Layout Menu

Option 1: This option prepares the SMARTSET for data from a 5X intrafield reticle.

Option 2: This option prepares the SMARTSET for data from a 10X intrafield reticle.

Option 3: This option allows the user to choose which test pattern to use for the data entry. The user must create a test pattern layout before using this option.

Option 4: This option allows the user to enter array information so the SMARTSET can display the data correctly (Figure 4-21).

Option 5: This option returns the user to the Intrafield Analysis menu.

INTRAFIELD ANALYSIS
Test Pattern Layout

Filename:
Number of Rows:
Number of Columns:

Step Size in X (mm):
Step Size in Y (mm):

Figure 4-21
Intrafield Test Pattern Layout Display
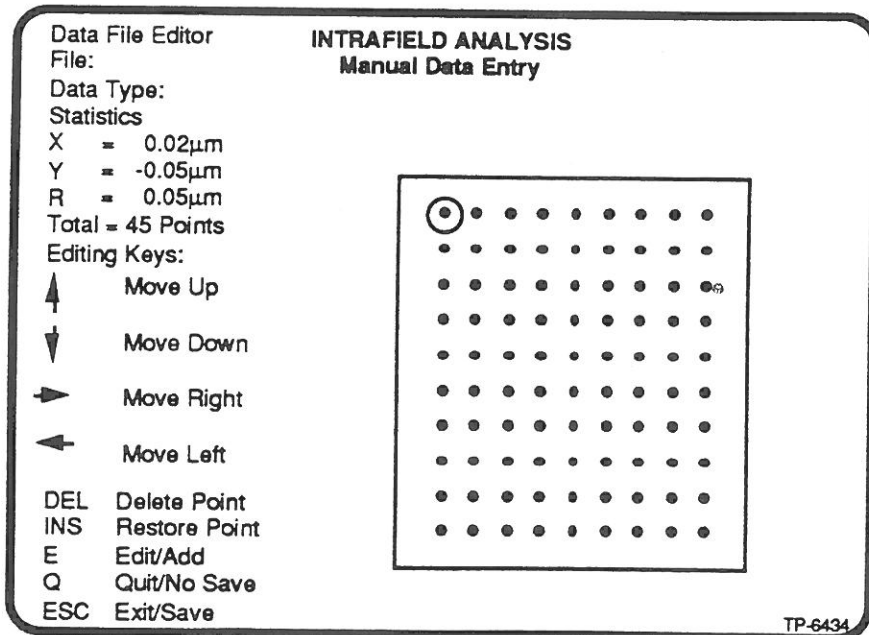
Figure 4-22
Manual Intrafield Data Entry Display

Spec Field Size Option

This option allows the user to limit the field size displayed and used for the SMARTSET calculations. When this option is selected the user must enter the current filename and the new filename. The Type of Field menu is displayed (Figure 4-23).

SPEC FIELD SIZE

Type of Field

1. **Circular**
2. **Rectangular**
3. **Previous Menu**

Figure 4-23
Type of Field Menu

Option 1: This option allows the user to enter a radial distance, from the center of the field, to be displayed. This option is useful to drop the outer edge of the field for more accurate readings in the center of the field.

Option 2: This option forces the user to enter the height and width, in mm, of the desired field area to display. This option is useful to display an area of the field where a particular chip is.

Option 3: This option returns the user to the Intrafield Analysis menu.

Model/Plot Vectors Option

This option displays a submenu of all the available intrafield analysis functions (Figures 4-24 and 4-25).

INTRAFIELD ANALYSIS

A. **Measured**
B. **Correctable**
    1. **Translation**
    2. **Rotation**
    3. **Reduction**
    4. **Trapezoid**
C. **Anamorphism**
D. **Lens Distortion**
E. **Residual**
F. **Previous Menu**

Figure 4-24
Intrafield Analysis Model/Plot Vectors Menu

Option A: This option displays the data as it was measured by the local alignment system.

Option B: This option displays the total correctable error readings.

Option 1: This option displays the translation error of the data read. The translation error is typically caused by incorrect local alignment baseline.

Option 2: This option displays the reticle rotation error of the data read. The error can be corrected either by entering an RMS reticle offset in MODE or by physically rotating the reticle with the micromanipulator (non-RMS systems).

Option 3: This option displays the reduction error of the data read. The error can be corrected by adjusting the MMP adjustment knobs or by using PPC.

Option 4: This option displays the trapezoid error of the data read. The error can corrected by making the suggested corrections from the Platen Corrections option to the platen.

Option C: This option displays the anamorphism error of the data read. This is an intrinsic lens error and cannot be corrected.

Option D: This option displays the lens distortion error of the data read. This is an intrinsic lens error and cannot be corrected.

Option E: This option displays the residual error of the data read. The error cannot be corrected; however, it can be minimized by making sure that the local alignment system and the wafer stepper system stages are operating optimally.

Option F: This option returns the user to the SMARTSET file directory.
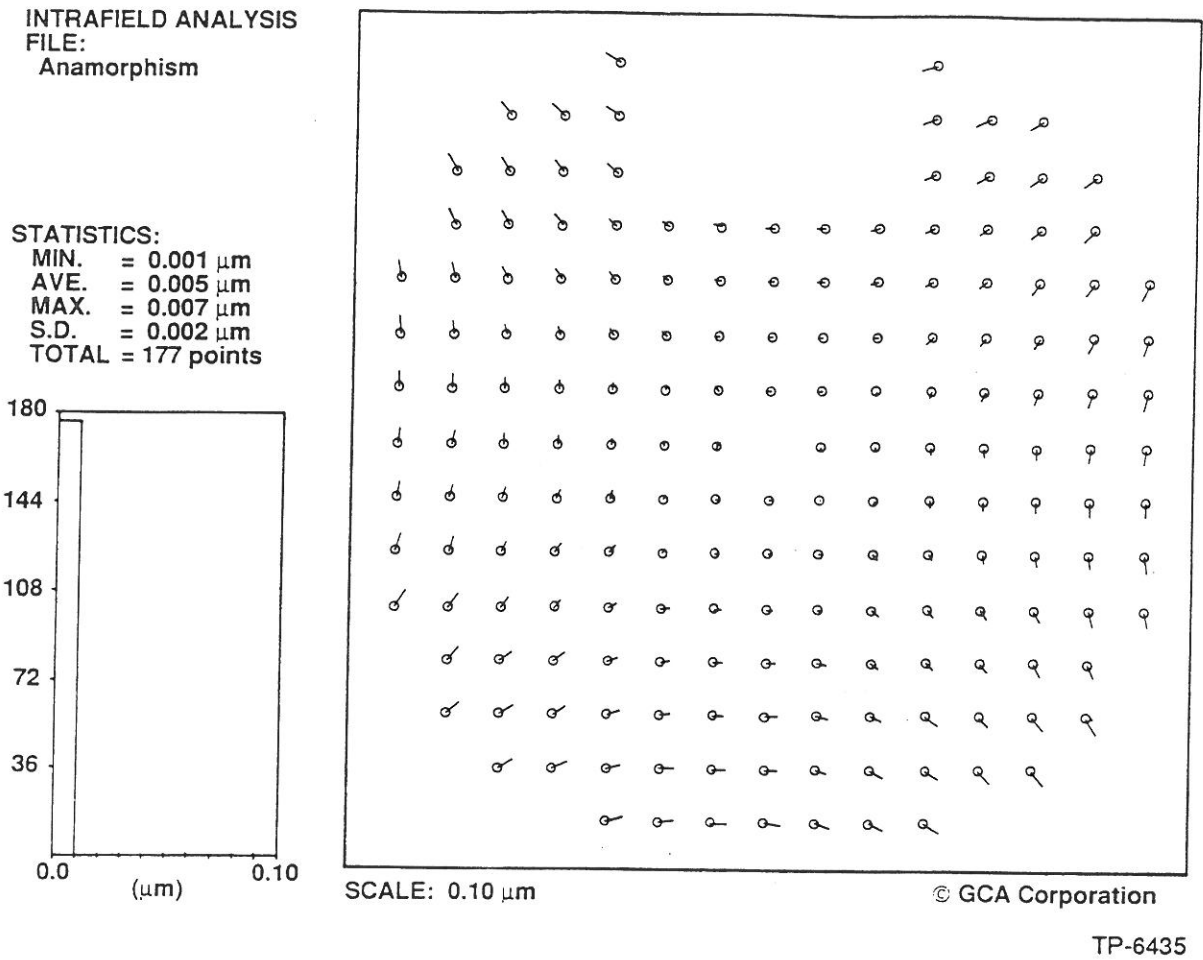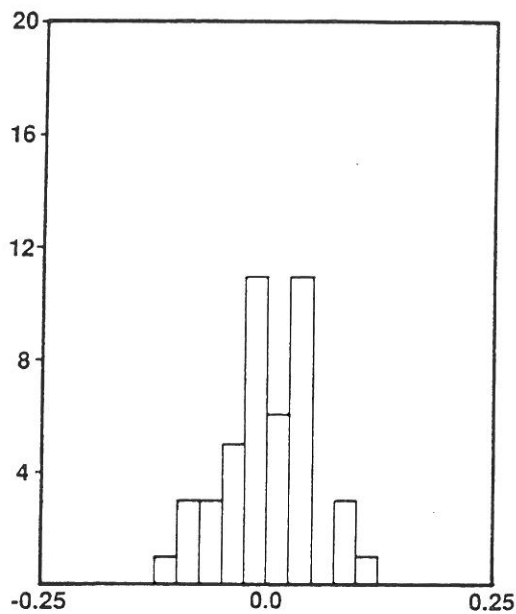
INTRAFIELD ANALYSIS
FILE:
Anamorphism

STATISTICS:
MIN.   = 0.001 µm
AVE.   = 0.005 µm
MAX.   = 0.007 µm
S.D.   = 0.002 µm
TOTAL = 177 points

SCALE: 0.10 µm   © GCA Corporation

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Figure 4-25
Typical Intrafield Analysis Model/Plot Vectors Display

Function Keys from within the Intrafield Analysis Menu

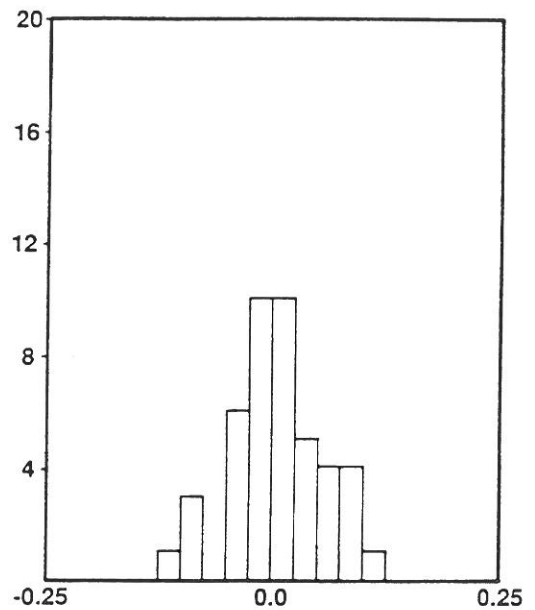The following function keys can be used while displaying vector diagrams.

F 1   Toggles between the vector diagram and the individual X and Y
           distribution bar charts (Figure 4-26).

F 2   Enables the scale of the present vector plot to be changed.

F 9   Outputs the vector diagram to the high-speed dot matrix printer.

SMARTSET
INTRAFIELD ANALYSIS
FILE:

X - statistics		+ Measured	Y - statistics	
MIN.	= -0.114 μm	- Translation	MIN.	= -0.115 μm
AVE.	= 0.000 μm	- Residual	AVE.	= 0.008 μm
MAX.	= 0.114 μm		MAX.	= 0.120 μm
S.D.	= 0.048 μm		S.D.	= 0.050 μm
TIR	= 0.228 μm		TIR	= 0.235 μm

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Figure 4-26
Typical Bar Chart Display

Platen Adjustments Option

This option displays the required platen corrections graphically for the user to apply to the platen (Figure 4-27).

INTRAFIELD ANALYSIS
Platen Adjustments File:

0.01 mils

Reticle Rotation Adjustments

XL = -0.028 μm
XR = 0.028 μm

② PLATEN ADJUSTMENTS
(Trapezoid + Reduction)
Reduction Only=
0.01 mils

③ ①

0.03 mils   0.02 mils

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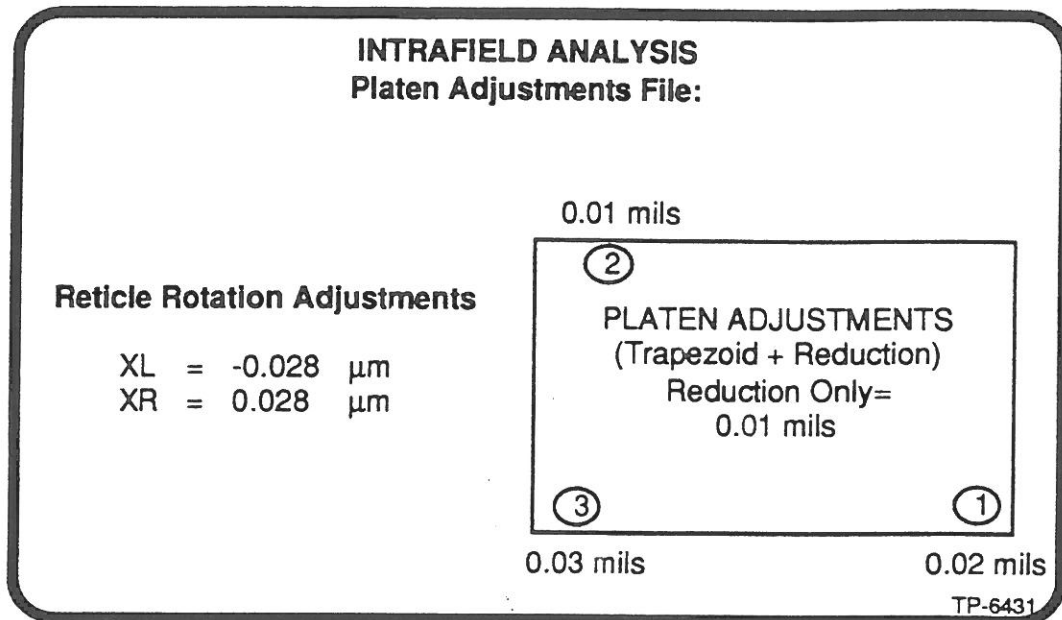
Figure 4-27
Intrafield Platen Adjustments Display

Tabulate Results Option

This option displays the intrafield alignment results numerically for individual alignment points. When this option is selected, a submenu is displayed requesting either radial coordinates or field coordinates, as shown in Figure 4-28.

TABULATED RESULTS

1. **Radial Coordinates**
2. **Field Coordinates**
3. **Previous Menu**

Figure 4-28
Tabulated Results Field Coordinate Menu

Option 1: This option requires that the user enter the desired radial distance, from the center of the field to be displayed. SMARTSET automatically selects the largest trapezoid and anamorphism to be displayed. The field size is the maximum distance that can be displayed (Figure 4-29 and 4-30).

Option 2:   This option requires the user to enter X and Y coordinates (in mm) to have the results for that alignment point to be displayed. Once the user enters the coordinates, the tabulated results are displayed (Figure 4-29 and 4-30).

Option 3:   This option returns the user to the file directory menu.

INTRAFIELD ANALYSIS

Tabulated Results

Radial Distance (mm)   10.00
[Field Coordinates (mm) X: 10.00   Y: 10.00]

		X Component	Y Component	Scalar
Symmetrical Parameters				
Reduction	(μm)	-0.04	-0.04	0.06
Rotation	(μm)	-0.09	-0.09	0.13
Distortion	(μm)	-0.05	-0.05	0.07
Asymmetrical Parameters (Maximum Value)				
Trapezoid	(μm)	0.03	-0.03	0.04
Anamorphism	(μm)	-0.05	-0.02	0.05

Figure 4-29
Intrafield Tabulated Results Display

NOTE: Field coordinates are only displayed if the Field Coordinates option is selected.
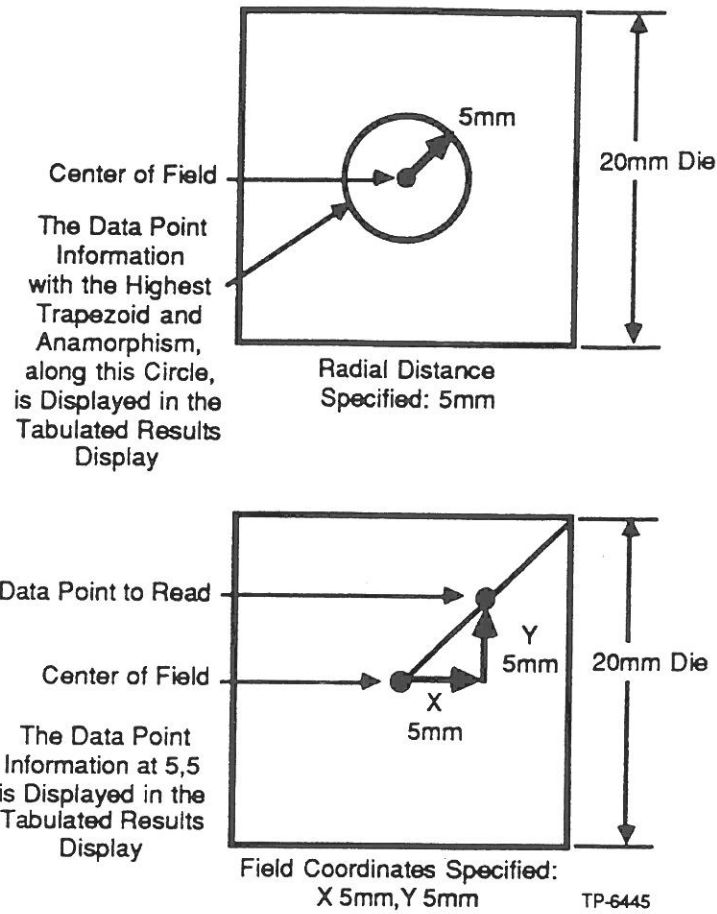
Figure 4-30
Radial/Field Coordinate Diagram

Plot Distortion Data Option

This option allows the user to graphically display the distortion of the wafer stepper system. If SMARTSET readings from different systems are available, the distortion can be overlaid to determine how well the wafer stepper systems can be matched.

PLOT DISTORTION DATA

Distortion Plot

1. **Single System**
2. **Overlay Files**
3. **Previous Menu**

Figure 4-31
Distortion Plot Menu

Option 1: This option plots the distortion of 1 system (1 data file). See Figure 4-32.

Option 2: This option plots the distortion of 2 or more systems (2 or more data files). See Figure 4-32.

Option 3: This option returns the user to the Intrafield Analysis menu.

Displaying Distortion Data

Perform the following to display the distortion data from 1 or more systems.

1. Select option 1 or 2 from the Distortion Plot menu, the file directory is displayed.
2. Enter the file number to display.
3. Enter a name for the file to be displayed.
4. Enter the field size to be displayed from 1-15mm.
5. Enter the maximum range of the distortion to plot, in μm from 0.1 - 0.05. The distortion plot is displayed as in Figure 4-32.
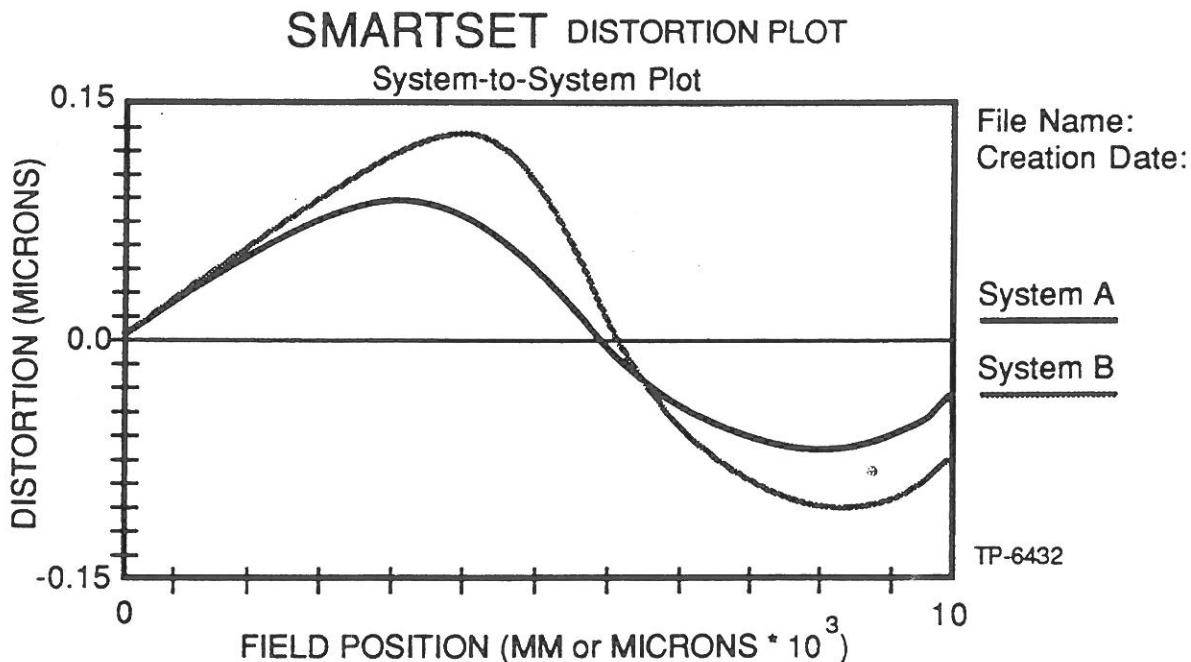
Figure 4-32
Distortion Plot Display

Uniformity Analysis Menu Selections

Uniformity Analysis Menu

This menu is displayed when the user selects option 3 from the System Analysis menu. These options allow the user to analyze and manipulate MAXIMUS uniformity data from IQ (Illumination Qualification) files (Figure 4-33).

UNIFORMITY ANALYSIS
Version 7.1

1. **Average Data Files**
2. **Difference of Data Files**
3. **Edit Data File**
4. **Analyze Data File**
5. **Previous Menu**

Figure 4-33
Uniformity Analysis Main Menu

Option 1: This option allows the user to take 2 or more IQ uniformity data files and average the results of those files to create a new file. The original files are not changed.

Option 2: This option allows the user to take 2 data files and subtract the second file selected from the first. The results are used to create a new file which is then analyzed to view the matching difference between systems. The original files are not changed.

Option 3: This option allows the user to modify, examine, or delete readings. When this option is selected, a picture of the original readings is displayed. Use the cursor keys to move around the plot, the DEL key to delete data points, and the INS key to replace any deleted data points.

Option 4: This option displays the uniformity data file. The display shows a 3-dimensional plot of the uniformity with red displaying the hot areas, green displaying the average temperature areas, and blue displaying the cold areas (Figure 4-34).

Option 5: This option returns the user to the System Analysis menu.

●●▲
GCA Intensity Analysis
Data File Name: 10-10-89.unf

Array size = 21 x 21
Field Size in X = 14.1 mm
Field Size in Y = 14.1 mm

Intensity within Field

Maximum = 308.011 mW/cm^2
Warm   > 313.622 mW/cm^2
Average = 305.973 mW/cm^2
Cool   < 298.323 mW/cm^2
Minimum = 277.595 mW/cm^2

Uniformity within Field

$\dfrac{Max - Min}{Max + Min}$ *100.0 = 5.19%

F1	Enter title
F3	Change array size
F4	Smooth plots
F9	Print screen
F10	Select cutoff

Legend

Red = Hot
Green = Midpoint + -2%
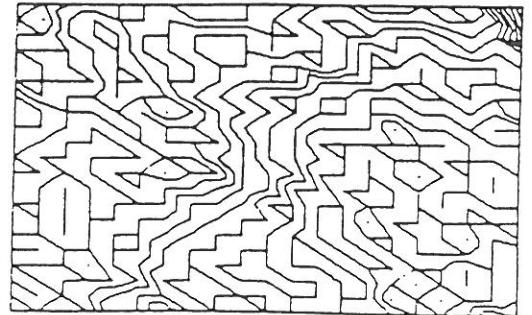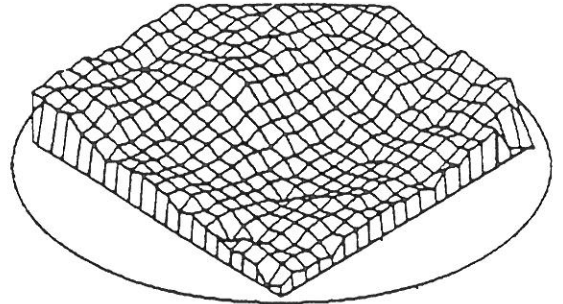Blue = Cold

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Figure 4-34
Uniformity Analysis Plot Display

Function Keys from within the Uniformity Analysis Menu

The following function keys can be used while displaying uniformity plots

F 1   Allows the user to enter a title name for the uniformity analysis display.

F 3   Allows the user to enter the number of rows and columns to display.

F 4   Smooths the plot display.

F 9   Prints the uniformity analysis display.

F 10   Allows the user to enter a cutoff point for the data being displayed.