Section 10 - Determining the Best System Focus

Introduction

Before exposing wafers using a newly created job specification, the process should be tested to determine the best focus for the array being used. Three methods are used to determine the best focus (listed in order of preference):

- **The INSITU command** is the easiest and most precise method available, and is not process-dependent, since it does not use any wafers.
- **The FOCUS command** uses a test wafer; it first exposes, then reads the wafer.
- **The EXPO, DEXPO, and AEXPO commands** are optional methods, used primarily for visual focus inspection.

The INSITU Command

The INSITU command is used to test the system focus, intrafield, and the Micro DFAS baseline. Entering the command INSITU at the system prompt displays the INSITU Utility Options menu (Figure 10-1).

NOTE: Refer to **Section 13 - Achieving Best System Performance** for a complete description of the INSITU Utility Options menu.

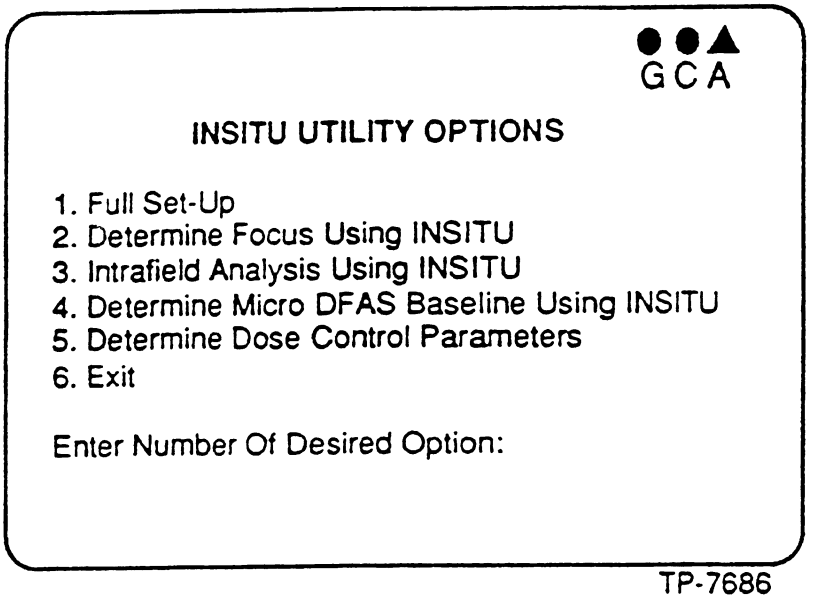


Figure 10-1
INSITU Utility Options Menu

System Focus

The system focus is the absolute focus. The zero or reference point of the system focus is now 0. All focus changes or offsets are applied to this value. All compensation values for pressure or temperature are applied to system focus so as to be transparent to the user.

Since the job focus offset is directly referenced to the system focus in MODE, the operator should have to set the job focus for each process level only once. When all job focuses are properly set, the system focus in MODE should be the only necessary focus change (unless the process has been changed). Any atmospheric changes affect the AUTOSTEP 200 system as a whole (all jobs) and therefore, the system focus in MODE sets all the jobs back to the best focus position.

FOCUS Command

Figure 10-3 is a flowchart showing the FOCUS command operation.

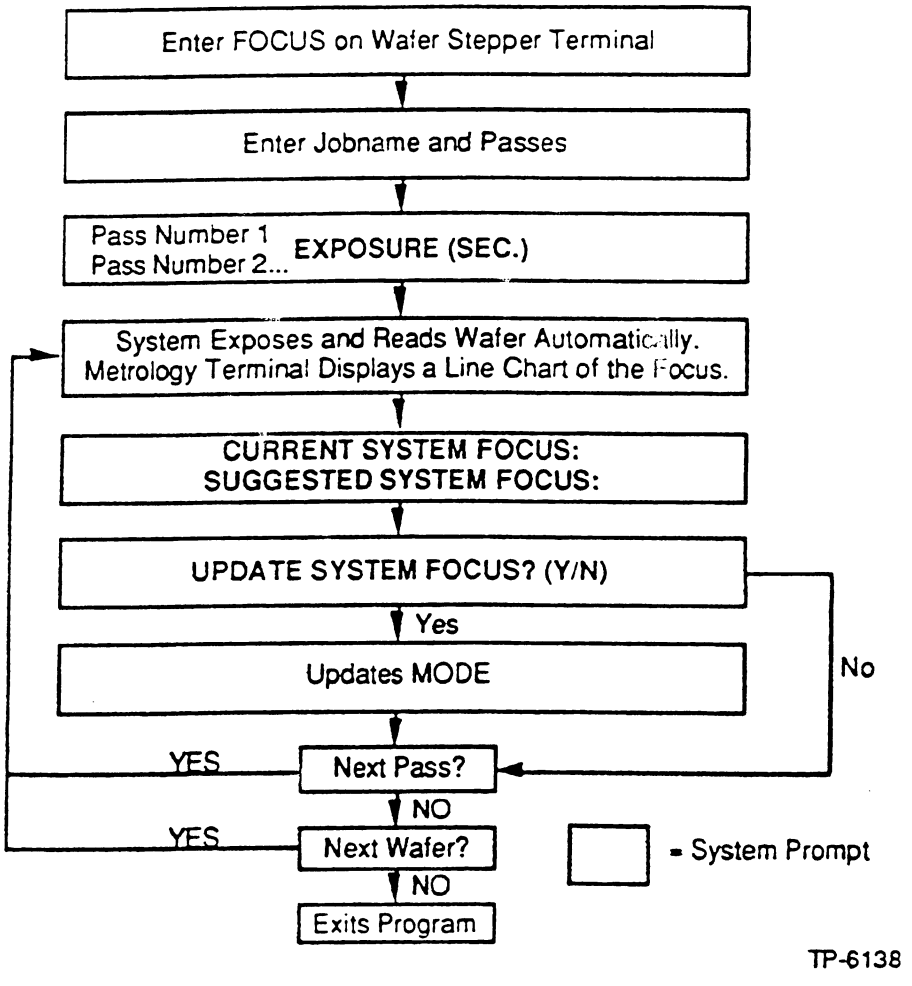


Figure 10-3
Flowchart of FOCUS Command Operation

When the operator enters the FOCUS command, the system prompts for a job program name, pass, and exposure time, but not for focus information. The wafer is automatically stepped with focus increments being controlled by the FOCUS command software to produce approximately ±6µm change in focus. The array is automatically centered around the current system focus (see Figure 10-4 for an example).

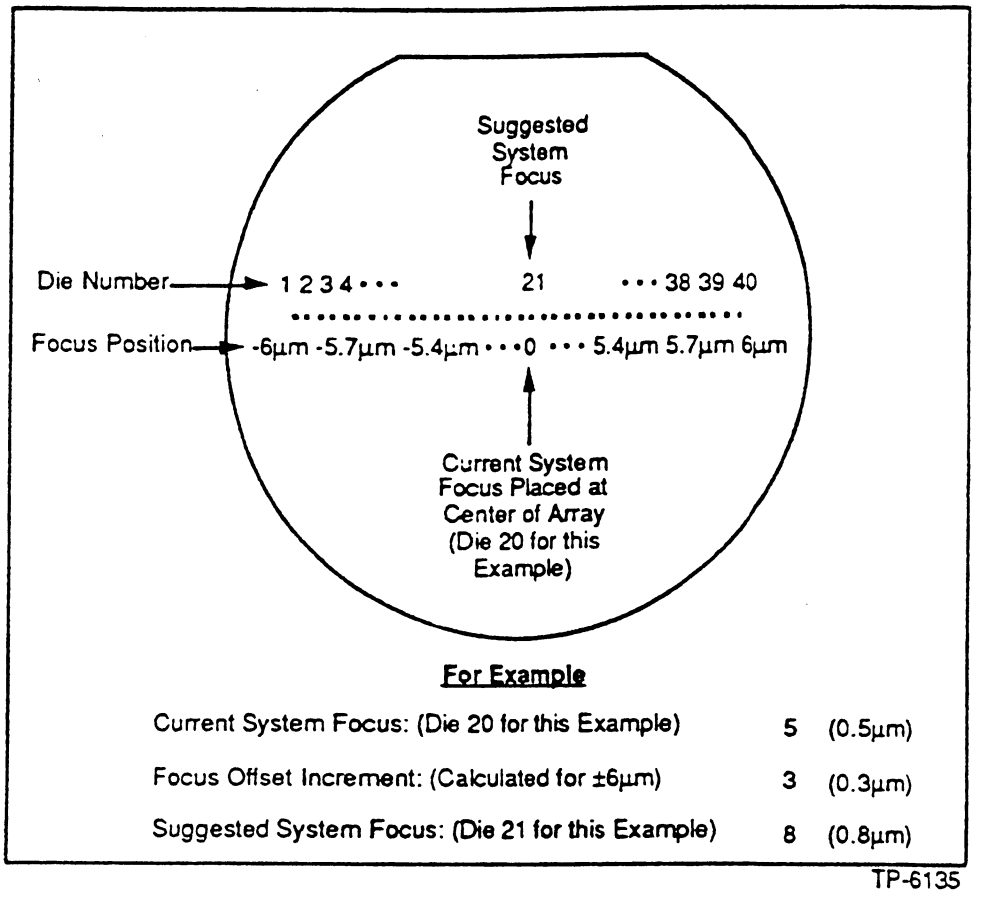


Figure 10-4
Example of FOCUS Array

After the wafer is exposed, it is read by the metrology system. The results are then displayed on the monitor. The user is then prompted with the new suggested system focus and asked whether to update the system focus in MODE. A YES response updates the system focus setting in MODE with the new focus value. If a NO response is entered, the system does not update the system focus value; however, the system prompts the user with the suggested job focus offset. This job focus offset should be entered into the specific job and will only affect that job.

Enter the FOCUS command using the following procedure:

NOTE: Make sure that the AGC option for Micro DFAS is turned ON before operating the FOCUS command.

1. At the system prompt (:), enter the command **FOCUS jobname\pass,** where **jobname** is the job containing the array to be tested, and **pass** is the pass name used from within the job. The FOCUS command automatically controls the focus increments to create a focus change of approximately ±6µm centered around the current system focus.
2. At the prompt **DOSE UNITS,** enter the best known value for the process being used.
3. When the Micro DFAS displays **WAITING FOR MOP COMMAND,** load a standard test wafer into a cassette and place on the send elevator.
4. At the system prompt, enter **RST,** then press RETURN.
5. Press the 1ST LEVEL and then the S/C keys on the VT340 keyboard. To position the wafer at the align position, press the S/C key.
6. Press the MANUAL key.
7. At the system prompt, enter **EXEC,** then press RETURN. The system then automatically loads and exposes the wafer.

When the exposures are complete, the Micro DFAS automatically reads the latent dies and displays a line graph of the system focus (see Figures 10-5 through 10-7 for examples of the Evaluate Grid Focus display). The FOCUS command automatically performs all the Micro DFAS functions. The system then displays the current system focus in MODE and the newly-calculated, suggested system focus value.

8. At the prompt **UPDATE SYSTEM FOCUS,** perform one of the following:

   - To automatically enter the new system focus in MODE and save it on the hard disk drive, enter **Y.**
   - To exit the program (unless another pass was specified or another wafer is ready to be loaded onto the wafer chuck), enter **N.**

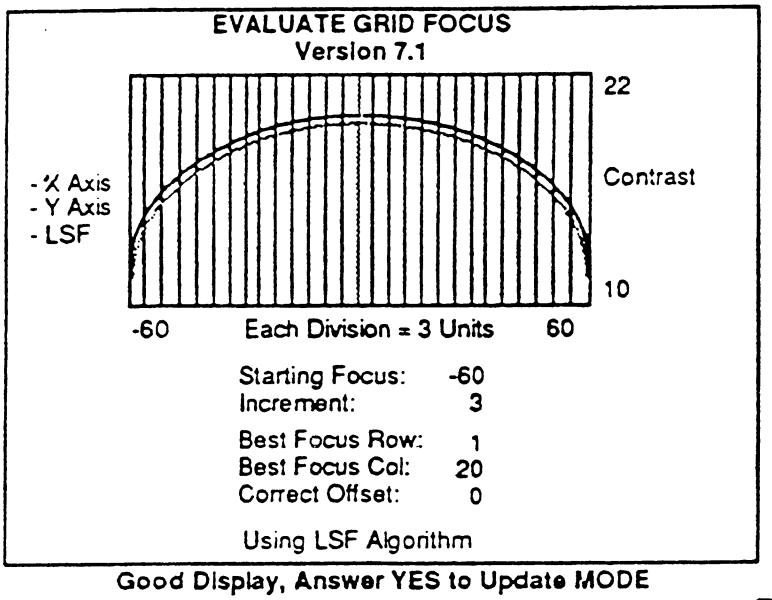
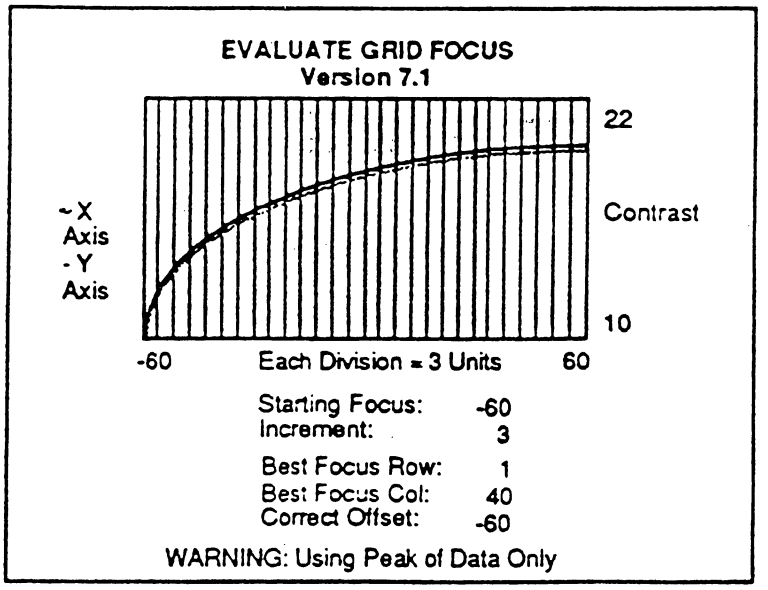


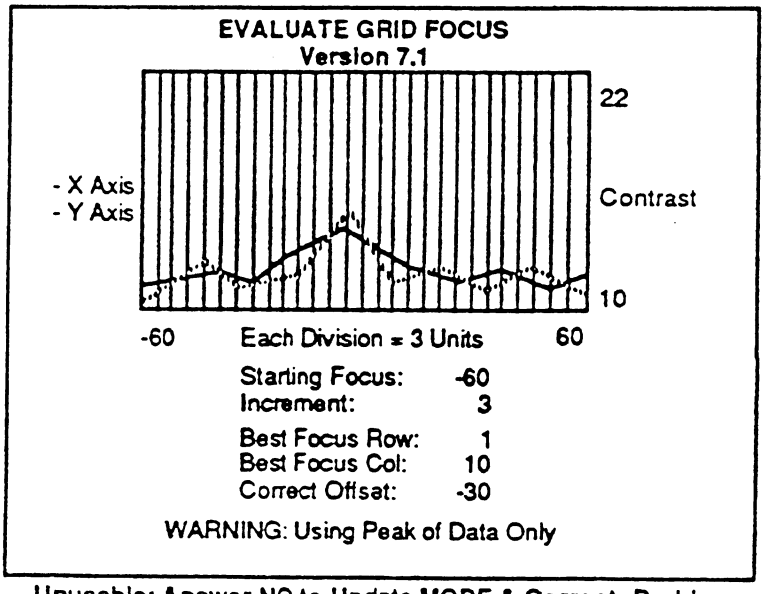
Figure 10-5
Best Evaluate Grid Focus Display



Display is OK; Answer YES to Update MODE and Repeat FOCUS Test to Center Array

TP-6133

Figure 10-6
Improperly Centered Evaluate Grid Focus Display



Unusable; Answer NO to Update MODE & Correct Problem

TP-6134

Figure 10-7
Unusable Evaluate Grid Focus Display

For more information on the FOCUS command, see the Metrology System Operation Manual (P/N 069062).

The EXPO Command

The EXPO command creates various focus/exposure arrays from a previously specified job program that contains different focus and dose settings at each exposure site of the array. The array is a one-time pass that is exposed on the wafer. The user sets the array parameters again in order to expose the array a second time.

Enter the EXPO command using the following procedure:

1. At the system prompt (:), enter the command **EXPO jobname\pass**, where **jobname** is the job containing the array to be tested, and **pass** is the pass name used from within the job. (This should be an array pass, since EXPO exposes all sites within the boundaries of the array specified in the job.)
2. At the prompt **STARTING ROW**, enter the first row number within the array.
3. At the prompt **ENDING ROW**, enter the last row number within the array.
4. At the prompt **STARTING COLUMN**, enter the first column within the array.
5. At the prompt **ENDING COLUMN**, enter the last column within the array.
6. At the prompt **OVER C-OARSE FOCUS ARRAY, F-INE FOCUS ARRAY, E-XPOSURE ARRAY, OR R-OW**, enter the type of array to be exposed:

    - To use the micrometer on the left of the column, enter **C**.
    - To use the autofocus system to increment or decrement focus using a boustrophedonic pattern on the wafer, enter **F**.
    - To use a constant focus, and increment or decrement dose using a boustrophedonic pattern on the wafer, enter **E**.
    - To increment focus for each row within the array, and dose for each column, enter **R**.

When **R** is entered, the prompt **DO YOU WANT TO RUN AN OPEN FRAME TEST** is displayed (described later in this section of the manual); when either C, E or F is entered, the system continues with the following prompts:

7. At the prompt **STARTING EXPOSURE (SEC.)**, enter the starting exposure setting for the first site within the array.
8. At the prompt **INCREMENTAL EXPOSURE (SEC.)**, enter the value that will increment the exposure setting for each site within the array. When a negative value is entered, exposure will decrement for each site by the value specified.
9. At the prompt **INITIAL FOCUS SETTING**, enter the starting focus setting for the first site within the array.
10. At the prompt **FOCUS INCREMENT**, enter the value that will increment the focus setting for each row within the array. When a negative value is entered, the focus is decrement for each site by the value specified.
11. At the prompt **DO YOU WANT TO RUN AN OPEN FRAME TEST**, enter **N**. (An open frame test uses no reticle on the platen: this is done only when MAXIMUS uniformity is being tested.)

12. At the prompt **RETICLE BAR CODE**, perform one of the following (a reticle code will appear after the prompt, indicating that a reticle is specified within the job):

    - To keep the reticle being used in the test, press RETURN.
    - To change the reticle being used in the test, enter the new reticle code.
    - To use a reticle in a particular floor number of the RMS elevator, enter NONE. At the prompt **FLOOR NUMBER**, enter the elevator floor number where the desired reticle is contained.

13. At the prompt **PRESS 'RESET' THEN 'S/C', LOAD WAFER AND THEN PRESS MANUAL**, initiate the stepping by performing the following:

    a. Make sure that the wafer is properly loaded.
    b. Press the RESET key.
    c. Press the MANUAL key, after the AWH has reset (approximately 10sec.).
    d. Press the MANUAL key again. The monitor then displays (along with the appropriate values):

       X:
       Y:

    e. Press the EXPOSE key.

The AUTOSTEP 200 system then executes the job using the focus and exposure settings specified. The array is exposed in a boustrophedonic fashion.

To store an EXPO array in memory, see The DEXPO Command in this section of the manual.

The DEXPO Command

Dose/focus tests can also be performed using a file that contains all settings to be used for focus and/or dose increments. The DEXPO command creates a file that contains the responses to the EXPO prompts. The DEXPO command saves the user from entering data each time the same job is needed.

Edit a DEXPO file using the following procedure:

1. At the system prompt (:), enter **DEXPO filename\pass**. (The filename requires no extension.)
2. Press RETURN.

The system then displays the responses to the EXPO prompts for the specified job.

NOTE: When responding to the prompts, enter an asterisk (*) to allow the user to change the parameter at run time during AEXPO.

3. Edit the desired response as follows:

   a. Use the up- and down-arrow keys to position the cursor at the desired response.
   b. Enter the new response.
   c. Press RETURN to continue.
   d. Repeat step 3 until all responses are accurate for the specified job.

4. At the prompt **COMMENT**, enter the desired comment.
5. At the prompt **PURGE DEXPO FILES? (*Y/N)**, type either **Y** or **N**.

To run a DEXPO file, see The AEXPO Command in this section of the manual.

The AEXPO Command

The AEXPO command allows the user to retrieve DEXPO files that have been stored in memory. DEXPO files contain various focus/dose arrays and parameters used to expose a wafer. The following is an *example* of the AEXPO command using sample responses.

Enter the AEXPO command in the following format: **AEXPO filename.** The system then displays a screen similar to the following:

```
JOB NAME AND PASS:    RES\1
METRIC JOB CREATED:  8:55      06/06/89
JOB COMMENT:
THIS IS A 5X5 ARRAY AT 20mm STEPPING.
ARRAY PASS #1 NAME: 1
PASS COMMENT.
DO YOU WANT TO RUN AN OPEN FRAME TEST (Y/*N):
RETICLE BAR CODE:  4800-009       4800-003
FLOOR # (OPTIONAL):    5
RETICLE NAME IS:  4800-003
ORIGINATING PROGRAMMABLE OFFSET
CONTROL.....COMPLETE
PRESS 'RESET' AND START AWH
```

Section 11 - The SETUP Command: Preparing the System for Operation

The SETUP command adjusts the system parameters to a reference or zero value without the use of send-ahead wafers using INSITU. The operator must make sure that the INSITU SETUP-01 reticle is present in the RMS library to run the SETUP command function. The SETUP command automatically reads focus, intrafield, and local aligner baseline, then automatically updates the MODE program with the new corrections. If the AUTOSTEP 200 system is equipped with PPC, RMS, and AWA/D, the focus, intrafield, and the baseline tests are performed automatically without user intervention. When the SETUP command is entered on the VT340 keyboard, the following steps are executed automatically (Figure 11-1).

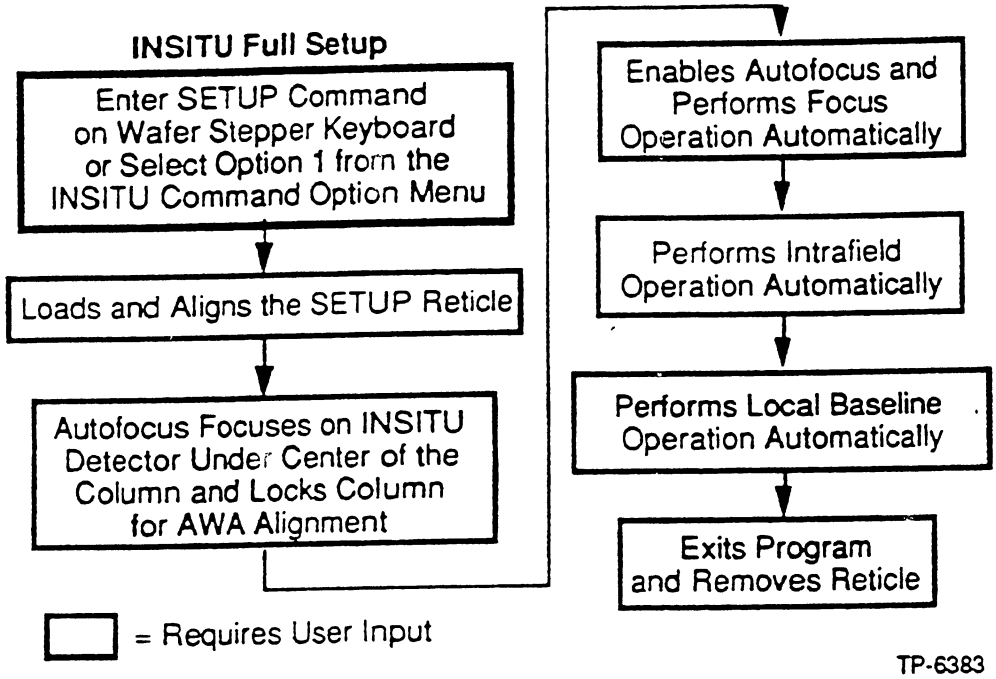


Figure 11-1
Flowchart of SETUP Command Operation

Determining System Focus

The SETUP command relies on INSITU alignment techniques (see **Section 13 - Achieving the Best System Performance**), and the SETUP-01 reticle to determine system focus. The INSITU detector is commanded to be placed directly under the lens and to perform a series of alignment scans on the center of the cell of the reticle. The optical column is commanded to move up 12microns from the current focus position and then moves down. A scan is performed at every 0.6 microns of downward movement and the movement and scanning process

continues until the column is 12microns below the current focus setting. The software then plots a curve of the relative contrast values at the different 0.6micron positions on the metrology monitor screen and then performs a least-squares-fit analysis to determine the nominal focus position as it relates to the peak contrast level. The new focus value is determined and automatically entered into the MODE file in the MOP.

Determining Intrafield Corrections

The intrafield parameters consist of lens magnification, X-axis trapezoid, Y-axis trapezoid, and reticle rotation errors which are all measured and corrected by using INSITU and the SETUP-01 reticle. This reticle contains an array of quad-style Micro DFAS alignment targets spaced on 1.0mm steps. The lens magnification errors are measured by stepping the INSITU detector to each user-selected target and performing a local alignment to determine the positional X-axis and Y-axis displacement. After the alignment data has been collected, the intrafield error coefficients are calculated and displayed on the metrology monitor screen. The X-axis and Y-axis trapezoid errors are automatically sent to the PPC where the PPC piezoelectric crystals position the platen at the new calculated platen position. The reticle rotation errors are sent to the RMS aligner controller and the reticle is realigned to the new calculated position.

Determining Local Alignment Baseline

Local alignment baseline is the nominal distance between the local alignment system (Micro DFAS) and the center of the reticle. INSITU aligns to four marks at the edges of the field and calculates the exact center of the reticle. The INSITU detector is positioned under the Micro DFAS where the alignment system performs an alignment to the INSITU alignment mark. The software calculates the X-axis and Y-axis local baseline corrections and automatically applies the corrections in the MODE file.

For more information on the SETUP command, see the Metrology System Operation Manual (P/N 069062).

Section 12 - Operating the System

Before processing any wafers on the AUTOSTEP 200 system, make sure that the following tasks have been performed:

- The VT340 monitor and keyboard are set up
- All subsystems are powered up
- The system is configured
- Parameters and subsystems are set
- A job specification is developed

Initializing and Loading the AWH III

At the start of each job, the AWH III automatically resets itself. The send and receive elevators rise to their uppermost position, and the transfer arm, robot, and prealign assemblies return to their home positions. To reset the system (if desired), at the system prompt, enter **RST**, then press RETURN.

Initialize and load the AWH III by performing the following:

1. Place an empty cassette on the receive elevator.
2. Fill a cassette with up to 25 wafers.
3. Place the filled cassette on the send elevator.

Loading the RMS

Load the RMS by loading reticles into cassettes and placing the cassettes in the elevator/cassette library. Load the RMS using the following procedure:

1. Load the reticle cassettes with reticles as follows (Figure 12-1):

    a. Place the reticle cassette on a level surface.
    b. Open the top hinged cover by pulling the locking tabs slightly outward, while simultaneously pulling up on the top cover.
    c. Hold the reticle by the side edges with the chrome side facing down.
    d. Place the leading edge of the reticle against the backstops, and lower the reticle onto the support platform.
    e. Close the reticle cassette cover.
    f. Repeat steps 1a through 1e until all reticles required have been loaded into reticle cassettes.

As each cassette is loaded, it can be stacked on top of another. Stacking the cassettes enables easy and safe transport to the RMS assembly.

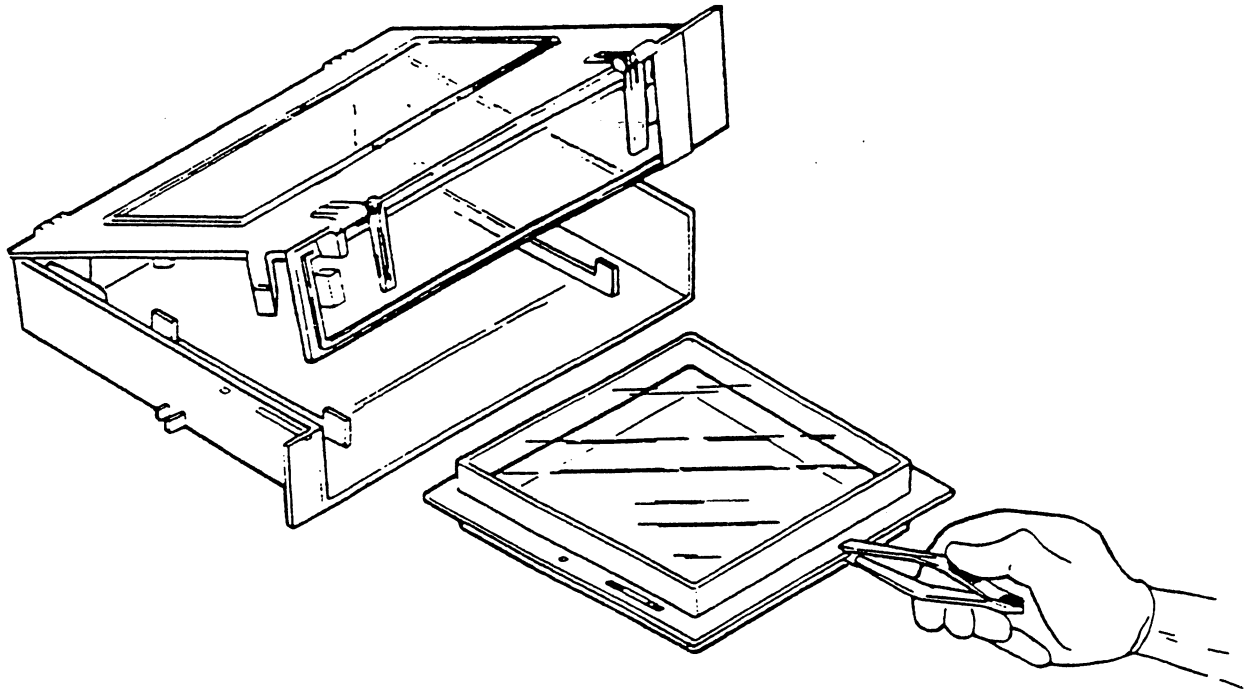


Figure 12-1
Loading Reticles into the RMS

2. At the system prompt (:), enter the command **RMSLOAD**.
3. Load the elevator/cassette library with the loaded reticle cassettes as follows:

   a. Pull out and hold a cassette locking pin on the cassette library.
   b. Insert the loaded reticle cassette into the slot (floor).
   c. Make sure that the reticle cassette sits fully at the rear of the slot.
   d. Release the cassette locking pin.
   e. Repeat steps 3a through 3d until all reticle cassettes required have been loaded into the RMS.

4. Press RETURN. The system automatically inventories the new reticles.

Executing a Job

Once the system has been powered up, configured, programmed, and loaded with the required reticles and wafer cassettes, wafer processing can begin. Wafer processing begins by executing a job.

Execute a job by entering the **EXEC** command using the following procedure:

1. At the system prompt, enter **EXEC jobname\pass**, where *jobname* is the name of the job program to be used, and *pass* is the pass number within the job. (To specify more than one pass for use, enter up to ten pass names separated by commas.)

The system then displays the job's creation date and time, and the units in which parameters were specified in the file.

> **CAUTION**
>
> When setting exposure time in the pulse mode, maximum exposure time is 1sec. If exposure time when pulsing is over 1sec., the MAXIMUS bulb could explode.

2. At the prompt **EXPOSURE (SEC): setting, (G-O, S-KIP, M-ODIFY EXPOSURE AND GO)** perform one of the following:

   - To change this value, enter **M**, and enter the new exposure setting at the prompt.
   - To leave the value as is and use the pass for job execution, enter **G**.
   - To leave the exposure setting as is and not execute this pass, enter **S**.

NOTE: When in the pulse mode, if an exposure time greater than 1sec. is entered, the system displays a warning that 1sec. is the maximum recommended exposure time.

3. At the prompt **FOCUS SETTING: setting**, perform one of the following:

   - To change this value, enter the focus setting required.
   - To leave the value as is, press RETURN.

4. At the prompt **RETICLE BAR CODE: reticle code**, perform one of the following:

   - To use this reticle, press RETURN.
   - To specify a different reticle from the one displayed, enter the desired reticle code.
   - If no bar code is available on the reticle being specified for use, enter **NONE**. At the prompt **FLOOR NUMBER**, enter the floor number of the elevator within which the reticle is located.

Using the AWH to Automatically Load Wafers

To use the AWH for automatic loading and unloading of wafers, perform the following:

1. Make sure that the AWH has been initialized and loaded.
2. Perform one of the following:

   a. For first-level exposures, press the 1ST LEVEL key on the VT340 keyboard.
   b. For second-level and above exposures, press the S/C key on the VT340 keyboard.

Manually Loading Wafers

Manually load and unload wafers onto the AUTOSTEP 200 system as follows:

1. At the system prompt (:), enter EXEC, then pressing RETURN. The stages then move to the load position.
2. At the prompt **START AWH**, press the MANUAL key.
3. At the prompt **LOAD NEW WAFER**, press the MANUAL key. The stages will then move to the align position.

Executing Exposures on Product Wafers (EXEC)

Execute exposures on product wafers as follows:

1. At the system prompt (:), enter EXEC.
2. At the prompt **ENTER DEVICE, UFD, AND FILENAME**, enter the job program name, then press the RETURN key. The system displays the job comment, if applicable.
3. At the prompt **PASS**, enter the number of passes required, then press the RETURN key.
4. At the prompt **PASS COMMENT**, edit the existing pass comment if desired, then press the RETURN key.
5. At the prompt **EXPOSURE (SEC) = nnnnnnn, (*G-O, S-KIP, M-ODIFY EXPOSURE & GO)**, perform one of the following:

   - To proceed with the indicated exposure time (which was set as part of the job file), type G, then press RETURN.
   - To skip this pass, type S, then press RETURN.
   - To modify the indicated expose time, type M, then press RETURN.

6. At the prompt **FOCUS SETTING: nnn**, perform one of the following:

   - If no changes are required, press RETURN.
   - If changes are required, edit the current focus setting, then press RETURN.

7. At the prompt **RETICLE BAR CODE: nnnn-nnn**, perform one of the following:

   - To accept the reticle shown, press RETURN.
   - To change the reticle shown, edit the current reticle selection, then press RETURN.

8. At the prompt **FLOOR # (OPTIONAL):**, either enter the floor number required (if no bar code exists on the reticle), or press the RETURN key.
9. Repeat steps 4 through 8 for all passes selected at step 3.

The system then performs the following functions (where applicable): retunes the laser, originates the laser counter, resets the RMS, and originates the offset control.

10. Press the key representing the desired function:

    - If executing first-level exposures, press the 1ST LEVEL key.
    - If executing second-level or above exposures, press the S/C key.
    - If manually executing a job, press the MANUAL key.

11. Follow the instructions on the prompts that appear on the monitor.

The system automatically steps through the job. Once the stage has returned to the docking position, perform the following:

12. Switch the CHUCK VAC switch to OFF.
13. Remove the wafer from the wafer chuck.
14. At the prompt **CONTINUE THIS JOB? (Y/*N)**, perform one of the following:

    - To discontinue the job, enter N. The system will prompt **DO YOU WANT RETICLE TO BE RETURNED? (Y/*N)**. Respond Y or N.
    - To continue the job, enter Y. At the prompt **LOAD NEW SUBSTRATE AND PRESS 'MANUAL'**, perform the following:

      a. Load the next wafer.
      b. Repeat steps 10 and 11 to run the next job.
      c. Repeat steps 12 and 13 until all jobs are complete.

Manually Removing Reticles From the Reticle Platen

To manually remove a reticle from the reticle platen, enter RMSRET. The RMS transfers the reticle from the platen to the cassette.

Aborting a Job

To abort a job, perform the following:

1. Simultaneously press the **CTRL** and **C** keys. The system then displays a double prompt (::).
2. Enter **ABORT**.

Edge Die Capability

Edge die capability permits the user to increase the number of die-per-wafer by allowing the use of the previously non-used 3mm edge band wafer area. The AUTOSTEP system detects that a die has been placed in this area of the wafer and reports the detection to the user as shown in the following example:

```
EDGE DIE DETECTED:  ROW 2  COLUMN 3
```

NOTE: The AUTOSTEP system does not stop stepping wafers when an edge die is detected and the report is listed on the screen.

When an edge die is detected, the optical column position is measured, the optical column is held at the measured position, the auto-focus system is disabled and the edge die is exposed. The last measured position of the optical column is maintained if there is more than one edge die being exposed in succession.

Once the edge die has been exposed, the autofocus system resumes normal activity and controls the position of the optical column with respect to the topography of the wafer until the next edge die is detected.

Selecting Automatic or Manual Global Alignment

The user now has the capability of enabling or disabling automatic global wafer alignment during the global alignment sequence. By pressing the S key during automatic global alignment, the software prompts the user with the current alignment method status (auto or manual), and permits the user to change the status without aborting the job program.

If the AUTOSTEP system is in automatic alignment mode and the S key is pressed, the AWA/D stops aligning and asks the following question:

```
AWA IS IN AUTO, DO YOU WANT IT IN MANUAL? (Y/*N):
```

If the AUTOSTEP system is in manual alignment mode when the S key is pressed, the following question appears:

```
AWA IS IN MANUAL, DO YOU WANT IT IN AUTO? (Y/*N):
```

Viewport Operation

NOTE: The Viewport Operation procedure replaces and eliminates the use of the Peak MAXIMUS Intensity option located within the Illumination Qualification menu.

1. Align mercury arc-lamp to pencil marks on the front and side Viewport screens as shown in Figure 5 by adjusting X,Y,Z lamp adjustment knobs on MAXIMUS 2000 lamphouse cover. This position indicates the position which the lamp should be aligned to when the lamp is replaced.

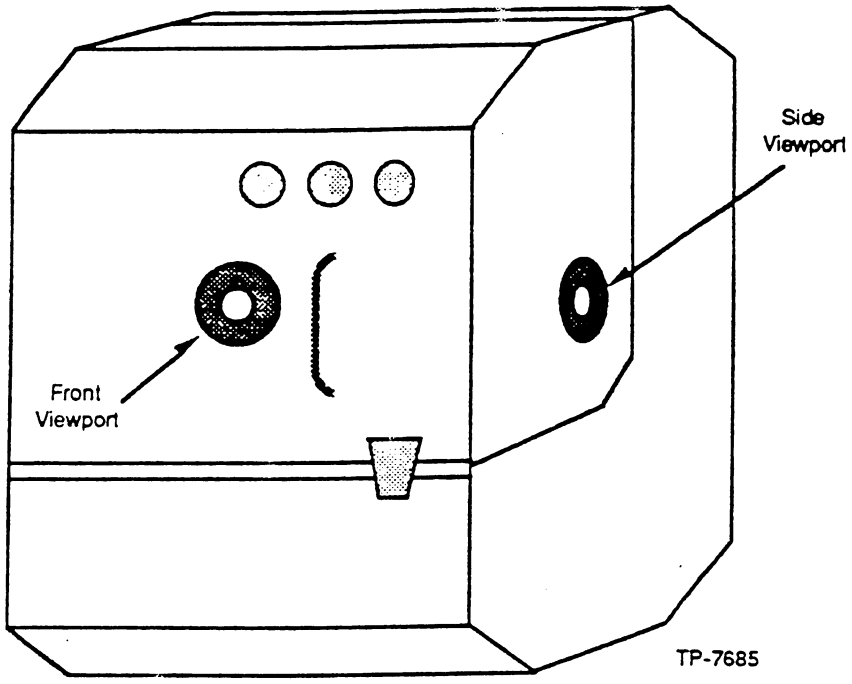


Figure 12-2
Viewport Locations

2. Perform uniformity with I.Q. or O.A.I meter

- **8, 9, and 10 - T1, T2, and T3 Index Scaling** automatically execute the ACS commands st1i, st2i, and st3i, respectively, to set the index compensation coefficient sensitivity due to the material probe. The default is 0.0µm/°C, with the limits being from -1.0ppm/°C to -1.0ppm/°C.

Reset Menu

Selecting the Reset option in the ACS Main menu displays the following menu shown Figure 13-22.

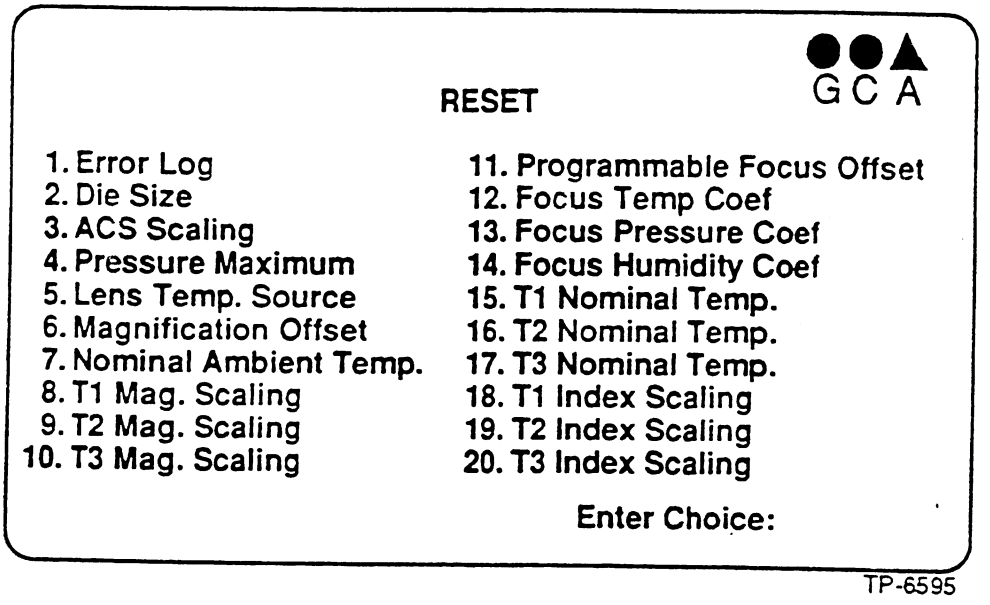


Figure 13-22
Reset Menu

- **1 - Error Log** clears the error log listing.
- **2 - Die Size** executes the ACS command rds which resets the die size parameter to the default value of 20.0mm.
- **3 - ACS Scaling** executes the ACS command ras which resets the ACS scaling parameter to the default value of 0.10 volts/µm.
- **4 - Pressure Maximum** executes the ACS command rpm which resets the pressure maximum (PMAX) parameter to the default value of 790 mm/Hg.
- **5 - Lens Temp Source** executes the ACS command rls which resets the lens temperature source parameter to the default value of 1.

- 1 - **Reset Focus Saturation Point 1** resets the primary focus saturation value which models the absorption behavior of the lens. This value is based on the lens absorption measurements using the "ICE 100%" ICE setup reticle.

- 2 - **Reset Focus Saturation Point 2** resets the secondary focus saturation value which models the absorption behavior of the lens. This value is based on the lens absorption measurements using the "ICE 100%" ICE setup reticle.

- 3 - **Reset MAG Saturation Point 1** resets the primary MAG saturation value which models the absorption behavior of the lens. This value is based on the lens absorption measurements using the "ICE 100%" ICE setup reticle.

- 4 - **Reset MAG Saturation Point 2** resets the secondary MAG saturation value which models the absorption behavior of the lens. This value is based on the lens absorption measurements using the "ICE 100%" ICE setup reticle.

- 5 - **Reset Heating Time Constant 1** resets the primary heating exponential time constant value which models the absorption behavior of the lens. This value is based on the lens absorption measurements using the "ICE 100%" ICE setup reticle.

- 6 - **Reset Heating Time Constant 2** resets the secondary heating exponential time constant value which models the absorption behavior of the lens. This value is based on the lens absorption measurements using the "ICE 100%" ICE setup reticle.

- 7 - **Reset Cooling Time Constant 1** resets the primary cooling exponential time constant value which models the absorption behavior of the lens. This value is based on the lens absorption measurements using the "ICE 100%" ICE setup reticle.

- 8 - **Reset Cooling Time Constant 2** resets the secondary cooling exponential time constant value which models the absorption behavior of the lens. This value is based on the lens absorption measurements using the "ICE 100%" ICE setup reticle.

- 9 - **Reset Lamp Intensity Reference** resets the intensity of the lamp on the system from which the saturation point is determined during calibration.

- 10 - **Reset All** resets all of the current ICE constant values to their default values.

Lens Type

The lens type display indicates the lens type that was selected for the ACS chassis. Depending upon customer needs, one of several different lenses can be installed in the AUTOSTEP 200 system.

NOTE: The ACS system must be set to the specific lens type installed in the AUTOSTEP 200 system to ensure optimum compensation.

VOV

The variable orifice valve (VOV) controls the flow of Nitrogen to the reduction lens to maintain target pressure. The VOV display has a range of -150 to 475. When the VOV number is below 0, lens pressure is being vented. When the VOV number is above 0, the lens is pressurized with Nitrogen. The VOV display value changes as required to meet nitrogen flow requirements.

NOTE: The VOV value should not be compared to other AUTOSTEP 200 systems as a measurement of absolute nitrogen flow.

Lens Parameters

Target pressure is the nitrogen pressure internal to the lens which the ACS computer calculates to correct for environmental effects.

The focus temperature coefficient is a value which compensates for focus sensitivity due to minor lens temperature changes caused by ambient effects within the environmental chamber temperature regulation. The focus temperature coefficient is expressed in units of µm/deg C. Typical temperature excursions are a fraction of 1 degree C.

The focus saturate parameter is a calibration value used to compensate for exposure energy which has been absorbed by the lens.

The mag saturate parameter is a calibration value used to compensate due to exposure energy which has been absorbed by the lens.

Probe Status

The probe status indicates whether a material temperature probe is on or off. A probe is automatically considered off if a valid temperature value between 15-30°C is displayed. A disconnected probe cable reads *off* and is not recognized by the ACS during the start-up process. The temperature measured by the material probes within the AUTOSTEP system are also displayed. The MT1 probe is the material temperature probe which typically provides the lens temperature to the ACS system.

The offset parameter is the current amount of magnification offset programmed by the user. ACS incorporates a lens pressure shift accordingly.

The temp parameter is the current amount of compensation being applied to the lens from the magnification temperature coefficient.

The available mag parameter is the total ACS operating range of magnification control in ppm. The amount of control is defined by current ambient ait conditions degree of expo saturation, and the user selected mag offset.

ACS Commands vs. Menu Options List

The following ACS commands and options may be input to the ACS system by one of 2 methods:

- from the ACS terminal keyboard (if so equipped)
- by using the *ACS Command Line* option within the ACS Utilities menu on the AUTOSTEP 200 workstation

Top Level Options:

ACS Abbrev	Command Description	Menu
c	Calibrate	ACS Main Menu
d	Display	ACS Main Menu
dis	Disable	Set Constants menu
e	Enable	Set Constants menu
fr	Free	Set Constants menu
fx	Fix	Set Constants menu
r	Reset	ACS Main Menu
s	Set	

Display Options:

ACS Abbrev	Command Description	Menu	Menu Option
daf	Display ACS Focus (on/off)		
dah	Display Ambient Humidity	Display menu	Current Status
dap	Display Ambient Pressure	Display menu	Current Status
das	Display ACS Scaling	Display menu	System Config.
dat	Display Ambient Temperature	Display menu	Current Status
datn	Display Nominal Ambient Temp	Display Menu	
db	Display Baud		
dct	Display Comp. Type	Display menu	System Config.
dd	Display Display	Display menu	
ddf	Display Focus Sensitivity to Mag Offset Pressure		
de	Display Errors	Display menu	
dff	Display Focus Sensitivity for Atmospheric Compensation		
del	Display Error Log	Display menu	
df	Display Focus	Display menu	Current Status
dfh	Display Focus Humidity Coef.	Display menu	Current Status
dds	Display Die Size	Display menu	System Config.
dfo	Display Prog. Focus Offset	Display menu	System Config.
dfp	Display Focus Pressure Coef.	Display menu	Current Status

Display Options (continued):

ACS Abbrev	Command Description	Menu	Menu Option
dfs1	Display Focus Saturation Point 1		
dfs2	Display Focus Saturation Point 2		
dft	Display Focus Temp. Coef.	Display menu	Current Status
dht	Display Host Terminal		
dif	Display ICE Focus/Exposure		
dim	Display ICE Mag/Exposure		
dio	Display ICE (on/off)		
dlp	Display Lens Pressure	Display menu	Current Status
dlr	Display Lamp Intensity Reference		
dls	Display Source Lens Temp.	Display menu	Probe Config. Param.
dli	Display Lamp Intensity		
dlt	Display Lens Temperature	Display menu	Current Status
dmf	Display Mag Offset Pressure Sensitivity		
dms1	Display Mag Saturation Point 1		
dms2	Display Mag Saturation Point 2		
dmo	Display Mag. Offset	Display menu	System Config.
dn	Display Air Index	Display menu	Sys Cnfg or Curr Stat
dpf	Display Lens Pressure/ Barometric Pressure Slope		
dpm	Display Pressure Maximum	Display menu	System Config.
dpn	Display Nominal Pressure	Display menu	
drm	Display Relative Mag.	Display menu	Current Status
drl	Display Rev. Level	Display menu	System Config.
ds	Display Scroll		
dst	Display Shutter Time		
dt	Display Term		
dtc1	Display TAU Cooling Time Constant 1		
dtc2	Display TAU Cooling Time Constant 2		
dth1	Display TAU Heating Time Constant 1		
dth2	Display TAU Heating Time Constant 2		
dt1	Display Material Probe 1	Display menu	Current Status
dt2	Display Material Probe 2	Display menu	Current Status
dt3	Display Material Probe 3	Display menu	Current Status

Display Options (continued):

ACS Abbrev	Command Description	Menu	Menu Option
dt1i	Display T1 Index Scaling	Display menu	Probe Config. Param.
dt2i	Display T2 Index Scaling	Display menu	Probe Config. Param.
dt3i	Display T3 Index Scaling	Display menu	Probe Config. Param.
dt1m	Display T1 Mag. Scaling	Display menu	Probe Config. Param.
dt2m	Display T2 Mag. Scaling	Display menu	Probe Config. Param.
dt3m	Display T3 Mag. Scaling	Display menu	Probe Config. Param.
dt1n	Display T1 Nominal Temp.	Display menu	Probe Config. Param.
dt2n	Display T2 Nominal Temp.	Display menu	Probe Config. Param.
dt3n	Display T3 Nominal Temp.	Display menu	Probe Config. Param.
dtp	Display Target Pressure		
dtx	Display Reticle Transmission		

Set Options:

ACS Abbrev	Command Description	Menu
saf	Set ACS Focus (on/off)	
sas	Set ACS Scaling	Set System Config. menu
satn	Set Ambient Temp Nominal	Set System Config. menu
sb	Set Baud	
sd	Set Display	Set System Config. menu
sdf	Set Focus Sensitivity to Mag Offset Pressure	
sds	Set Die Size	Set System Config. menu
sel	Set Error Log	
sff	Set Focus Sensitivity for Atmospheric Compensation	
sfh	Set Focus Humidity Coef.	Set System Config. menu
sfo	Set Programmable Focus Offset	Set System Config. menu
sfp	Set Focus Pressure Coef.	Set System Config. menu
sfs1	Set Focus Saturation Point 1	
sfs2	Set Focus Saturation Point 2	
sft	Set Focus Temperature Coef.	Set System Config. menu
sht	Set Host Terminal	
sio	Set ICE (on/off)	
slr	Set Set Lamp Intensity Reference	

Set Options (continued):

ACS Abbrev	Command Description	Menu
sls	Set Lens Temp Source	Set Probe Config. menu
smf	Set Mag Offset Pressure Sensitivity	
smo	Set Mag. Offset	Set System Config. menu
sms1	Set Saturation Point 1	
sms2	Set Saturation Point 2	
spf	Set Lens Pressure/Barometric Pressure Slope	
spm	Set Pressure Maximum	Set System Config. menu
spn	Set Nominal Pressure	
ss	Set Scroll	
st	Set Term	
stx	Set Reticle Transmission	
sth1	Set TAU Heating Time Constant 1	
sth2	Set TAU Heating Time Constant 2	
stc1	Set TAU Cooling Time Constant 1	
stc2	Set TAU Cooling Time Constant 2	
st1i	Set T1 Index Scaling	Set Probe Config. menu
st2i	Set T2 Index Scaling	Set Probe Config. menu
st3i	Set T3 Index Scaling	Set Probe Config. menu
st1m	Set T1 Mag. Scaling	Set Probe Config. menu
st2m	Set T2 Mag. Scaling	Set Probe Config. menu
st3m	Set T3 Mag. Scaling	Set Probe Config. menu
st1n	Set T1 Nominal Temp.	Set Probe Config. menu
st2n	Set T2 Nominal Temp.	Set Probe Config. menu
st3n	Set T3 Nominal Temp.	Set Probe Config. menu

Reset Options:

ACS Abbrev	Command Description	Menu
raf	Reset ACS Focus (on/off)	
ras	Reset ACS Scaling	Reset menu
ratn	Reset Ambient Temp Nominal	Reset menu
rb	Reset Baud	
rd	Reset Display	
rdf	Reset Focus Sensitivity to Mag Offset Pressure	
rds	Reset Die Size	Reset menu
rel	Reset Error Log	Reset menu
rff	Reset Focus Sensitivity for Atmospheric Comp	
rfh	Reset Focus Humidity Coef.	Reset menu
rfo	Reset Program. Focus Offset	Reset menu
rfp	Reset Focus Pressure Coef.	Reset menu
rfs1	Reset Focus Saturation Point 1	
rfs2	Reset Focus Saturation Point 2	
rft	Reset Focus Temperature Coef.	Reset menu
rht	Reset Host Terminal	Reset menu
rio	Reset ICE (on/off)	
rlr	Reset Lamp Intensity Reference	
rls	Reset Lens Temp Source	Reset menu
rmf	Reset Mag Offset Pressure Sensitivity	
rmo	Reset Mag. Offset	Reset menu
rms1	Reset Mag Saturation Point 1	
rms2	Reset Mag Saturation Point 2	
rpm	Reset Pressure Maximum	Reset menu
rpf	Reset Lens Pressure/Barometric Pressure Slope	
rpn	Reset Nominal Pressure	Reset menu
rs	Reset Scroll	
rt	Reset Term	Reset menu
rth1	Rest TAU Heating Time Constant 1	
rth2	Rest TAU Heating Time Constant 2	
rtc1	Rest TAU Cooling Time Constant 1	

Reset Options (continued):

ACS Abbrev	Command Description	Menu
rtc2	Rest TAU Cooling Time Constant 2	
rt1i	Reset T1 Index Scaling	Reset menu
rt2i	Reset T2 Index Scaling	Reset menu
rt3i	Reset T3 Index Scaling	Reset menu
rt1m	Reset T1 Mag. Scaling	Reset menu
rt2m	Reset T2 Mag. Scaling	Reset menu
rt3m	Reset T3 Mag. Scaling	Reset menu
rt1n	Reset T1 Nominal Temp.	Reset menu
rt2n	Reset T2 Nominal Temp.	Reset menu
rt3n	Reset T3 Nominal Temp.	Reset menu
rtx	Reset Lamp Intensity Reference	

Fix Options:

ACS Abbrev	Command Description	Menu
fxah	Fix Ambient Humidity	Fix menu
fxap	Fix Ambient Pressure	Fix menu
fxat	Fix Ambient Temperature	
fxf	Fix Focus Offset	Fix menu
fxlt	Fix Lens Temperature	Fix menu
fxtp	Fix Target Pressure	Fix menu
fxt1	Fix Material Probe 1	Fix menu
fxt2	Fix Material Probe 2	Fix menu
fxt3	Fix Material Probe 3	Fix menu

Free Options:

ACS Abbrev	Command Description	Menu
frah	Free Ambient Humidity	Free menu
frap	Free Ambient Pressure	Free menu
frat	Free Ambient Temperature	Free menu
frf	Free Focus Offset	Free menu
frlt	Free Lens Temperature	Free menu
frtp	Free Target Pressure	Free menu
frt1	Free Material Probe 1	Free menu
frt2	Free Material Probe 2	Free menu
frt3	Free Material Probe 3	Free menu

Wafer Stepper Commands:

ACS Abbrev	Command Description
cu	Column Up
ep	Column Down
fo	Apply Focus Offset
fs	Trim Status
lf	Lock Focus
mo	Apply Magnification Offset
oc	Focus Oscillate
uf	Unlock Focus

SMARTSET

SMARTSET is a menu-driven software package that characterizes the AUTOSTEP 200 system to optimize system performance. SMARTSET uses metrology capabilities and the local alignment system to perform this characterization.

The major SMARTSET features are outlined below. For additional information on SMARTSET, see the Metrology System Operation Manual (P/N 069062).

Intrafield Analysis

Intrafield analysis characterizes both the optical column setup and the intrinsic lens properties which determine image placement within a field.

Intrafield analysis evaluates the optical quality of an AUTOSTEP 200 system independently from the mechanical quality. This two-step process separates mechanically correctable errors (such as reduction, rotation, and trapezoid) from total image placement errors, to optimize the system's optical column.

SMARTSET measures image placement errors, displays vector maps of modeled components, and recommends corrections required for column setup.

Correctable intrafield errors are:

Error	Cause
Die rotation and translation	Improper reticle placement
Reduction	Barometric pressure and temperature changes
Trapezoid	Improper platen position

After mechanical corrections have been made, the remaining image placement errors (such as distortion and anamorphism) are intrinsic to the lens. The remaining errors unaccounted for in the model (such as alignment errors, stage precision, and local lens distortions) are referred to as *residuals*.

Grid Analysis

Grid analysis optimizes the stepping characteristics of an AUTOSTEP 200 system by comparing the *actual* array placement on the wafer in relation to the *expected* placement. The location of each field within the stepped array, specified by coordinates X and Y, is analyzed to determine any deviation.

Grid placement errors and their causes are:

Error	Cause
Translation	Improper baseline
Scale	Improper stage setup
Orthogonality	Improper stage setup
Rotation	Microscope rotation

SMARTSET measures and displays vector maps of grid placement components and recommends corrections, which must be entered into the MODE file on the AUTOSTEP 200 system. These corrections include baseline, scale, orthogonality, and microscope rotation.

Grid analysis can be used for setting up of a single system, or for matching multiple systems to one reference system. When matching is performed, the reference system must be set up first.

SMARTSET Analysis

Using SMARTSET to perform intrafield and grid analysis involves the following:

- **Data Collection**, which uses the local alignment system to gather alignment data. The arrays read can be any logical stepping pattern with enough dies to provide accurate data.
- **Data Averaging**, which gains statistical confidence in the data. If more than one wafer is read and averaged, the vector plots are more precise.
- **Data Viewing**, which displays the data and the suggested corrections.

Once this is accomplished, the user manually enters the corrections recommended by SMARTSET into the AUTOSTEP 200 system.

Using SMARTSET to Match Lens Characteristics

Lens image placement characteristics and mechanical characteristics are matched as part of any system matching program. SMARTSET enables rapid calculation of the differences in characteristics between two lenses.

This is done by collecting the data from each system, and analyzing the data. The image placement errors of the two lenses are then subtracted, and the difference between the lenses is then displayed by SMARTSET. This enables determination of the degree of lens matching, after the optical columns of the systems have been matched.

INSITU

INSITU is a local alignment system that is made up of a combination hardware and software package that automates the calibration process of the AUTOSTEP 200 system in system focus, intrafield analysis, and Micro DFAS baseline. The system MOP contains software that controls the INSITU local alignment system. INSITU hardware, software, and operational process are described in the following paragraphs.

INSITU Hardware

INSITU is made up of a small detector attached to the Theta III stage as shown in Figure 13-31. The reticle must also contain corresponding windows for the Micro DFAS and INSITU windows on the INSITU detector. The INSITU detector assembly is made up of an 8mm diameter quartz artifact that is chrome-plated on one side, and contains a quad style Micro DFAS window, and INSITU window, and an AWA/D alignment mark all etched through the chrome. This artifact is fixed above a silicon photo diode sensor which detects varying amounts of light that travels through the window as the artifact wafer and detector scans across the laser light path.

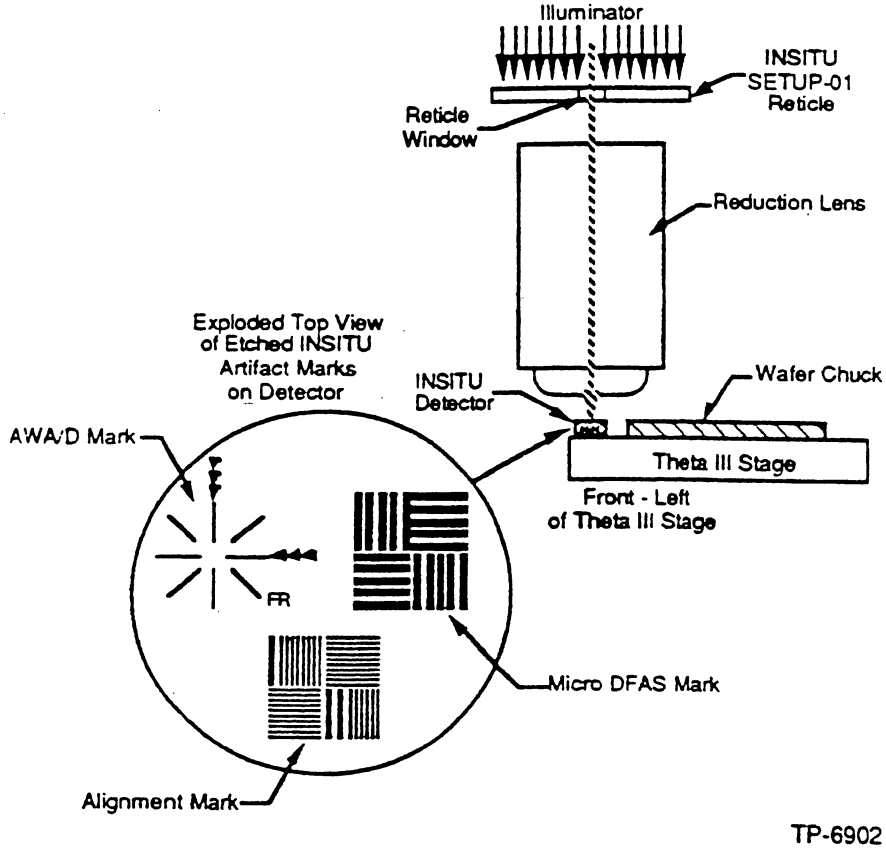


Figure 13-31
INSITU Detector and Alignment Path

INSITU Software

The system MOP contains the software that controls the INSITU local alignment system. INSITU is used to test the system focus, intrafield, and the Micro DFAS baseline. From the system prompt, enter the command **INSITU** to display the INSITU Utility Options menu. See **Section 10 - Determining the Best System Focus** for more information on the INSITU command.

The INSITU Alignment Process

During the INSITU alignment process, the INSITU artifact is positioned under the reduction lens to detect the light that passes through the window in the reticle. The artifact scans in the X-axis and the Y-axis directions about 2.5microns to determine the centered or aligned position between the alignment windows in the reticle and the artifact. INSITU uses this alignment process to determine the system focus, intrafield, and Micro DFAS baseline corrections.

The INSITU Utility Options Menu

The INSITU Utility Options Menu, as shown in Figure 13-32, permits the user to perform various system tasks using INSITU as a measuring device. Each option within the menu is described in the following paragraphs.

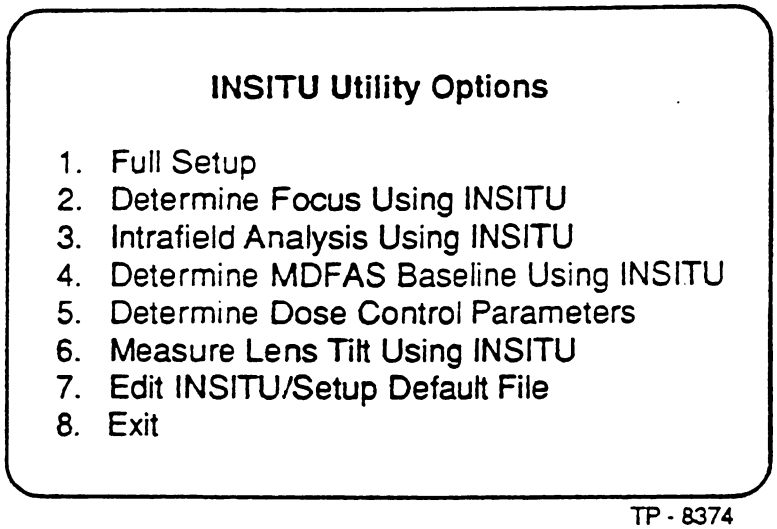


Figure 13-32
INSITU Utility Options Menu

Full Set-Up

The full set up all command automatically adjusts system focus, intrafield and local aligner baseline, then automatically updates the mode file with the new corrections. The find focus test is performed first, the set mag/trap test is performed second and the set Micro DFAS baseline test is performed last.

The full set up all command adjusts system parameters to a reference or zero value without the use of send-ahead wafers. The operator must make sure that the Setup-01 reticle is present in the RMS library to run the full set up command function.

Determine Focus Using INSITU

The determine focus using INSITU software is a metrology tool which analyzes the best focus offset for the INSITU detector. The focus offset used to expose wafers is a fixed offset from the INSITU focus offset.

Since the job program focus offset is directly referenced to the system focus in mode file, the operator should have to set the job program focus for each process level only once. When all job program focus settings are properly set, the system focus in mode file should be the only necessary focus change (unless the process has been changed). Any atmospheric changes affect the AUTOSTEP system as a whole (all jobs) and therefore, the system focus in the mode file sets all the jobs to the best focus position.

The software relies on INSITU alignment techniques and the Setup-01 reticle to determine system focus. The INSITU detector is commanded to be placed directly under the lens and to perform a series of alignment scans on the center cell of the reticle. The autofocus system moves the optical column ±12 microns from the current focus position. A focus cycle which performs 41 focus samples is performed until the fixed lens assembly is 12 microns below the current focus setting. The increment between focus samples is equal to 0.6 microns. The software then plots a curve of the relative contrast values at the different 41 focus sample positions on the automatic focus calibration plot and then performs a least-squares-fit analysis to determine the nominal focus position as it relates to the peak contrast level. The new focus value, as displayed by the red vertical bar on the automatic focus calibration plot, is determined and automatically entered into MODE.

Intrafield Analysis Using INSITU

The intrafield analysis using INSITU software is a metrology tool which determines lens magnification, X-axis trapezoid, Y-axis trapezoid, and reticle rotation errors which are all measured and corrected by using INSITU and the Setup-01 reticle. This reticle contains an array of quad-style Micro DFAS alignment targets spaced on 1.0mm steps. The lens magnification errors are measured by stepping the INSITU detector to each user-selected target and performing a local alignment to determine the X and Y-axis position displacement.

After the alignment data has been collected, the intrafield error coefficients are calculated and displayed. The X and Y-axis trapezoid and mag errors are automatically sent to the reticle stage where the platen is calibrated to the new calculated position. The reticle rotation errors are sent to the RMS aligner controller and the reticle is realigned to the new calculated position.

Determine Micro DFAS Baseline Using INSITU

The determine Micro DFAS baseline using INSITU software is a metrology tool which determines the nominal distance between the local alignment system (Micro DFAS) and the center of the reticle. INSITU aligns to four marks at the edges of the exposure location and calculates the exact center of the reticle. The INSITU artifact is positioned under the Micro DFAS where it performs an alignment to the INSITU artifact. The software calculates the X-axis and Y-axis local baseline corrections and automatically applies the corrections in the MODE file.

Determine Dose Control Parameters

The determine dose control parameters ensure that all GCA AUTOSTEP 200 systems deliver the same amount of energy to the wafer surface for the same number of units in the job description file during exposure. The dose control parameters assumes that every MAXIMUS 2000 can deliver 500mW/cm^2. In reality, no MAXIMUS 2000 light source delivers the same amount of energy, therefore, we adjust the shutter opening time by the following linear equation:

New Time (sec) = Scale x Job Time(sec) + Offset(sec)

The scale and offset values are contained in the MODE file. Use the following procedure to calculate the scale factor and offset values.

1. Enter the INSITU command at the system keyboard.
2. Select menu option 5 - Determine Dose Control Parameters from the INSITU utility options menu. The following sequence of events occur automatically:

    a. The reticle is removed from the platen.
    b. The aperture blades are set to 5mm (at the wafer) in the X and Y-axis.
    c. The IQ probe is placed under the center of the lens.
    d. The shutter opens and closes from 0 to 800msec to sample light intensity and the data is collected and presented on the metrology screen as shown in Figure 13-35.
    e. The new scale and offset values are calibrated. The absolute dose error, which is displayed in the **Error %** column of Figure 13-33 and plotted on the graph, should be within ±2% or the test is automatically repeated.

Once the dose error is within specification, the new scale and offsets values are automatically loaded into the MODE file.

Dose Control System

Expected mJ	Real mJ	E-R mJ	Error %	Time Sec
30.00	30.12	-0.12	-0.4	0.177
50.00	50.20	-.20	-0.4	0.290
100.00	100.24	-.24	-0.2	0.573
150.00	150.01	-.01	0	0.850
200.00	200.02	-.02	0	1.139
250.00	249.99	.01	0	1.422
300.00	300.34	-.34	-0.1	1.708
350.00	350.68	-.68	-0.2	1.992
400.00	400.52	-.52	-0.1	2.274

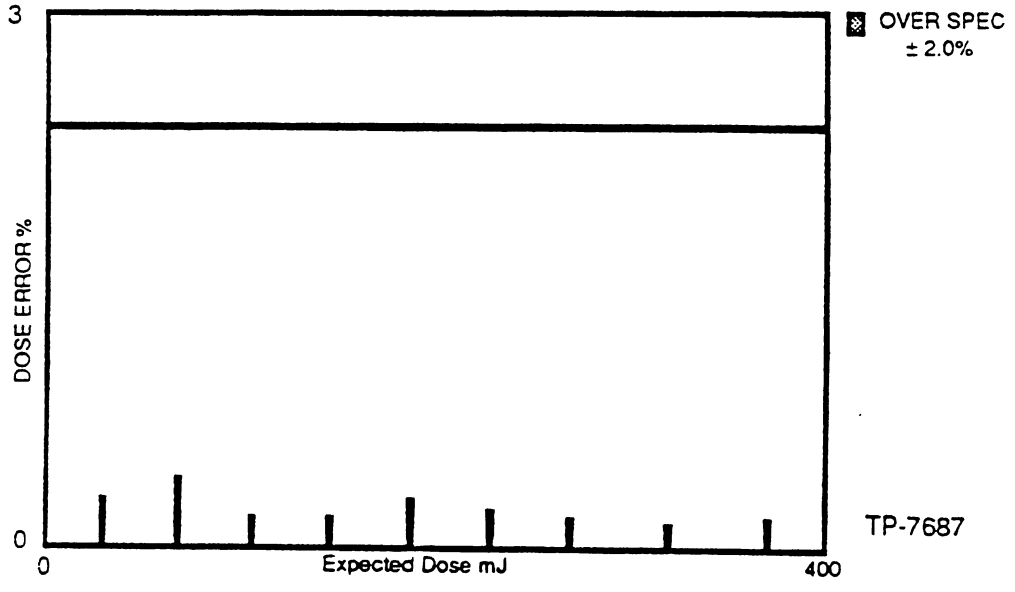


Figure 13-33
Dose Control System Display Example

Measure Lens Tilt Using INSITU

NOTE: A template file named, "TILT" must be created by the user before the Measure Lens Tilt Using INSITU option can be used.

The Measure Lens Tilt Using INSITU option analyzes an intrafield template array using the INSITU probe to determine the attitude of the lens. The INSITU probe is moved to the center of the template array and performs a focus test. The optical column Z-axis position data is measured (in tenths of microns) and saved for use later in the analysis. Once the Z-axis position data is saved, the INSITU probe is moved to each point within the template array and measures the Z-axis position data. Once all data points have been analyzed, the software calculates best focus

position at each data point within the array and plots the data on the metrology monitor as shown in Figure 13-34.

To analyze this lens tilt file use option

7. Analyze Lens Tilt File

in METROLOGY UTILITY MENU from the main METROLOGY SYSTEM menu.

NUMBER OR MEASUREMENTS: 4

Maximum Z	= -3.9µm
Minimum Z	= -4.6µm
Average Z	= - 4.1µm
STD DEV (S)	= 0.3µm
3*S	= 1.0µm
TIR	= 0.7µm
TILT IN X	= -19.1µm
TILT IN Y	= 30.9µm

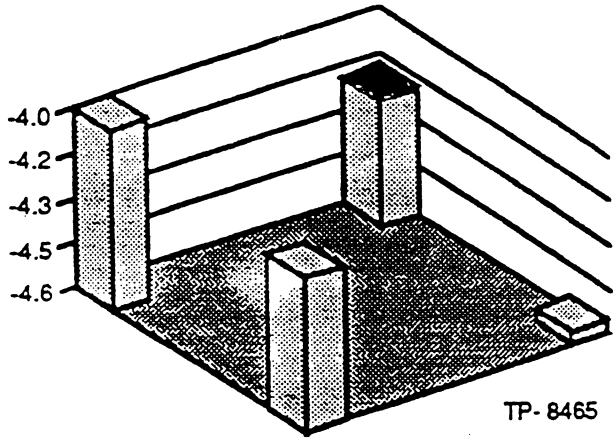


Figure 13-34
Measure Lens Tilt Using INSITU Data

SETUP/INSITU Default File

The SETUP/INSITU Default File is used to modify the default values of calibration parameters used during the SETUP or INSITU commands. The options within the default file, shown in Figure 13-35, are described in the following paragraphs.

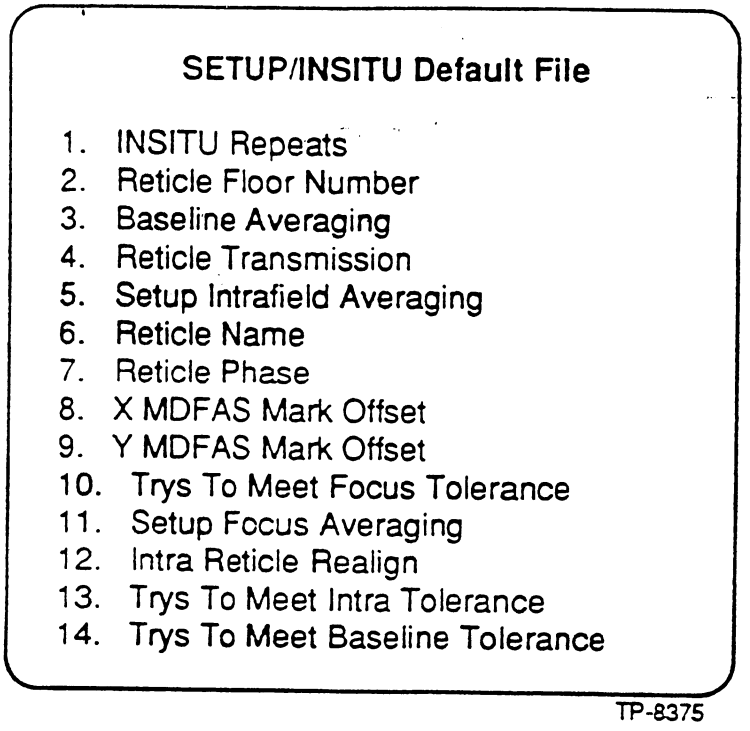


Figure 13-35
Setup/INSITU Default File Menu

INSITU Repeats

The INSITU Repeats option determines the number of times focus, intrafield, and baseline tests are repeated when the SETUP or INSITU commands are executed. The default value is 1 and the values range from 1 - 999.

Reticle Floor Number

The Reticle Floor Number option specifies the RMS elevator floor number in which the Setup/INSITU reticle is stored. This option is only used when the Setup/INSITU reticle does not contain a bar code. The default value is 0 and the values range from 0 - 10.

Baseline Averaging

The Baseline Averaging option specifies the number of times the baseline test will be repeated when the SETUP or INSITU commands are executed before averaging the data. This option applies for both SETUP or INSITU commands.
The default value is 4 and the values range from 1 - 999.

Reticle Transmission

The Reticle Transmission option specifies the reticle transmission value of the SETUP-01 reticle. The default value is 0 and the values range from 0 - 300%.

Setup Intrafield Averaging

The Setup Intrafield Averaging option specifies the number of times the intrafield test is repeated before averaging the data. This option applies for both SETUP or INSITU commands. The default value is 1 and the values range from 1 - 999.

Reticle Name

The Reticle Name option specifies the reticle to be used for the setup of the INSITU probe. The default reticle name is SETUP-01.

NOTE: This option can be used in conjunction with the Reticle Floor Number option to specify a reticle other than the SETUP-01 reticle that does contain a bar code.

Reticle Phase

The Reticle Phase option specifies the phase (P - positive, N - negative or X - no alignment) of the reticle alignment targets for a reticle which does not contain a bar code. The default value is N (negative).

X MDFAS Mark Offset

NOTICE

The X MDFAS Mark Offset option value should only be changed by GCA Field Service Personnel. Changing this value may cause equipment calibration problems and unnecessary equipment down-time.

The X MDFAS Mark Offset option specifies the distance from the center of the MDFAS alignment target to the center of the INSITU probe, in the X-axis. The default value is 1 and should not be changed.

Y MDFAS Mark Offset

NOTICE

The Y MDFAS Mark Offset option value should only be changed by GCA Field Service Personnel. Changing this value may cause equipment calibration problems and unnecessary equipment down-time.

The Y MDFAS Mark Offset option specifies the distance from the center of the MDFAS alignment target to the center of the INSITU probe, in the Y-axis. The default value is 1 and should not be changed.

Trys To Meet Focus Tolerance

The Trys To Meet Focus Tolerance option specifies the number of times the SETUP or INSITU focus test is repeated while attempting to meet the focus tolerance which is specified in the metrology setup specifications. An error message appears which provides the user with an option to retry or quit if the tolerance value has not been met. The default value is 1 and the values range from 1 - 999.

Setup Focus Averaging

The Setup Focus Averaging option specifies the number of times the focus test is repeated before the data is averaged during Setup or INSITU. The default value is 1 and the values range from 1 - 999.

Intra Reticle Realign

The Intrafield Realign option removes the reticle from the platen after intrafield measurement has been completed during the setup routine. This option allows the realignment of the reticle to be calculated into intrafield averaging data. The default value is Y and the values are Y (Yes) or N (No).

NOTE: The *Setup Intrafield Averaging* option must be set to more than 1 in order for the Intra Reticle Realign option to be utilized.

Trys To Meet Intra Tolerance

The Trys To Meet Intrafield Tolerance option specifies the number of times the INSITU intrafield test is repeated while attempting to meet the intrafield tolerance which is specified in the metrology setup specifications. An error message appears which provides the user with an option to retry or quit if the tolerance value has not been met. The default value is 1 and the values range from 1 - 999.

Trys To Meet Baseline Tolerance

The Trys To Meet Baseline Tolerance option specifies the number of times the INSITU baseline test is repeated while attempting to meet the baseline tolerance which is specified in the metrology setup specifications. An error message appears which provides the user with an option to retry or quit if the tolerance value has not been met. The default value is 1 and the values range from 1 - 999.

Exit

The Exit menu selection removes the user from the INSITU Utility Options menu and returns to the system prompt.

Using the FLAT Command

The Flat command is a diagnostic utility which measures the flatness of a wafer and the wafer chuck. When this command is used, a wafer is loaded on the wafer chuck and leveled. The wafer is then stepped in a user specified array where the position of the optical column is measured at each die location. The column position information is sent to the metrology system which processes the data and displays a wafer/chuck flatness diagram and data on the metrology monitor.

The Flat command can be used with any job program to determine the flatness of a wafer and the wafer chuck. The user simply selects the job program and pass, and uses the Flat command as follows:

: FLAT jobname\passname

The AUTOSTEP system then automatically measures and displays the wafer/chuck flatness diagram and data on the metrology monitor.

Using the LATMAP Command

The LATMAP command permits the user to expose a latent image array on a wafer and then automatically map the wafer. The metrology software automatically creates history files for the mapped data. Typically, several wafers are exposed and mapped using the LATMAP command and the metrology software records the history files which can be averaged by the user to determine the Micro DFAS mapping offset.
The LATMAP command is used as follows:

: LATMAP jobname\exposure passname, mapping passname

Once the desired number of wafers are exposed, mapped and history files have been collected, the user can determine the Micro DFAS mapping offset by using the following procedure.

Creating and Analyzing Average History Files

Use the following procedure to create an average history file.

1. Press the **Switch Sessions** key.
2. Select menu option **5** - Utilities from the metrology system menu.
3. Select menu option **11** - Average History Files from the metrology utility menu.

NOTE: A maximum of 10 history files can be averaged in step 4.

4. Select the appropriate history files from the file directory.
5. Press the **Escape** key.
6. Enter the extension number (0-99) of the file which contains the averaged data file. The software automatically names the file TEST. This step permits the user to add an extension number to the file for ease of identification as follows:

   TEST.N

7. Enter **Y** to the Create Average History File question:

   Are you sure? (Y/N): **Y**

   The results of the analysis will be saved in the file; TEST.N. The average history file named HISTORYAV.FIL is a temporary data file.

NOTE: The n within the *test.n* title reflects the number which was entered during step 6 of this procedure.

The average history file has been created and can now be analyzed using the next procedure.

8. Select menu option **1** - Offset Corrections from the analyze average history file menu. The following mapping offset data appears as shown in Table 13-3.

Table 13-3
Mapping Offsets Data Example

	Current Offsets	Calculated Correction	Recommended New Offsets
Setup Specif.			
Local X (mm)	0.00123	0.00000	0.00123
Local Y (mm)	0.00139	0.00000	0.00139
Micro DFAS Offset			
X-Scale (ppm)	0.428	0.428	0.000
Y-Scale (ppm)	-0.448	-0.448	0.000
Orthogon. (ppm)	3.378	3.378	0.000
Theta (µrad)	-1.363	-1.363	0.000

9. If the mapping offsets are to be updated, answer Y to the following question:

   Do you want to update mapping offsets? (Y/N)

The user will be able to update the mapping offsets on the screen.

Obtaining History File Statistics

1. Select menu option 2 - Statistics of History Files from the analyze average history file menu. The following history file statistics appear as shown in Table 13-4.

Table 13-4
History File Statistics

	MAX	#HF	MIN	#HF	T.I.R.	3*ST.DIV
BLX	0.00000	1	0.00000	1	0.00000	0.00000
BLY	0.00000	1	0.00000	1	0.00000	0.00000
THETA	0.00000	1	0.00000	1	0.00000	0.00000
SC-X	0.00000	1	0.00000	1	0.00000	0.00000
SC-Y	0.00000	1	0.00000	1	0.00000	0.00000
ORTHOG	0.00000	1	0.00000	1	0.00000	0.00000
RX	0.00000	1	0.00000	1	0.00000	0.00000
RY	0.00000	1	0.00000	1	0.00000	0.00000

To print screen information - <p> To quit - <ESC>

2. Press the ESC key to quit and return to analyze average history file menu.

Section 14 - Additional System Functions

The following additional system functions are available, and can be used during system operation:

- Shutting Down the System
- Booting the System
- Aborting a Task
- Listing Job Information
- Printing Text and Screens
- Changing the Background Colors

Shutting Down the System

The command SHUTDN is used to stop all system operation, to prepare the system for power down or to disable system operation. Shut down the system with following procedure:

1. Enter **SHUTDN**.
2. At the prompt **SHUTDOWN REASON** , enter a comment to be placed in the currently opened history file.
3. At the prompt **DO YOU REALLY WANT TO SHUT DOWN THE SYSTEM? (Y/*N)** perform one of the following:

   a. To return to the system prompt without shutting down the system, type **N**.
   b. To shut down the system, type **Y**. When Y is entered, the system continues with the following prompts.

4. At the prompt **ENTER MINUTES TO WAIT FOR SHUTDOWN**, enter the number of minutes before a system shutdown is to occur.

   - When a value of *less than 5* is entered, a message is displayed every minute on all logged in monitors that the system will be shutting down.
   - When a value of *5 or more* is entered, the system prompts for the frequency at which this message should be displayed to other monitors.
   - When a value of **0** is entered (which is the default), the system immediately begins shutting down.

5. At the prompt **REASON FOR SHUTDOWN**, enter a comment to be displayed to all logged in users.
6. At the prompt **OK TO SHUT DOWN**, perform one of the following:

   a. To exit the shutdown task, type **N**.
   b. To begin shutdown, type **Y**.

When Y is entered, all monitors currently logged in to the system display the following:

```
ALL FURTHER LOGINS ARE DISABLED

16-DEC-89  07:35:34
SYSTEM IS SHUTTING DOWN IN n MINUTES
REASON:
```

where **n** is the number of minutes previously specified.

Once the system is shut down, the system displays the prompt @. To return to the system prompt, boot the system using the procedure in Booting the System in this section of the manual.

Booting the System

> **CAUTION**
>
> Never use booting or simply turning the power off to the MICROPDP-11/53 to shut down the system, since it aborts all operations currently taking place and may damage any files that are open. When shutting down the system, always use the SHUTDN command.

Boot the system using the following procedure.

1. Press the HALT key, then the RESTART key on the MICROPDP-11/53 computer. The system then reloads the software, and displays the system prompt.
2. Log into the system (see Logging Into and Out of the System in Section 5 of this manual).
3. To see a directory of all reticles currently in the RMS elevator cassettes, enter **INVENTORY** (see **Appendix A - System Commands** for information about the directory displayed).

Aborting a Task

The command ABORT stops any current system operation resulting from the previous command entered at that terminal. Abort a task by performing the following procedure:

1. Simultaneously press the CTRL and C keys.
2. At the system double prompt (::), enter **ABORT**.

Listing Job Information

Display a list of information for a particular job that currently resides on the system, by using the command LIST.

Enter the command **LIST**, along with the name of the job for which information is requested. When the command is entered, the system displays the following:

- Whether the job is specified in metric or English units
- The date and time the job was created
- The job's comment (if any exists)
- The order, names and comments of all passes, and the array type (plug or array)

Printing Text and Screens within the MOP

Print text displayed on the VT340 monitor on the optional Digital Equipment Corporation printer by pressing the LOCAL PRINT key. Print screens (including any graphics that are currently displayed on the screen) on the system by simultaneously pressing the SHIFT and LOCAL PRINT keys. The full-page screen will then be printed.

Changing the Background and Text Colors

The user can change and permanently save the background and text colors on the monitor using the command COLORS. The VT340 color monitor has the capability of displaying 16 different colors for selection. A HELP screen is available with the COLORS program by pressing the HELP key.

The background and text colors are set using the same procedure. Change the background or text colors as follows:

1. At the system prompt (:), enter **COLORS**. then press RETURN.

The system then displays the Terminal Color Selection screen similar to the following (Figure 14-1):

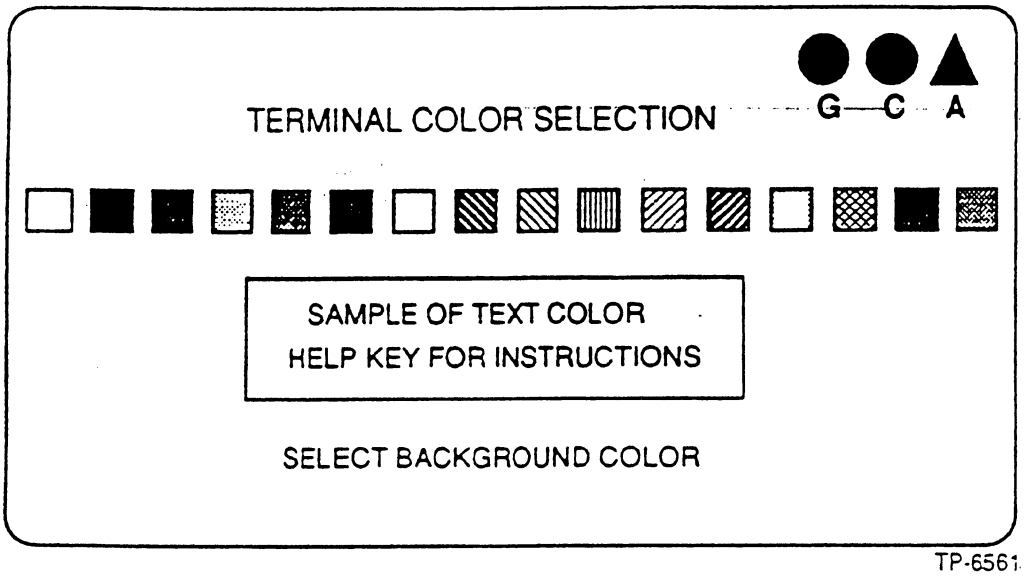


Figure 14-1
Terminal Color Selection Screen

NOTE: Each box on the Terminal Color Selection screen contains a different shade of color (indicated by the different patterns in Figure 14-1). The current color choice is identified by a *color bar cursor* (a heavy border around the color).

2. At the prompt **SELECT BACKGROUND COLOR** or **SELECT TEXT COLOR**, select the desired color by moving the color bar cursor to the desired location by pressing the left- and right-arrow keys.

The demo window displays what the selected colors will look like on the screen.

3. If changing the color for other than the currently-displayed mode, press the up- or down-arrow key to access the other mode. (The current mode is displayed at the bottom of the screen.)
4. Change the color by repeating step 2.
5. When color changes are complete, permanently save the background and text colors by pressing either RETURN or ENTER. The system then returns to the system prompt.

NOTE: The user must exit the COLORS program before using the new background and text colors.

Changing the Colors within the Color Map

If the color map does not currently display the desired color, the user can change the color shades. Color shades are changed using the Color Set-Up screen within the SET-UP command. Refer to **Section 5 - Setting Up and Powering Up the System** for the procedure used to change the color shades.

Appendix A - System Commands

This section presents an alphabetical listing of all AUTOSTEP 200 system commands used during system operation.

@

@ allows comments to be inserted into the history file, when one is open. Use the syntax @ text, where text is the comment to be inserted. Press the RETURN key twice when all text is typed.

ABort

ABORT is used to interrupt the execution of the most recently issued command. When a command that is being executed must be interrupted, press the Ctrl key and simultaneously press the C key: the system displays a double prompt (::). Enter the command ABORT. When the command ABORT is entered, the current system activity is aborted.

ACnt

ACNT is an interactive procedure that allows user accounts to be created, deleted, or modified. When accounts are created, access to all system commands can be allowed or denied, and a password corresponding to the account can be assigned, deleted, or changed. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information about ACNT.

ACS

ACS displays the ACS program menus that are used to maintain focus and reduction ratio, to compensate for atmospheric effects on the lens imaging properties and the expansion and contraction of the optical column.

AExpo

AEXPO executes a previously created job (using the DEXPO command) containing a frequently used focus/exposure array. When a filename is not specified along with the command, the system prompts for one. If the filename specified does not exist, an error message is displayed, and the system returns to the system prompt.

NOTE: The RRS is reset to the home position once the AEXPO command is entered.

ALign

ALIGN accesses the IASDBG, which contains all the utilities for setting up, calibrating, and testing the AWA/D system and process parameter files.

AWACont rol

AWACONT is a control file that contains various flags and software switches used in setting up, calibrating, and operating the AWA/D.

AWAEdit

AWAEDIT edits an existing process parameter file.

AWALive

AWALIVE clears a digitized picture from the VT340 monitor and puts the datacube into live mode.

AWAMach

AWAMACH sets the AUTOSTEP 200 system hardware configuration for the IAS.

AWAOffset

AWAOFFSET measures the difference between the AWA/D alignment of a target and an operator's manual alignment of the same target, and generates conversion information for accurate automatic alignment of the wafer. This routine is followed with the AWASAVE command.

AWAPixel

AWAPIXEL determines the size of a pixel used for the accurate fine positioning of the alignment targets.

AWASAve

AWASAVE is used after the AWAOFFSET command to upload the alignment difference information into the appropriate process parameter file.

AWASPec

AWASPEC creates a process parameter file with a filename usually referring to a specific process level. A process parameter file contains the information needed to optimize the performance of the AWA/D on process-dependent alignment targets.

AWAVideo

AWAVIDEO uploads (stores) the AWA screen setup and pixel calibration information to the hard drive of the MICROPDP-11/53 computer.

AWLCal

AWLCAL calibrates the wafer leveler.

AWLT

AWLT exercises the lever to make sure it functions correctly.

BACkup

BACKUP backs up or restores the system files, using floppy disks or streaming tapes. When this command is entered, HELP messages are displayed for each prompt when the ESC key is pressed. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information about BACKUP.

BASic

BASIC invokes the GCA BASIC interpreter. GCA BASIC is typically used to calculate simple arithmetic, although it has the capability of executing small, user-specified, BASIC programs. This interpreter has minimal storage capacity.

The calculator uses the following commands:

- To add two values, enter **X+Y**, where **X** and **Y** represent the two user-specified values.
- To subtract two values, enter **X-Y** where **X** and **Y** represent the two user-specified values.
- To multiply two values, enter **X*Y**, where **X** and **Y** represent the two user-specified values.
- To divide two values, enter **X/Y**, where **X** and **Y** represent the two user-specified values.

NOTE: This command has *no connection* with the **GCABSC** command.

CHANGEBL

CHANGEBL allows the system's baseline to be displayed and/or changed, without entering the command MODE.

CHANGEFzp

CHANGEFZP allows the system's local alignment baseline to be displayed and or changed, without entering the command MODE.

CHANGEOrth

CHANGEORTH allows system orthogonality to be displayed and/or changed, without entering the command MODE.

CHANGERot

CHANGEROT allows the software correction for microscope rotation to be displayed and/or changed, without entering the command MODE.

CHANGEWs

CHANGEWS allows the wafer scaling corrections to be displayed and/or changed, without entering the command MODE. This command does not have any direct effect on wafer scaling performed by the global alignment system during automatic wafer alignment (used during grid calibration).

CLoseh

CLOSEH closes the history file currently open, and temporarily halts history processing. If no history file is currently open, a message is displayed.

COLors

COLORS allows the user to change the background colors on the monitor, when operating the system.

COMP

COMP provides access to the laser compensator, to display and/or change the current compensator value, and to display the chamber or column temperature (either in degrees F or C), or the chamber's relative humidity. This value can also be set to display momentarily or continuously.

- To momentarily display the value, enter **COMP**.

- To display the value for a designated period of time, enter **COMP n**, where n is the number of seconds.

For either of these, the temperature of the column or the air within the chamber (in degrees F or C), the relative humidity, or the last 4 digits of the compensator is displayed, depending on the knob's setting.

To change the compensator value, enter **COMP =n**, where n is the value required.

CONFIG

Password : ATS1799

CONFIG is used to configure the system. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information on CONFIG.

COPy

floppy dr. = DU2

COPY copies a file or files from one directory to another. System users can copy only *to* their directory, although they can copy *from* any other directory. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information about COPY.

COPY [10,1] FN DU2:[10,1] FN

CVTJOB

floppy located in A2 rack

CVTJOB allows job programs which were created using version 6.05.1 MOP to be converted and used with the 7.3MOP. The CVTJOB command is automatically enabled when the user edits a job program using the EDIT or JOB commands or when a version 6.05.1MOP job program is executed. This command can also be used off-line.

DELete

DELETE permanently removes a file or files from the system. Files can be deleted only within the account from which the command is entered. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information about DELETE.

DEXpo

DEXPO creates a job containing a frequently used focus/exposure array, for an EXPO job used frequently. The command AEXPO is then used to execute the job created using this command.

EXECute

EXECUTE executes a specified job, and the pass number within the job required. When a pass number is not specified, the system prompts for one. See **Section 12 - Operating the System** for more information on EXECUTE.

NOTE: The RRS is reset to the home position once the EXEC command is entered.

EXPO

EXPO executes a one-time exposure focus array with different exposures and/or focus settings. Rows and columns that will be exposed during job execution must be specified. See **Section 10 - Determining the Best System Focus** for more information on EXPO.

NOTE: The RRS is reset to the home position once the EXPO command is entered.

FLAT

FLAT is a diagnostic utility command which measures the flatness of a wafer and the wafer chuck. When this command is used, a wafer is loaded on the wafer chuck and leveled. The wafer is then stepped in a user specified array where the position of the optical column is measured at each die location. The column position information is sent to the metrology system which processes the data and displays a wafer/chuck flatness diagram and data on the metrology monitor. See **Section 13 - Achieving the Best System Performance** for more information on FLAT.

FOCus

FOCUS is used in conjunction with the local alignment system using the latent image to determine the best system focus. The FOCUS command allows the system focus to be verified and updated without wafer processing or microscopic examination. See **Section 10 - Determining the Best System Focus** for more information on FOCUS.

GCABsc

GCABSC is an interactive routine that places the stages of the AUTOSTEP 200 system directly under software control. This command is used for diagnostic purposes, including performing stage integration and MAXIMUS shutter manipulation.

HELP

HELP displays a help screen that contains information about the function currently open.

HISRec

HISREC displays the contents of all closed history files on the monitor. Open history files are not reviewed by HISREC and therefore are not displayed.

IAS

IAS invokes the IAS host program.

IASBAckup

IASBACKUP archives the AWA/D calibration files and process parameter files to a floppy diskette.

IASInit

IASINIT initializes the IAS hardware only. It does not reload the calibration or system files and should not be used after the IAS is corrupted. Use the IASRESET command instead.

IASLoad

IASLOAD transfers a copy of the IAS AWA/D software from the MICROPDP-11/53 to the IAS chassis. The software remains in the IAS chassis until a new copy is downloaded on top of it, or until the chassis powered off and on again.

IASRESet

IASRESET resets the AWA/D hardware and software. IASRESET downloads a new copy of the calibration and system files. IASRESET is always used after a hardware reset has been performed. A hardware reset is initialized from the front of the IAS chassis by toggling the reset switch.

IASRESTore

IASRESTORE reinstalls previously backed up calibration files and process parameter files from a floppy diskette to the hard drive of the MICROPDP-11/53 computer.

INSitu

INSITU displays the INSITU Command Options menu, used to determine the optimum system focus by testing the system focus, intrafield, and Micro DFAS baseline.

local align also, Dose control

INVENtory

INVENTORY directs the RMS to perform an inventory of all reticles currently within the elevator cassettes. When the procedure is complete, the contents of all cassettes and their locations within the elevator are displayed on the monitor.

JOB

JOB combines functionality of old commands such as SPEC, EDIT, and DISPLAY into a menu-driven utility. JOB sets defaults for, creates, edits, and displays job specification files.

JOBCNV

JOBCNV allows jobs created using the V6.04.1 MOP to be converted and used with the V7.3 MOP. This command can also be used off-line.

LATent

LATENT performs baseline autocalibration using latent images in conjunction with the AWA. This interactive procedure exposes latent images on a clean resist-coated wafer, and aligns the latent images using the AWA, without removing the wafer from the chuck.

NOTE: The RRS is reset to the home position once the LATENT command is entered.

LATMAP

LATMAP permits the user to expose a latent image array on a wafer and then automatically map the wafer. The metrology software automatically creates history files for the mapped data. Typically, several wafers are exposed and mapped using the LATMAP command and the metrology software records the history files which can be averaged by the user to determine the Micro DFAS mapping offset. **Section 13 - Achieving the Best System Performance** for more information on FLAT.

LIST

LIST prints the job comment and creation date of the job specified with the command, along with the associated pass name (if a pass is specified in the command), pass comments, and the pass type (either an array or plug).

LISTF

LISTF displays a directory of files specified. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information about LISTF.

LISTID

LISTID lists all user accounts currently active on the system, storage space allocated for each account, and the total storage space used and allocated for all accounts.

LOAD

LOAD moves the stages to the load position. If this command is issued before the ORIG command, it also originates the laser counter.

LOG

LOG identifies the user to the system. LOG IN gains access to the system; LOG OUT is used before another user can log on using the same terminal. See **Section 5 - Setting Up and Powering Up the System** for more information on LOG.

MAP

MAP allows the AUTOSTEP 200 system to read actual production wafers to determine the corrections needed for the AUTOSTEP 200 system to dynamically calibrate itself in X and Y stage axis scaling, X and Y baseline, stage orthogonality, and microscope rotation. These calculations are only used during the current production run.

NOTE: The RRS is reset to the home position once the MAP command is entered.

MODE

MODE is used to reference and change specific parameters for the AUTOSTEP 200 system, such as chuck size, orthogonality, and baseline correction. It is also used to specify subsequent use of AUTOSTEP 200 subsystems for job execution.

See Section 6 - The MODE Command: Setting Parameters and Subsystems for more information on MODE.

NEWDSK

NEWDSK prepares a preformatted floppy disk for subsequent use on the MICROPDP-11/53 computer. The disk must be preformatted according to Digital's RX50K or RX33 format. Which disk drive will be used must be specified, since either floppy drive can be used. Formatting need only be done the first time each floppy disk is used. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information about NEWDSK.

NOTE: RX33 format cannot be used to transfer files to or from a MICROPDP-11/23-based system.

OPENH

OPENH activates history file processing when it is not currently activated, if history processing has been selected in MODE.

OPER

OPER changes the speed of the wafer alignment joysticks before job execution: during job execution, the O function key can be used to perform this same function.

ORig

ORIG retunes the stage laser and originates the laser counter to move the stages to the load position, after the laser's path has been temporarily blocked.

PPC

PPC is used to activate the PPC software, used during periodic maintenance for the AUTOSTEP 200 system.

PRInt

PRINT is used to display on the monitor a text file or files created using the TEDIT command.

PUrge

PURGE deletes all but the most recent version of the files specified; wildcards are allowed.

REMF

The REMF command instructs the AUTOSTEP 200 system to move the stages to the wafer load/unload position, remove the wafer from the wafer chuck with the send paddle, and place the wafer in the send cassette.

REMW

The REMF command instructs the AUTOSTEP 200 system to move the stages to the wafer load/unload position, remove the wafer from the wafer chuck with the receive paddle, and place the wafer in the receive cassette.

REName

RENAME renames a file or files as specified. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information about RENAME.

RESet

RESET resets the reticle management system.

RESUMH

RESUMH reopens the most recently closed history file, to continue history processing within that same file.

RETicle

RETICLE displays data pertaining to the reticle currently loaded on the reticle platen by the RMS.

RMCC

RMCC is used to display RMS pass information (if the J control key is toggled to ON) when the pass is executed, until the J control key is turned off.

RMS

RMS enters a talkthru mode which allows the operator to communicate directly with the RMS subsystem.

RMSDir

RMSDIR prints the directory of the reticles stored in the RMS elevator and, when reticles are not located in their respective cassettes, specifies their location (reticle platen, transfer fork, etc.).

RMSLoad

allows reticle box removal

RMSLOAD resets the RMS, placing the elevator in its lowest position, to enable reticles to be manually loaded and unloaded into the RMS. When all cassettes are loaded as required, press the RETURN key to inform the system that the loading operation is complete. The command INVENT is then automatically invoked, and a directory of all reticles and their location in the elevator is displayed on the monitor.

RMSRET reticle return

RMSRET returns the reticle currently on the platen to its respective cassette in the RMS.

RRS

RRS accesses the reticle rotation system software, which enhances reticle positioning without replacing existing reticle offsets or adjustments.

RST

RST sends the reset command to the AWH III feature, that homes the mechanics, and resets the electronics.

RSX

RSX allows the user to directly communicate with the RSX-11M-PLUS operating system, without using the V7.3 MOP.

comp. operating system

SETDSK use before copy

SETDSK is an interactive routine that allows the system to recognize the existence of a 5-1/4 inch floppy disk in either disk drive. This command does not need to be entered when the command BACKUP is entered.

SETUP

SETUP automatically reads focus, intrafield, and Micro DFAS baseline, then automatically updates the MODE program with the new corrections.

NOTE: The RRS is reset to the home position once the SETUP command is entered.

SHUTDN parks hard drive

SHUTDN shuts down the computer safely within specified time given after the command is entered. Any currently open history files are closed when the command is entered, and a message is sent and displayed to all currently logged-in monitors that a computer shutdown is in process.

SPEC

SPEC invokes an interactive procedure that creates job specifications. See **Section 8 - The SPEC Command: Developing a Job Specification** for more information on the SPEC command.

SPACE hard drive available

SPACE displays the amount of free (available) storage space on the system disk, in 512 byte blocks.

TEDIT text editor

TEDIT allows text files to be created and modified. TEDIT *cannot* be used to create or edit job specifications; use the command EDIT for this function. Files created by using TEDIT have default extension TXT, unless one is defined.

TIME

TIME accesses the system clock and displays and/or changes the current time and date. See the AUTOSTEP 200 Advanced Lithography System Administrator's Supplement (P/N 069422) for more information about TIME.

UNIF

UNIF is a menu-driven utility that allows the operator to measure and determine the uniformity of the MAXIMUS illumination.

~~WTRAC~~

WTRAC allows the user to communicate with the WAFERTRAC system and issue WAFERTRAC commands from the VT340 keyboard directly to the WAFERTRAC system.

NOTE: WTRAC is not currently available for AUTOSTEP 200 systems.

COMMON CMMDS

EX

SETUP

RMSL

IASL - AWT

RST - ACWH

OR ~~- RMS~~

Reset - rms

Appendix B - Error Messages

This section explains all error messages that appear on the AUTOSTEP 200 system monitor. Messages are listed in alphabetical order.

Message	Cause	Action Required
ABORT EXECUTE	Usually preceded by a particular failure.	Simultaneously press the CTRL and C keys, and enter ABORT.
ALIGNMENT DIE DOES NOT EXIST	Job array does not have sufficient columns to include the selected alignment dies.	Modify the job to include standard alignment dies, or select nonstandard alignment keys.
ALL PASSES SKIPPED	For some reason, the system was unable to extract the job.	Re-enter the EXEC command.
ATMOSPHERIC COMPENSATION ERROR	The compensator is not returning valid responses.	Check the cable connections to the compensator. If problem persists, contact GCA Field Service.
AUTOFOCUS FAILURE	The Autofocus electronics is attempting to focus off the edge of the wafer.	Press RETURN to try again. If this consistently occurs, type Q to halt processing on the current wafer.
AWL NOT IN SYSTEM	AWLC or AWLT command was entered on a system without the leveler configured.	Enter the correct command.
BAD DATE STRING	The date was not entered in the correct format.	Re-enter the command using the correct format.
BAD JOB FILE SPECIFICATION	An invalid job filename was entered: either the filename was greater than 9 characters, or the extension was greater than 3 characters.	Enter the correct job filename.
COMMAND SYNTAX ERROR - PLEASE RETRY	A command was entered incorrectly.	Re-enter the correct command.
CORRECT THE PROBLEM AND PRESS S/C BUTTON	AWH has timed out.	Correct the problem, and continue by pressing the S/C key.

Message	Cause	Action Required
DATABASE IS CORRUPTED	Software problem.	Reload the AUTOSTEP-200 system software.
DATA NOT SAVED - DISK WRITE-PROTECTED	The disk is write-protected.	Make sure that the write-protect button on the hard disk is not depressed, or that no write-protect tab is present on the floppy disk being used.
DEVICE ACCESS ERROR	A non-existent or failed device was entered for access.	Enter the correct device.
DEVICE NOT LEGAL FOR NEWDSK	A device other than DU0, DU1, DU2 or DU3 was specified with the NEWDSK command.	Enter the correct device.
DEVICE NOT LEGAL FOR SETDSK	A device other than DU0, DU1, DU2 or DU3 was specified with the SETDSK command.	Enter the correct device.
DEVICE SPECIFICATION INVALID	A non-existent device was specified.	Enter the correct device.
DEXPO FILE I/O ON	The specified DEXPO file is corrupted.	Create a new DEXPO file.
DXD DEVICE DOES NOT EXIST	A local alignment system that is not configured was specified for use.	Correct the job specification, and re-enter the EXEC command.
DXD DEVICE NOT IN USE	The local alignment system is turned off in MODE.	Change local alignment use in MODE, then re-enter the command.
EQUIPMENT IN USE	The EXEC command (or another hardware command) was entered from one terminal while the instrument was being accessed from another terminal.	Re-enter the command when the other terminal has completed its activity.
ERROR ALLOCATING DU1:	DU1 is already being used by another user.	Re-enter the command after a few minutes.
ERROR ALLOCATING DU2:	DU2 is already being used by another user.	Re-enter the command after a few minutes.

Message	Cause	Action Required
ERROR DEALLOCATING DU1:	Hardware problem.	Boot the system; if problem persists, contact GCA field service.
ERROR DEALLOCATING DU2:	Hardware problem.	Boot the system; if problem persists, contact GCA Field Service.
ERROR DURING DISK READ	Disk may be corrupted.	Re-enter the command; if problem persists, contact GCA Field Service.
ERROR DURING DUPLICATION	Output disk may be corrupted.	Check the disk and re-enter the command; if problem persists, disk is permanently damaged and should not be used.
ERROR: FILE WAS FOUND OPEN	System was not shut down using the SHUTDN command.	Delete the file.
ERROR IN COMMAND LINE RECEIVED FROM CLI	A command was entered using an incorrect format.	Re-enter the command; if problem persists, contact GCA Field Service.
ERROR IN FINDING WAFER SIZE	Wafer size was not specified in MODE or SPEC.	Edit the job to include the wafer size. If the wafer size is present within the job, contact GCA Field Service.
ERROR LOCATING BAD SPOTS ON DU2:	Hardware problem.	Re-enter the command. If problem persists, contact GCA Field Service.
ERROR MAKING DUn: PRIVATE	Hardware problem.	Make sure that no other user is accessing the disk specified, then boot the system; if problem persists, contact GCA Field Service.
ERROR MAKING DUn: PUBLIC	Hardware problem.	Make sure that no other user is accessing the disk specified, then boot the system; if problem persists, contact GCA Field Service.
ERROR ON OPEN FILE FOR READ	File is damaged.	Delete the file.

Message	Cause	Action Required
ERROR ON OPEN FILE FOR WRITE	File is damaged.	Delete the file.
ERROR READING RSX DIRECTORY FILE	Disk is corrupted.	Contact GCA Field Service.
ERROR WHILE CLOSING READ FILE	File is corrupted.	Delete the file.
ERROR WHILE CLOSING WRITE FILE	File is corrupted.	Delete the file.
ERROR WRITING CONFIG FILE	Disk is write-protected.	Remove the write-protection, and re-enter the command.
EXCESSIVE SITE ALIGNMENT MOTION	The total movement of the stages during an attempt to align the target has exceeded 6 microns, either in the X or Y direction. The system abandons alignment of this die, and instead exposes the site based on the alignment data from the last die aligned.	If this message occurs frequently, check the parameters in the job and the FZT baseline parameters in MODE for accuracy. Also examine the wafer to ensure that the FZT was processed clearly.
FATAL DISK ERROR	Parity error on the disk.	Contact GCA Field Service.
FILE NOT FOUND	The specified file is not found on the device and/or account specified in the command.	Check the device and account, as well as other portions of the file specification.
FILE OPEN ERROR	File cannot be opened for reading.	Re-enter the command using the correct filename.
FILE READ ERROR	File cannot be opened for reading.	Re-enter the command using the correct filename.
FIRST LEVEL NOT ALLOWED WITH THIS COMMAND	First-level passes are not valid with this command.	Re-enter the EXEC command and enter N to **1st Level?**.
FOCUS SETTING OUT OF RANGE	Invalid focus setting was specified.	Confirm the focus setting and enter accordingly.
FOCUS VALUE OUT OF RANGE	Invalid focus value was specified.	Confirm the focus value and enter accordingly.
FORMAT ERROR	NEWDSK command failed.	Re-enter the command using another disk.

Message	Cause	Action Required
ILLEGAL FILENAME	Filename was not entered correctly.	Re-enter the command using the correct format for the filename.
ILLEGAL VALUE	Value entered was either out of range or incorrectly formatted.	Re-enter the value.
ILLEGAL WAFER INPUT	The filename entered is not correct.	Enter the correct filename.
INVALID PASSWORD - TRY AGAIN	The password used is not valid.	Log in again using the proper password.
INPUT ERROR	Time entered is not in correct format.	Enter the time again, in the correct format.
INVALID COMMAND UIC GROUP LESS THAN 10 NOT ALLOWED	An account was entered that is not a user account.	Re-enter the correct account.
INVALID DATE FORMAT	The date was entered using an incorrect format.	Re-enter the date using the correct format.
INVALID DEVICE	The device specified cannot be used with the command selected.	Enter the correct device, or the appropriate command required.
INVALID UFD SPECIFICATION GROUP 1 NOT ALLOWED	An account was entered that is not a user account.	Re-enter the correct account.
INVALID USER ID	The user account entered is not valid.	Enter the appropriate account.
JOB MUST HAVE AT LEAST ONE PASS	No pass has been defined for the job.	Enter at least one pass.
LASER CURRENT MARGINAL	Hardware problem.	Contact GCA Field Service.
LASER METERING LOSS	Laser path was momentarily blocked.	Enter the command ORIG, and begin the job again.
LASER RETUNE FAILURE	Defective ±15V DC supply, or possible defective laser transducer.	Use the command ABORT. If the system fails again, contact GCA Field Service.

Message	Cause	Action Required
LIGHT TOO LOW	The light integrator circuit is signaling that the mercury arc lamp may need replacing.	Check the lamp, and replace as necessary. To continue, press RETURN.
LOGGED IN AT ANOTHER STATION	An account has been accessed from a terminal other than the one entering the command.	Log in to another account, or log off the other terminal.
MODE MUST BE SET BEFORE ALIGNMENT DIE CAN BE DETERMINED	The MODE file for the system cannot be found, or does not exist.	Enter the command **MODE** at the system prompt and enter all all information as necessary.
NAME IN USE	The job being specified already contains a pass with the name specified.	Rename the pass.
NO REACHABLE KEYS	Alignment die cannot be positioned under the alignment microscope.	Use the **EDIT** command to check the job's ORIGIN TRANSLATION, PASS and SHIFT. Make sure that the number of columns and rows specified in the job are sufficient.
ONLY SUPERVISOR CAN CHANGE TIME	The TIME command was entered with a new time specified, from an account not authorized to change the system time.	Enter the command from an account having access to this command.
OPERATOR MUST BE PRIVILEGED TO USE RMS TALKTHROUGH	RMS talkthrough command was entered by a user that is not programmed to have access.	Re-enter correct command, or enter the RMS talkthrough command from another account having access to these commands.
OUT OF RANGE	The value entered exceeds the maximum limit, is less than the minimum limit, or is not a number.	Enter the number within the acceptable range.
PASS NOT FOUND	The pass name specified does not exist in the job specified.	Enter the correct pass name.
PLEASE TYPE CR IF READY OR Q TO QUIT	This prompts for the hardware to be checked.	Check the hardware setup, or enter a new one.

Message	Cause	Action Required
PLUG PASS REQUIRES AT LEAST ONE EXPOSURE	The plug pass has been terminated before any plugs were entered.	Specify a plug.
PRIVILEGE VIOLATION	An attempt was made to enter an unauthorized account.	Enter another account that is not unauthorized.
PROGRAMMABLE FOCUS DEVICE IS TURNED OFF	PFCORG command was entered with the PFC disabled in MODE.	Re-enter the correct command, or enter MODE and enable PFC.
PROGRAMMABLE FOCUS DEVICE TIMEOUT	Hardware problem.	Check the cabling from the focus system. If problem persists, contact GCA Field Service.
PROGRAMMABLE FOCUS DEVICE DOES NOT EXIST ON THIS SYSTEM	PFCORG command was entered when no focus system was specified in CONFIG.	Re-enter the correct command, or enter CONFIG and enable PFC.
RETRY/REJECT IS A FATAL ERROR	Global alignment failed, or the AWH timed out.	Re-enter the command using another master reference wafer.
RETICLE HAS MOVED OUT OF ALIGNMENT	RMS has reported that the reticle has moved.	Re-enter the EXEC command so that the reticle will be removed and realigned.
RMS DOES NOT EXIST	RMS use was not specified in CONFIG.	Enter the command CONFIG and enable RMS use.
RMS ERROR: COMMAND ABORTED	Fatal error occurred on RMS; job was aborted.	Re-enter the EXEC command; if problem persists, contact GCA Field Service.
ROW/COLUMN NOT FOUND	The specified row or column does not exist on the current dropout or plug list.	Enter the correct row or column.
SPECIFICATION INVALID	Data was entered that is not valid.	Re-enter the command.
STAGE LIMIT	The stage has reached a limit of travel.	Press the red limit button on the electronics rack, or the joystick. Determine the cause of the message, and press RETURN.

Message	Cause	Action Required
STAGES TIMEOUT	Stages could not move when the command required.	Check the stages' cabling for any obstructions. If problem persists, contact GCA Field Service.
SYSTEM WITHOUT STAGES	A command was entered that accesses the stages, when the system does not recognize their presence.	Enter the command CONFIG and specify stages.
THIS COMMAND CAN ONLY BE IMPLEMENTED WHEN IN EXEC	Either the V or O key was pressed when job execution was not in progress.	Enter the appropriate command.
TOO BIG	The value entered exceeds the maximum limit.	Enter a number within the acceptable limit.
TOO SMALL	The value entered is less than the minimum limit.	Enter a number within the acceptable limit.
UNAUTHORIZED COMMAND	A command was entered from an account that was not allowed access to the command.	Enter the command from another account, or enter a command that is acceptable.
UNITS NOT SET	No units (Metric or English) were specified in MODE.	Enter the command MODE and specify units.
UNUSUAL LASER COMPENSATION VALUE	The output of the autocompensator is out of range.	Check the compensator switch setting.
WAFER TOO THICK	The focus correction is out of range of the Autofocus system.	Check the wafer, try another wafer, or check the manual focus setting.
WAFER TOO THIN	The focus correction is out of range of the Autofocus system.	Check the wafer, try another wafer, or check the manual focus setting.
WRITE DISK PROTECTION DATA I/O ERROR	Hardware error.	Check to ensure that the write-protect mechanism is disabled on the disk in question. If problem persists, contact GCA Field Service.

Message	Cause	Action Required
WRITE MODE DATA I/O ERROR	Hardware error.	Check to ensure that the write-protect mechanism is disabled on the disk in question. If problem persists, contact GCA Field Service.
WRITE OPER DATA I/O ERROR	Hardware error.	Check to ensure that the write-protect mechanism is disabled on the disk in question. If problem persists, contact GCA Field Service.

Appendix C - ACS Error Codes and Messages

Front panel LEDs accompany error codes which may flash the system failure LED continuously or turn on the error LED. There is not much difference between the types of LED illumination or significance in which one is lit.

Both system failure and error conditions indicate that the ACS senses a situation not normal to proper ACS magnification or focus compensation. In some instances the error condition is noted as a warning. Other error conditions disable the ACS pressure servo until the error condition is corrected. Intermittent problems may cause the ACS to stop operation, then restart itself several minutes later.

The ACS error log is helpful for reviewing the sequence of events that occurred during the service person's absence. The error conditions are strongly influenced by the following basic assumptions about proper ACS performance:

1. Actual lens pressure must always be greater than ambient air pressure outside the lens.
2. Actual lens pressure must never exceed 100mmHg (approximately 2psi) above ambient air.
3. The proper operating range of the lens pressure is defined as 100mmHg total. Fixed at its lowest point by PMAX.
4. Ambient air pressure must never exceed PMAX and its range is 60mmHg. Fixed at its highest point by PMAX.

Some error conditions cause the ACS to halt its pressure servo operation. For troubleshooting purposes the halt-on-error function may be bypassed by turning switch S7D #4 to the ON position. However, this is not recommended for wafer steppers in a production environment because ACS will not flag problems. Reduction and focus regulation cannot be guaranteed.

When halt-on-error has been disabled, the ACS display indicates this special test mode for bench testing ACS without an HP5510 compensator available. When switch S7D #4 is on (no halt-on-error) ACS tests for the presence of an HP5510 compensator. If an HP5510 compensator is not recognized, ACS uses default weather parameters:

Pressure	760mmHg
Temperature	21.1°C
Humidity	50%

This allows ACS to function without an HP5510 compensator; however, no automatic compensation exists as the atmosphere changes from these default values. This is only recommended for testing purposes.

Table C-1 lists all the ACS conditions, with their codes, messages, and an explanation. Items shown in parentheses () are not displayed on the ACS monitor but are detected by the wafer stepper through the RS-232 when ACS does not respond.

Table C-1
ACS Error Codes

Code	Message	Indicator	State
1	**ACS Hardware Failure** One or more of the following is out of spec: +15V, -15V, +5V power supply voltage, 1.235V, 10V voltage reference. Power supply and reference voltages are tested to be within the following tolerances. 5V ±0.25V 15V ±0.5V -15V ±0.5V 10V Ref. ±0.06V 1.235V Ref. +0.055V to (–0.065V) ±12V Not tested in software The situation where all voltages fail is typically caused by the test circuitry failing since it is unlikely that the two ACS power supplies would fail simultaneously and the microprocessor continue to operate. Another common cause is the PROM software having been changed without resetting defaults. Clear the ACS memory by setting the ACS selector to the default position and turn on the ACS chassis. One or two voltages failing may be due to poor resistive connections at the ACS circuit board headers. Re-seat power supply connectors to locate the likely connectors. Power supplies are adjustable; however, several outputs may be affected with the common adjustment.	SYSTEM FAILURE	ON

Code	Message	Indicator	State
	Adjusting Power Supplies: a. Linear supply - located on the left side of the ACS chassis behind the front panel (top of chassis when in chamber). Single potentiometer adjusts 15V and -15V simultaneously. Monitor voltage on main ACS circuit board. Set 15VDC (±0.01V) Blk - J17J, pin 2 red - U17I, pin 1 (+15V). Set -15VDC (±0.01V) Blk - J17J, pin 2 red - U17I, pin 27 (-15V). b. Switching supply - located on right side of chassis behind front (top of chassis when in chamber). Single potentiometer adjusts 5V, 12V, and -12V. Monitor voltage on main circuit board. Set 5.05VDC (±0.01V) Blk - J9H, pin 1 Red - U9H, pin 24 (+5V) Check ±11-14VDC Blk - J5H, pin 1 Red - U4I, pin 11 (-12V), pin 4 (+12V). Optimize adjustment for 5V. The 12V needs only to be 11-14V. Test points are on silk screen of circuit board.		
2	**HP Compensator Disconnected** Signal HPOK* (HP5510AUX. PORT connector, pin 28) is not a TTL low (0.0-0.4) (on circuit board: U8C, pin 16). This condition is tested when an HP5510 compensator is selected in the setup with switch S7D.	SYSTEM FAILURE	FLASH
3	**HP Compensator Set Incorrectly** HP5510 must be in °C and display position for ACS software version 3.19 or earlier. For 3.20 and later use °F position.	SYSTEM FAILURE	FLASH

Code	Message	Indicator	State
4	**DSW System Disconnected** Signal DSWOK* (DSW INTERFACE AUC60-J2 connector, pin 28) is not a TTL low (0.0-0.4). (circuit board: U8C, pin 13)	SYSTEM FAILURE	FLASH
5	No longer used and should not occur except in units being operated in non-ACS modes with obsolete software.		
6	No longer used and should not occur except in units being operated in non-ACS modes with obsolete software.		
7	**No Positive Lens Pressure** With VOV=225, lens pressure is less than 5mmHg above ambient. Check upper lens, lower lens, 30psi nitrogen hoses for leaks or kinks blocking N_2 flow. Make sure gas is turned on. Check input filters for obstructions.	SYSTEM FAILURE	FLASH
	NOTE: Lens pressure is sensed in the ACS chassis. If error 7 occurs the ACS may have to be re-booted to start operation. Display will hang up.		
8	**Lens Sensor Calibration > 20mmHg** Lens pressure transducer offset is greater than recommended.	SYSTEM FAILURE	FLASH
9	**Lens Pressure > 116mmHg** With respect to ambient pressure. This is accompanied by flashing the overpressure LED and the VOV retracts to the home position (0).	SYSTEM FAILURE	FLASH
10	No longer used and should not occur except in units being operated in non-ACS modes with obsolete software.		
11	**Initializing For > 5 Minutes** Different from error code 7 in that lens pressure may be positive but servo can't regulate pressure after 5 minutes. If VOV is stuck open, it could cause non-regulation, or partial leaky hoses. This may only occur at higher lens pressures and therefore seem intermittent as lens pressures shift from day to day.	SYSTEM FAILURE	FLASH
	Initializing state = [Actual Lens Pressure - Target Lens Pressure] >2.5mmHg		

Code	Message	Indicator	State
12	**Calculated Pressure < Ambient** Lens target pressure is out of specification. One of the parameters used to calculate it is most likely incorrect: ambient pressure, temperature, humidity, or PMAX is set wrong for nominal site pressure. Also caused by erroneous HP5510 data.	ERROR	ON
13	**Calculated Pressure > Ambient + 100mmHg** Lens target pressure is out of range. One of the parameters used to calculate it is most likely incorrect: ambient pressure, temperature, humidity, lens temperature, magnification offset, etc. All of these parameters may add to their effects to cause this problem. If a large magnification offset has been programmed and the barometer falls, the ACS may exceed 100mmHg positive pressure limit.	ERROR	ON
14	**Ambient Pressure Greater than PMAX** Verify that maximum pressure is set at 30mmHg above the nominal ambient pressure for the geographical region. Also caused by erroneous HP5510 data.	SYSTEM FAILURE	FLASH
15	**Total Requested Mag Out of Range** Magnification offset requested is out of range of the available lens pressure. Ambient < Lens Pressure < Ambient plus 100mmHg. The available range changes each day with the weather. Be careful of large magnification offsets requested for matching or process control. Also beware of large magnification temperature coefficients (scaling factors), which with large temperature changes (0.5°C) may cause large magnification offsets to be requested of ACS. (20.5°C - 20.0°C nominal) .4µm/°C scaling= .5°C * .4µm/°C = .2µm. Across a 20mm field it would be 10ppm.	ERROR	ON

Code	Message	Indicator	State
16	**Timeout** Software stuck in a loop. Typically an indication of a software bug or intermittent hardware failure. This is a basic "watchdog timer". Program loop must be executed in less than 30 seconds. Reset the defaults to clear the zero power RAM or replace the chassis.	SYSTEM FAILURE	FLASH
17	**VOV Failure** Something is wrong with the variable orifice valve which is the heart of the the pressure servo. VOV positions range from -150 (vented), to 0 (home position, flow obstructed), to 450 (full flow to lens). ACS computer counts stepping motor steps to home position. If VOV sticks or misses steps, the computer recognizes it through the home position detector. Replace the chassis.	SYSTEM FAILURE	FLASH
18	**Lens Pressure > 100mmHg** With respect to ambient pressure. A soft error which is a warning and somewhat redundant with error #9.	OVERPRESSURE	FLASH
19	**Ambient Pressure Less than PMAX-60** This is a low limit for the ambient pressure. Verify that the maximum pressure is set at 30mmHg above the nominal ambient pressure for the geographical region. If extreme low pressures are common at this site, consider lowering PMAX. PMAX may be lowered in less than 10ppm steps by setting PMAX through ACS software. However, setting will have to be re-entered if memory is cleared.	SYSTEM FAILURE	FLASH
20	Not Used		

Code	Message	Indicator	State
21	**Parameter Out of Range** Any one of the parameters may be out of range, in which case (OOR) will appear next to the parameter on a standard display. OOR errors may be caused by a weather station failure, a bad interface to HP5510, etc. If this is detected, it will also possibly generate several other errors along with it. Typically error #'s 12, 13, 14, 15 or 19. If this occurs frequently, upgrade the ACS PROMs to version 3.22 or later.	SYSTEM FAILURE	FLASH
22	**Intermittent Parameter Received** In version 3.22 ACS PROMs or later, this error code means that ACS is receiving temporary glitches in weather parameters and is ignoring them for 1 refresh cycle.	SYSTEM FAILURE	FLASH
23	**Ambient Pressure Out of Range** Individual code for parameters causing error 22 if occurring for more than 1 refresh cycle.	SYSTEM FAILURE	FLASH
24	**Ambient Temperature Out of Range** Individual code for parameters causing error 22 if occurring for more than 1 refresh cycle.	SYSTEM FAILURE	FLASH
25	**Ambient Humidity Out of Range** Individual code for parameters causing error 22 if occurring for more than 1 refresh cycle.	SYSTEM FAILURE	FLASH
26	**Remote Material Temp Probe 1 Out of Range** Individual code for parameters causing error 22 if occurring for more than 1 refresh cycle.	SYSTEM FAILURE	FLASH
27	**Remote Material Temp Probe 2 Out of Range** Individual code for parameters causing error 22 if occurring for more than 1 refresh cycle.	SYSTEM FAILURE	FLASH
28	**Remote Material Temp Probe 3 Out of Range** Individual code for parameters causing error 22 if occurring for more than 1 refresh cycle.	SYSTEM FAILURE	FLASH

Code	Message	Indicator	State
(99)	**(Initializing Mode)** It normally takes 2-4 minutes to bring the lens to target pressure.	INITIALIZING	ON
( )	**(ERROR Mode)** ACS is operating in an illegal mode of operation, such as DEFAULT mode. DEFAULT is only valid a few seconds after reset/power up. Then it must be changed to a different mode.	ERROR	ON
( )	**(No Power)** Check AC line voltage and/or +5V on the ACS circuit board.	POWER ON	OFF
( )	**(Lens Pressure > 135mmHg)** Serious problem, generated by the pneumatic overpressure switch.	OVERPRESSURE	ON
( )	**(Reset or Hard Failure)** ACS circuit board is unable to boot or run the ACS program. Typically a component level failure. Monitor closely. If problem recurs, the microprocessor is halted and the ACS must be restarted to recover. Replace chassis.	POWER ON SYSTEM FAILURE OVERPRESSURE INITIALIZING ERROR	ON ON ON ON ON

NOTE: When using a local weather station option, allow the humidity probe to warm up for three minutes. During power up, the probe can falsely detect humidities above 100%. This causes error #21, which remains until the humidity reading falls below 100%.

ACS software uses 8 diagnostic LED indicators, located on the ACS circuit board, to determine the error code when an optional ACS terminal is not available. On board 123722, LEDs face the front panel, and on the new board 124318, they face the back panel. These errors are displayed in a hexadecimal code. Table C-2 lists error codes and LED indicator status. LEDs are shown in the same order as if viewed from the front panel of the ACS.

Table C-2
ACS LED Error Listing

Error Code	L13F	L13E	L12F	L12E	L11F	L11E	L10F	L10E
1	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
6	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
7	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
9	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF
0	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
11	ON	ON	OFF	ON	OFF	OFF	OFF	OFF
12	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
13	ON	OFF	ON	ON	OFF	OFF	OFF	OFF
14	OFF	ON	ON	ON	OFF	OFF	OFF	OFF
15	ON	ON	ON	ON	OFF	OFF	OFF	OFF
16	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
17	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
18	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
19	ON	ON	OFF	OFF	ON	OFF	OFF	OFF
21	ON	OFF	ON	OFF	ON	OFF	OFF	OFF

Appendix D - Inspect Screen Commands

This section presents a list of the Inspect screen commands with brief descriptions in the order in which they are displayed on the Inspect screen.

Command	Description
dir	Displays all 22 global mask waveforms on the monitor screen when entered at the Inspect program prompt.
con	Displays a contrast plot on the monitor screen that is used for adjusting the illumination of the wafer alignment microscope during process file setup.
dv	Displays a list of variables that contain the following information: **lcx** Left center position of the X-axis (in pixels) for wafer alignment reference mark. The information comes from the video parameters calibration. **lcy** Left center position of the Y-axis (in pixels) for the wafer alignment reference mark. The information comes from the video parameters calibration. **rcx** Right center position of the X-axis (in pixels) for wafer alignment reference mark. The information comes from the video parameters calibration. **rcy** Left center position of the Y-axis (in pixels) for wafer alignment reference mark. The information comes from the video parameters calibration. **xstep** The distance from the center of the wafer alignment mark to the center of the scan area in the X-axis. **ystep** The distance from the center of the wafer alignment mark to the center of the scan area in the Y-axis. **refyloc** The distance from the center of the wafer alignment microscope fiducial to the reference scan area. **tarsigw** The width of the target signal during a global scan. **refsigw** The width of the reference signal during a reference scan. The half variable switches the video information from the left to right sides of the screen. **conyloc** The row of pixels from which a video sample is taken during the contrast plot when using the CON command. **nsamp** The rate the video is sampled when using the contrast plot.

Command	Description
help	Displays the Inspect screen on the monitor for reference.
li	Refreshes the video screen with live movie video images on the screen. It can be used to clear the screen of waveforms from the **dt** or **dr** commands.
gf	Allows a snapshot of video to be obtained and displayed on the screen.
quit	Quits the program and returns to the IAS.VT prompt.
sv	Sets a variable.
am	Analyzes and displays single or multiple masks (1-22). The mask is applied to the video snapshot and the resulting waveforms are displayed on the screen.
dt	Analyzes and displays the global mask selected. The mask is applied to the video snapshot and the resulting waveform is displayed on the screen. The global mask is used for locating the wafer alignment mark.
dr	Analyzes and displays the reference mask selected. The mask is applied to the video snapshot and the resulting waveform is displayed on the screen. The mask number selected here is usually the same for most process files because the reference marks in the wafer alignment microscope do not usually change in appearance.