Section 7 - The JOB Command: Developing a Job Specification

Introduction

A job specification is a file that contains those parameters used by the AUTOSTEP 200 system to control the wafer exposure process. These parameters control the stage movement, the array to be exposed, and the alignment requirements. A job specification is developed on the system, using the JOB program.

This section is organized into the following three subsections:

- The Menus and Screens within JOB describes the location and function of the menus and screens within the JOB program that are used during system operation. Each of the screen prompts is also described within this subsection.
- Guide to Entering Data within the JOB Program describes an overview of the keyboard functions used within the JOB program, and any additional useful or helpful information regarding the JOB program.
- Developing a Job Specification: An Example describes how to develop a job specification file from setting the file default values, to creating, editing, and displaying a job specification file.

The Menus and Screens within JOB

Menus

Figure 7-1 is a flowchart showing the menus within JOB.

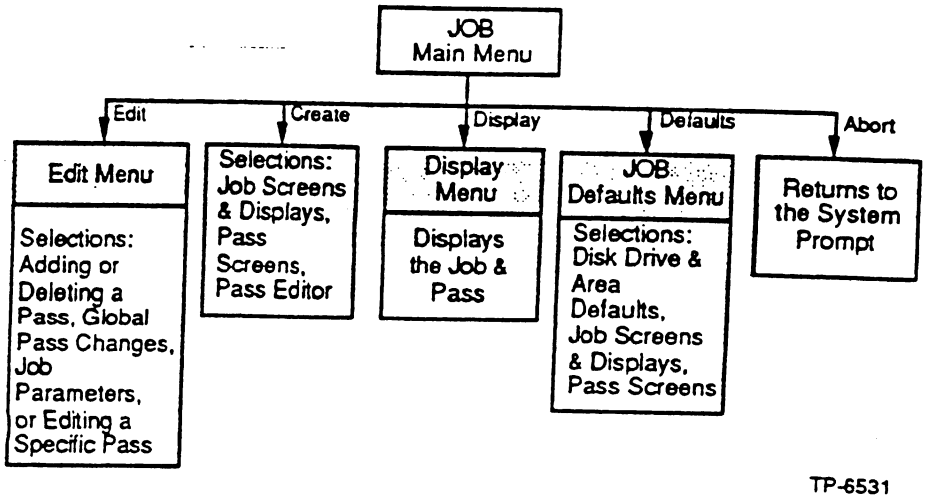

Figure 7-1
Flowchart of JOB Program Menus

The Job Main Menu

To display the Job Main Menu, at the system prompt (:) enter the command **JOB**, then press the RETURN key. The system then displays the Job Main Menu (Figure 7-2):

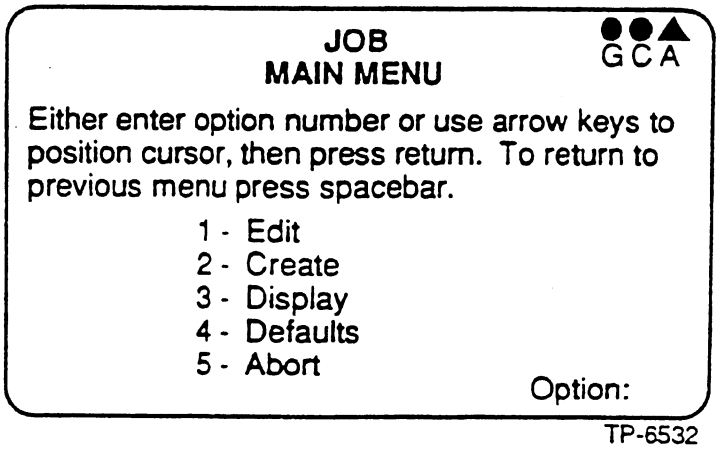

Figure 7-2
Job Main Menu

The Job Main Menu selections are:

- **1 - Edit** edits a pre-existing job program. When edit is selected, a particular job program is specified; then the system displays a separate Edit Menu used to edit the job program.
- **2 - Create** creates a new job program. A job program is first specified; then the system displays a series of screens and displays that define the job parameters and pass parameters, and then save and store the job program.
- **3 - Display** displays a pre-existing job program. When Display is selected, a particular job program is specified; then the system displays a separate Display Menu used to display the entire job, all passes within the job, or individual passes.
- **4 - Defaults** sets the defaults for the job program. When Defaults is selected, the system displays a separate Job Defaults menu that is used to set the defaults for the job parameters and the pass parameters, and to indicate where the user files are stored.
- **5 - Abort** exits the JOB program and returns to the system prompt.

The Edit Menu

Display the Edit Menu from the Job Main Menu as follows:

1. Select option 1 by either typing **1** or using the arrow keys to highlight option 1, then pressing RETURN.
2. At the prompts **ENTER JOBNAME, DRIVE,** and **AREA**, enter the appropriate responses, then press RETURN.

The system then displays the Edit Menu as follows (Figure 7-3):

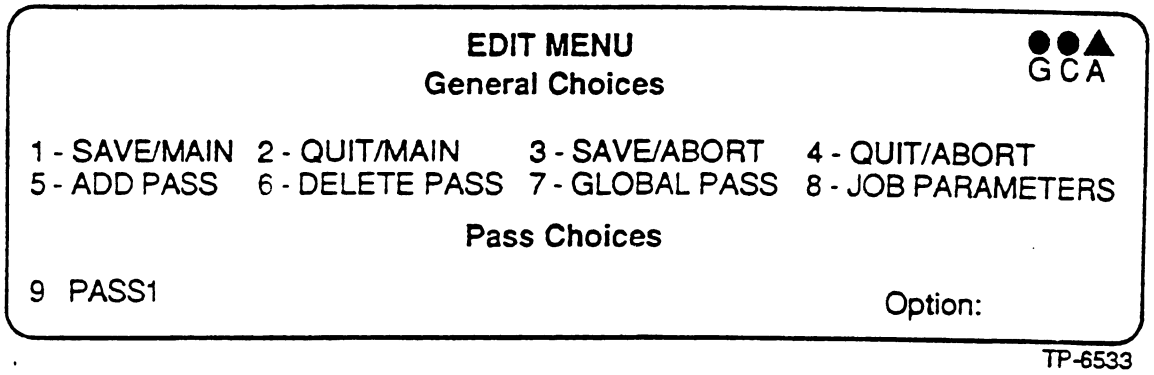

Figure 7-3
Edit Menu

The Edit Menu selections are:

- **1 - Save/Main** saves the job currently being edited, then returns to the Job Main Menu.
- **2 - Quit/Main** quits the current job without saving any changes that have been made, then returns to the Job Main Menu.
- **3 - Save/Abort** saves the changes that have been made to the current job, then exits the JOB program and returns to the system prompt.
- **4 - Quit/Abort** quits the current job without saving any changes that have been made, then exits the JOB program and returns to the system prompt.
- **5 - Add Pass** adds a pass to the currently specified job. The pass may be copied from another pass, or modeled after the pass template (refer to Creating a Pass Template in this section of the manual).
- **6 - Delete Pass** deletes a particular pass from the currently specified job. The deleted pass can only be restored by selecting either option 2 - Quit/Main or option 4 - Quit/Abort.
- **7 - Global Pass** edits the values of exposure, focus offset, and pass shift for all passes in the currently specified job program.

- **8 - Job Parameters** edits the general job parameters within the currently specified job. When Job Parameters is selected, the system displays the Job Specifications screen, and if selected, the Job Options screen and the job display.

- **Pass Choices: 9 -, 10 -, etc. edits** the parameters within individually specified passes. All existing passes within the job are listed, beginning with option 9. A maximum of 40 passes are allowable within the JOB program.

The Job Defaults Menu

Display the Job Defaults menu from the Job Main Menu by using one of the following procedures:

- Type **4**, then press RETURN.
- Use the arrow keys to highlight option 4, then press RETURN.

The system then displays the Job Defaults menu (Figure 7-4):

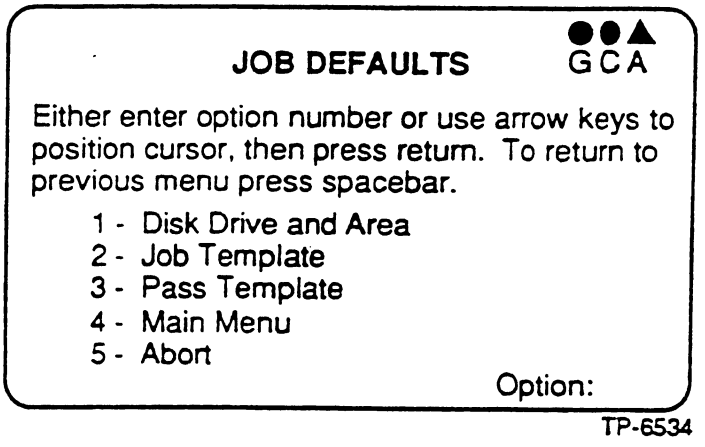

Figure 7-4
Job Defaults Menu

The Job Defaults menu selections are:

- **1 - Disk Drive and Area** displays a screen that sets the default storage location of the job specification file.

- **2 - Job Template** displays the Job Specifications screen that sets the default job parameters. Other accessible screens from the Job Specifications screen are the Job Options screen and the job display.

- **3 - Pass Template** displays the Pass Specifications screen that sets the default pass parameters. Other accessible screens from the Pass Specifications screen are the Local Alignment Options and RMS Options screens.

- **4 - Main Menu** exits the Job Defaults menu and returns to the Job Main Menu.
- **5 - Abort** exits the JOB program and returns to the system prompt (:).

The Display Menu

Access the Display Menu from the Job Main Menu as follows:

1. Select option 3 by either typing 3 or using the arrow keys to highlight option 3, then pressing RETURN.
2. At the prompts **ENTER JOBNAME, DRIVE,** and **AREA,** enter the appropriate responses, then press RETURN.

The system then displays the Display Menu (Figure 7-5):

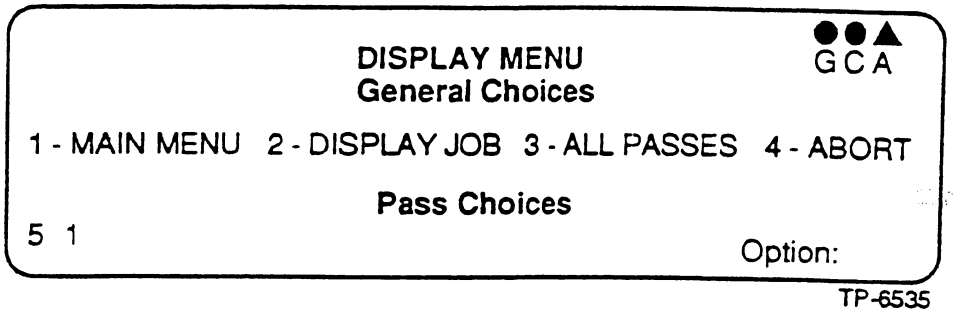

Figure 7-5
Display Menu

The Display Menu selections are:

- **1 - Main Menu** exits the display function, then returns to the Job Main Menu.
- **2 - Display Job** graphically displays the general layout of the currently specified job.
- **3 - All Passes** displays all existing passes within the currently specified job, superimposed over one another.
- **4 - Abort** exits the JOB program, then returns to the system prompt.
- **Pass Choices: 5 -, 6 -,** etc. displays an individually specified pass. All existing passes within the job are listed, beginning with option 5.

Job Screens and Displays

Figure 7-6 is a flowchart showing the job screens and displays within JOB.

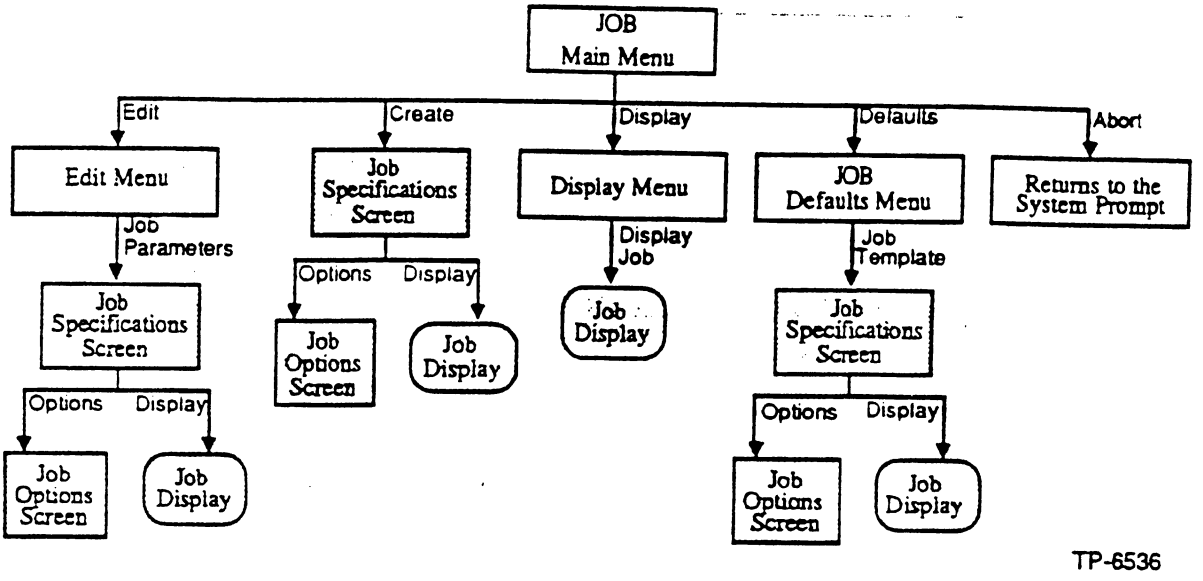

Figure 7-6
Flowchart of Job Screens and Displays

The Job Specifications Screen

Display the Job Specifications screen from the Job Defaults menu in one of three ways:

- When editing a job program, perform the following:

  a. From the Job Main Menu, select 1 (Edit), then press RETURN.
  b. At the prompts ENTER JOBNAME, DRIVE, and AREA, enter the appropriate responses, then press RETURN.
  c. From the Edit Menu, select 8 (Job Parameters), then press RETURN.

- When creating a new job program, from the Job Main Menu, select 2 (Create), then press RETURN.
- When setting default job parameters, perform the following:

  a. From the Job Main Menu, select 4 (Defaults), then press RETURN.
  b. From the Job Defaults menu, select 2 (Job Template), then press RETURN.

The system then displays a Job Specifications screen similar to the following example (Figure 7-7):

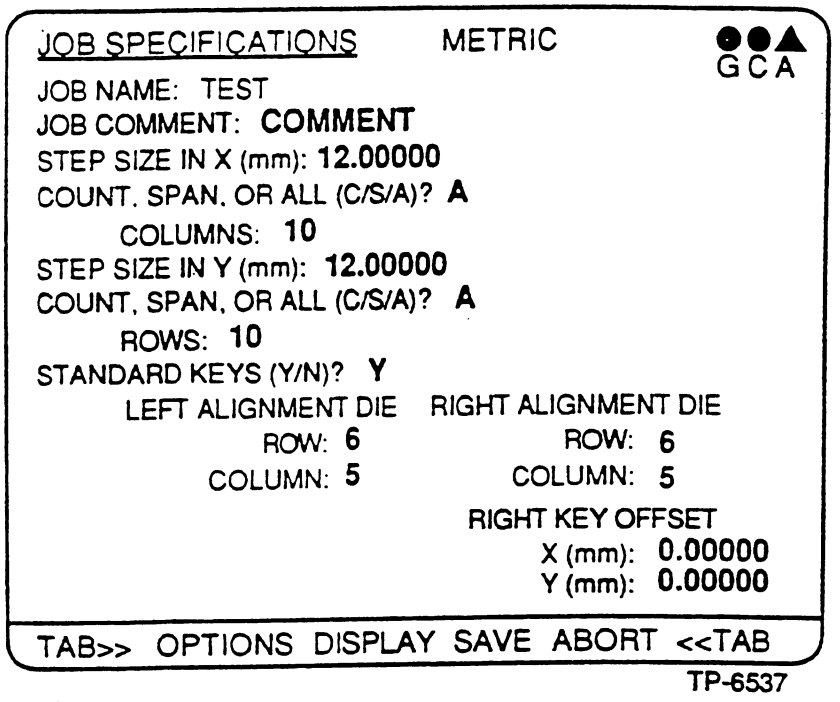

Figure 7-7
Job Specifications Screen

The monitor displays the current job name at the top of the screen. The prompts on the Job Specifications screen are:

- **JOB COMMENT:** is a free-form text that can range up to 40 characters long, including spaces. Only the first 40 characters of longer job comments are displayed.

- **STEP SIZE IN X (mm):** determines the stepping distance between the columns, and ranges between 0 and the usable size of the wafer.

- **COUNT, SPAN, OR ALL (C/S/A)** determines the method for allocating the area on the wafer that will be used for the array. *Count* allows the user to select the number of columns required for the array being exposed. *Span* instructs the system to span a certain width in the X direction for the array. *All* allocates all of the wafer's usable width for the array being exposed.

- **STEP SIZE IN Y (mm)** determines the center-to-center stepping distance between the rows of exposures, and ranges between 0 and the usable size of the wafer.

- **COUNT, SPAN, OR ALL (C/S/A)** determines the method for allocating the area on the wafer that will be used for the array. *Count* allows the user to select the number of rows required for the array being exposed. *Span* instructs the system to span a certain height in the Y direction for the array. *All* allocates all of the wafer's usable height for the array being exposed.

- **STANDARD KEYS (Y/N)** either enables automatic selection of the right and left alignment keys, or allows selection of specific alignment die and key offsets.

- **LEFT ALIGNMENT DIE (ROW and COLUMN)** identifies the row and column coordinates of the left alignment die.

- **RIGHT ALIGNMENT DIE (ROW and COLUMN)** identifies the row and column coordinates of the right alignment die.

- **RIGHT KEY OFFSET (X AND Y)** position the alignment keys within view of the wafer alignment system. The key offset values are the distances from the alignment mark on the die to the center of the alignment die.

Job Specifications Screen Submenu

Located at the bottom of the Job Specifications screen is a submenu that is used to display two additional screens: the Job Options screen, and the job display. Move the cursor to the Job Specifications screen submenu by pressing TAB. The Job Specifications screen submenu selections are:

- **OPTIONS** selects the Job Options screen, which is used to set defaults, edit, or create certain job parameters: translate origin, tolerance, scale corrections, orthogonality, leveler batch size, units used to specify the job, wafer diameter, and EPI shift.

- **DISPLAY** selects the job display, which graphically displays the general layout of the job. The job display also displays the number of rows and columns, the location of the center of the array, the job offsets, the alignment key locations, and the total number of dies.

- **ABORT** exits the JOB program, and returns to the system prompt.

- **SAVE** allows the user to save the edited job parameters in Edit mode and brings the user to the Edit Menu page. When in the Create mode, the save function saves the created job parameters and brings the user to the Pass Specifications page.

The Job Options Screen

Display the Job Options screen from the Job Specifications screen submenu by using the arrow keys to highlight the word OPTIONS, then pressing RETURN. The system then displays a Job Options screen similar to the following example (Figure 7-8):

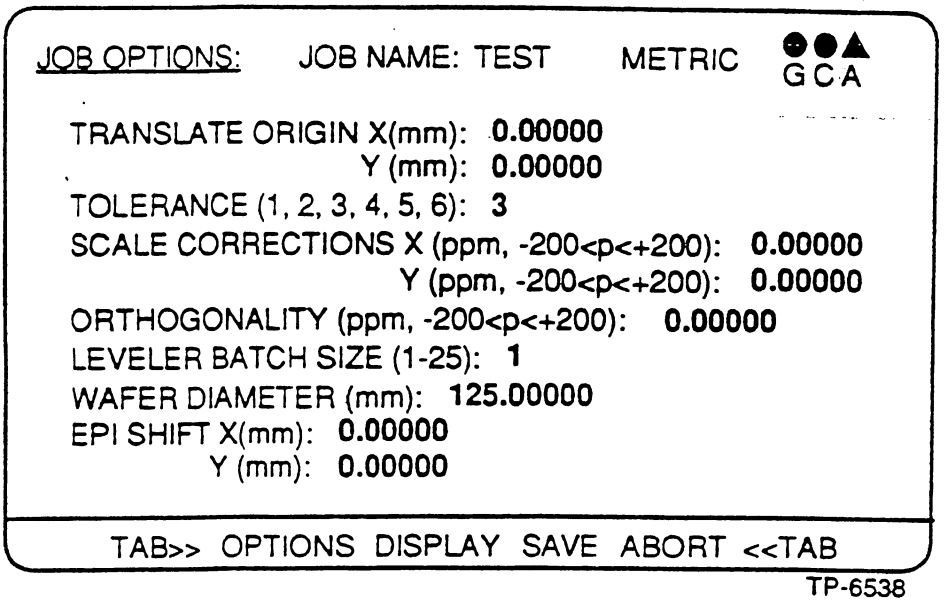

Figure 7-8
Job Options Screen

The monitor displays the current jobname at the top of the screen. The prompts on the Job Options screen are:

- **TRANSLATE ORIGIN (X and Y)** are used to offset the array in the X and Y directions on the wafer.
- **TOLERANCE (1, 2, 3, 4, 5, 6)** defines the range of acceptable speed and position values that the stages must fall within before the shutter opens. A value of 1 is 3 laser counts, and a value of 3 is 7 laser counts.
- **SCALE CORRECTIONS (X and Y)** increase or decrease the step size. A positive value increases the step size, while a negative value decreases the step size.
- **ORTHOGONALITY (ppm, -200<p<+200)** compensates for the stages' motion so that they move perpendicularly.
- **LEVELER BATCH SIZE (1-25)** indicates how often the leveler is used during job execution. When 1 is entered, every wafer is leveled; when 2 is entered, every other wafer is leveled, and so forth.
- **WAFER DIAMETER (mm)** specifies the wafer diameter.
- **EPI SHIFT (X and Y)** shifts the next exposure level to overlie a previously exposed epitaxial layer. Since epitaxial wafers "grow" at an angle, the top surface of an EPI layer shifts with respect to the substrate that the layer is grown on. Therefore, EPI shift corrections are required make sure that the new layer is placed directly over the EPI layer. EPI has an acceptable range of ±.005mm.

The Job Options Screen Submenu

Located at the bottom of the Job Options screen is a submenu that is used to return to the previous screen, access an additional display, or exit the JOB program. Move the cursor to the Job Options screen submenu by pressing TAB. The Job Options screen submenu selections are:

- **OPTIONS** selects the Job Options screen, which is used to set defaults, edit, or create certain job parameters: translate origin, tolerance, scale corrections, orthogonality, leveler batch size, units used to specify the job, wafer diameter, and EPI shift.

- **DISPLAY** selects the job display, which graphically displays the general layout of the job. The job display also displays the number of rows and columns, the location of the center of the array, the job offsets, the alignment key locations, and the total number of dies.

- **ABORT** exits the JOB program, and returns to the system prompt.

- **SAVE** allows the user to save the edited job parameters in Edit mode and brings the user to the Edit Menu page. When in the Create mode, the save function saves the created job parameters and brings the user to the Pass Specifications page.

The Job Display

Access the job display in one of three ways:

- From the Job Main Menu, perform the following:

  a. Select 3 (Display), then press RETURN.
  b. At the prompts **ENTER JOBNAME, DRIVE,** and **AREA**, enter the appropriate responses, then press RETURN.
  c. From the Display Menu, select 2 (Display Job), then press RETURN.

- From the Job Specifications screen submenu, use the arrow keys to highlight the word DISPLAY, then press RETURN.
- From the Job Options screen submenu, use the arrow keys to highlight the work DISPLAY, then press RETURN.

The system then displays a job specification file similar to the following example (Figure 7-9):

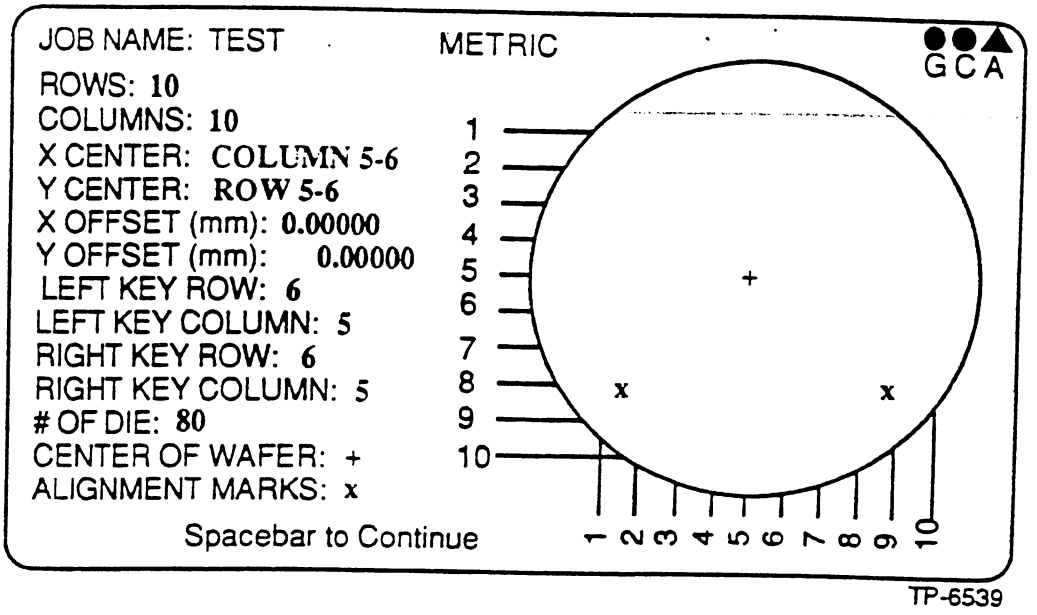

Figure 7-9
Job Display

When finished viewing the job display, press the spacebar key to return to the previous screen.

Pass Screens and Displays

Figure 7-10 is a flowchart showing the pass screens and displays within JOB.

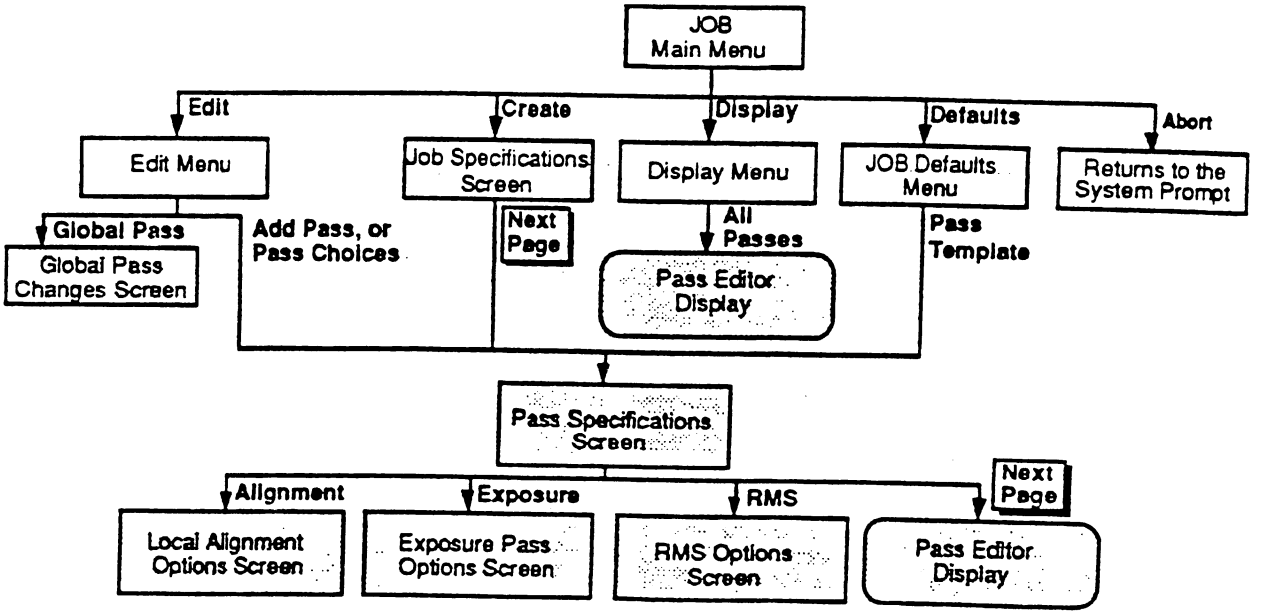

Figure 7-10
Flowchart of Pass Screens and Displays

The Global Pass Changes Screen

Display the Global Pass Changes screen from the Edit Menu by using one of the following procedures:

- Type 7, then press RETURN.
- Use the arrow keys to highlight option 7, then press RETURN.

The system then displays a Global Pass Changes screen (Figure 7-11):

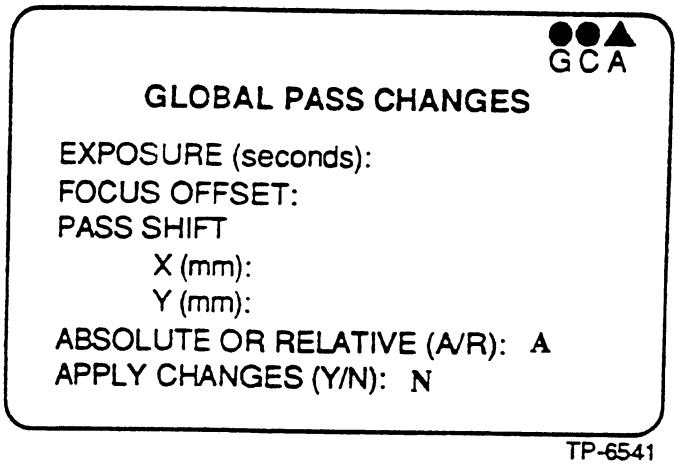

Figure 7-11
Global Pass Changes Screen

The Global Pass Changes screen prompts are:

- **EXPOSURE (seconds)** is the amount of time that the shutter remains open during system operation. The value can range from 0 to 128.000 seconds, in increments of 1 millisecond. Any exposures longer than 4 seconds are performed using multiple shots of 4.000 seconds each.

- **FOCUS OFFSET** is the value that is added to system focus entered in MODE. This offset is used during job execution to compensate for the focus shift that is due to processing. This value can range from -50 to +50 in increments of tenths of microns (for example: 15 = 1.5µm).

- **PASS SHIFT (X and Y)** shifts all exposures contained within the pass. These values are added to the values entered in TRANSLATE ORIGIN, and are used to correct for process-induced shifts or apparent movement in alignment marks to place a subsequent layer over a previous one.

- **ABSOLUTE OR RELATIVE (A/R)** specifies whether the changes made to each pass are to be either absolute (changes that replace the current value) or relative (changes that add the specified values to the current values).

- **APPLY CHANGES (Y/N)** determines whether or not to apply the global changes to the each pass.

The Pass Specifications Screen

Display the Pass Specifications screen in one of four ways:

- When setting defaults, from the Job Defaults menu, select option 3, then press RETURN.
- When creating a job specification, from the Job Main Menu, select option 2, then press RETURN. Respond to the Job Specifications screen prompts, and then press NEXT PAGE to display the Pass Specifications screen.
- When adding an additional pass to a job program, from the Edit Menu, select option 5, then press RETURN.
- When editing a pass, from the Edit Menu, type the particular pass' yellow option number, then press RETURN.

The system then displays a Pass Specifications screen similar to the following example (Figure 7-12):

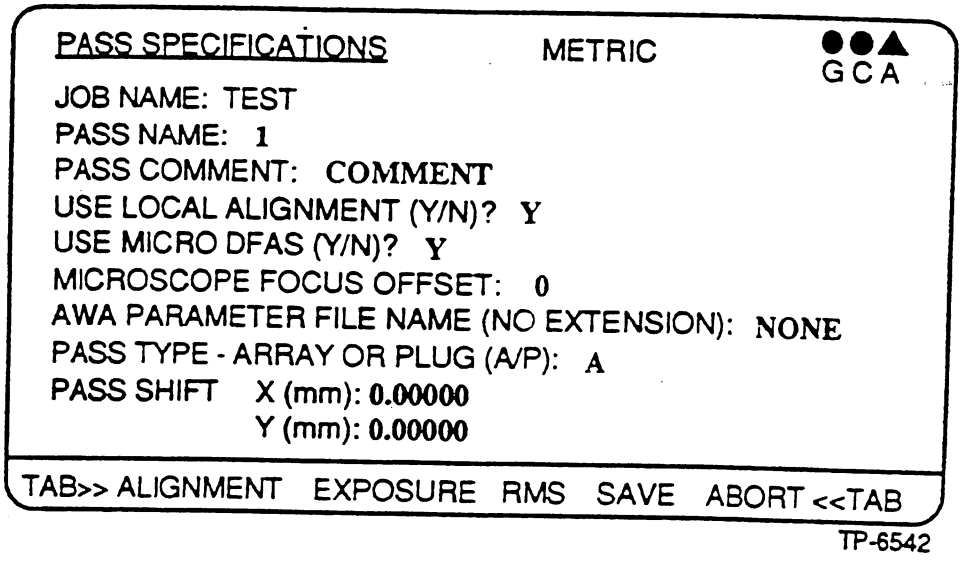

Figure 7-12
Pass Specifications Screen

The monitor displays the current job name at the top of the screen. The Pass Specifications screen prompts are:

- **PASS NAME** is a name between 1 and 9 alphanumeric characters long that is used to identify a pass.
- **PASS COMMENT** is a free-form text that can range up to 40 characters long, including spaces. Only the first 40 characters of longer pass comments are displayed.

- **USE LOCAL ALIGNMENT (Y/N)** determines if local alignment will be used during system operation. Answering Y allows access to the Local Alignment Options screen when ALIGNMENT is selected from the Pass Specifications screen submenu. Answering N allows access to the Exposure Pass Options screen when EXPOSURE is selected from the Pass Specifications screen submenu.

- **USE MICRO DFAS (Y/N)?** determines if Micro DFAS will be used during system operation. This prompt only appears if the system's CONFIG file contains Micro DFAS.

- **MICROSCOPE FOCUS OFFSET** compensates for focus changes when using different types of wafers. This value is added to MODE, and is displayed at the align position.

- **AWA PARAMETER FILE NAME (NO EXTENSION)** is the name of the AWA process parameter file to be allocated for the alignment parameters required (with no extension).

- **PASS TYPE - ARRAY OR PLUG (A/P)** specifies whether all sites previously specified within the array will be exposed during job execution, or only the user-specified sites within the array will be exposed.

- **PASS SHIFT (X and Y)** shifts all exposures contained within the pass. These values are added to the values entered in TRANSLATE ORIGIN, and are used to correct for process-induced shifts or apparent movement in alignment marks to place a subsequent layer over a previous one.

The Pass Specifications Screen Submenu

Located at the bottom of the Pass Specifications screen is a submenu that is used to display two additional screens: the Local Alignment Options screen, and the RMS Options screen. Move the cursor to the Pass Specifications screen submenu by pressing TAB. The Pass Specifications screen submenu selections are:

- **ALIGNMENT** selects the Local Alignment Options screen, which is used to set the following local alignment parameters: whether to use local alignment, whether to use Micro DFAS, which alignment location to revert to, how many dies to align on, the number and values of the alignment offsets.

- **EXPOSURE** selects the Exposure Pass Options screen, which is used to set the following parameters: the exposure, focus offset, reticle transmission, whether or not to use match, the match template name, how many wafers to match, and the reticle rotation offset.

- **RMS** selects the RMS Options screen which is used to set the following parameters: reticle bar code, phase of reticle alignment marks, the masking aperture settings, and the reticle alignment offsets. When Y is answered to the previous prompt **USE LOCAL ALIGNMENT**, this option is not available.

- **SAVE** displays the prompt **SAVE PASS (Y/N)?**, then returns to the previous menu.
- **ABORT** exits the JOB program, and returns to the system prompt.

The Local Alignment Options Screen

Display the Local Alignment Options screen from the Pass Specifications screen submenu by using the arrow keys to highlight the word ALIGNMENT, then pressing RETURN.

NOTE: To view the Local Alignment Options screen, Y must have been answered to the prompt **USE LOCAL ALIGNMENT** in the Pass Specifications screen.

The system then displays a Local Alignment Options screen similar to the following example (Figure 7-13):

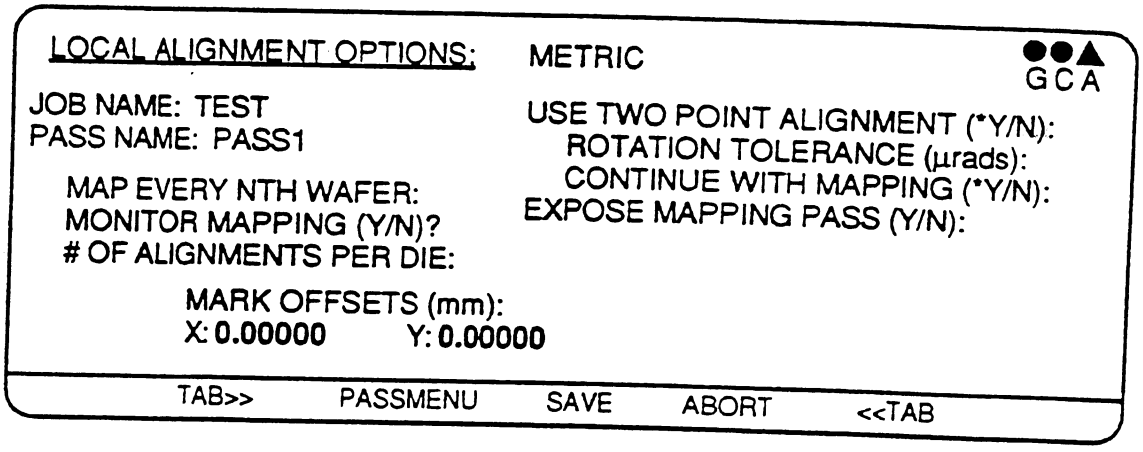

Figure 7-13
Local Alignment Options Screen

The monitor displays the current job and pass names at the top of the screen. The prompts on the Local Alignment Options screen are:

- **MAP EVERY Nth WAFER** determines the frequency at which mapping is to occur within the batch. For example, if every second wafer is to be mapped, enter 2. In this case, the first wafer is mapped, the alignment file parameters are determined, and the wafer is exposed. The second wafer is exposed using the same parameters. The third wafer is loaded and mapped, to determine the new key parameters.
- **MONITOR MAPPING** determines if the mapping process is monitored as it occurs. When mapping is monitored, the calculated best parameters are displayed after each mapped wafer. The system then requires the operator whether or not to apply the new parameters. This question is typically answered Y only when the system is being installed or troubleshot.

- **# OF ALIGNMENTS PER DIE** indicates the number of die alignment mark offsets to be used. This number can range from 1 to 10.

- **MARK OFFSETS (mm)** sets the X and Y values for each die alignment mark offset to be used.

- **USE TWO POINT ALIGNMENT** enables or disables the two point alignment function which is an enhancement to global alignment. Once the AWA has completed alignment and the expose button is pressed, the position of the global alignment dice are checked by Micro DFAS. If the rotation of the global alignment dice exceed that which is specified in the rotation tolerance prompt, than the wafer is rotated and the global alignment dice position are checked once again using Micro DFAS. This process is repeated until the rotation tolerance specification has been met.

NOTE: When this question is answered YES (enabled), the rotation tolerance and continue with mapping questions are presented.

- **ROTATION TOLERANCE** establishes the maximum rotation error allowed during two point alignment. A setting of 2μradians is recommended.

- **CONTINUE WITH MAPPING** allows the user to select one of two choices: if mapping should continue after two point alignment or direct wafer exposure should occur after two point alignment.

- **EXPOSE MAPPING PASS** allows all dice within a mapping pass to be exposed using individual die alignment data. A wafer is loaded and globally aligned in the usual manner. Once the wafer is aligned, each die within the pass is aligned and the alignment data for each die is stored in a metrology data file. When all dice have been aligned, then each die is exposed using the stored alignment correction for that die.

The Local Alignment Options Screen Submenu

Located at the bottom of the Local Alignment Options screen is a submenu that is used to return to the previous screen, or exit the JOB program. Move the cursor to the Local Alignment Options screen submenu by pressing TAB. The Local Alignment screen submenu selections are:

- **PASSMENU** returns to the previous Pass Specifications screen.

- **SAVE** displays the prompt **SAVE PASS (Y/N)?**, then returns to the previous menu.

- **ABORT** exits the JOB program, and returns to the system prompt.

The Exposure Pass Options Screen

Display the Exposure Pass Options screen from the Pass Specifications screen submenu by using the arrow keys to highlight the word EXPOSURE, then pressing RETURN.

NOTE: The Exposure Pass Options screen is only available if N was answered to the prompt **USE LOCAL ALIGNMENT** in the Pass Specifications screen.

The system then displays the Exposure Pass Options screen similar to the following example (Figure 7-14):

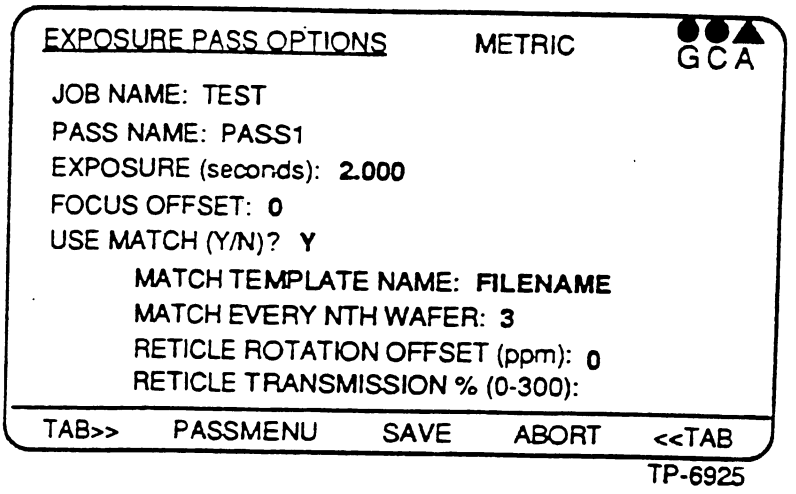

Figure 7-14
Exposure Pass Options Screen

The monitor displays the current job and pass names at the top of the screen. The prompts on the Exposure Pass Option screen are:

- **EXPOSURE (seconds)** is the amount of time that the shutter remains open during system operation. The value can range from 0 to 128.000 seconds, in increments of 1 millisecond. Any exposures longer than 4sec. are performed using multiple shots of 4.000 seconds each.

- **FOCUS OFFSET** is the value that is added to system focus entered in MODE. This offset is used during job execution to compensate for the focus shift that is due to processing. This value can range from -50 to +50 in increments of tenths of microns (for example: 15 = 1.5µm).

- **USE MATCH (Y/N)** indicates whether or not the MATCH utility is enabled during system operation.

- **MATCH TEMPLATE NAME** indicates the intrafield file located within the metrology software that is used as a template to align the wafer while the MATCH utility is in use. The name is between 1 and 8 alphanumeric characters long, including spaces.

- **MATCH EVERY NTH WAFER** determines how often Micro DFAS baseline is updated. The value entered indicates the number of wafers that are cycled through the system prior to the Micro DFAS baseline update. The value can range from 1 to 25.

- **RETICLE ROTATION OFFSET (ppm)** is the amount of offset that is sent to the RRS to rotate the reticle for this pass. The value can range from -40 to +40 in units of ppm.

- **RETICLE TRANSMISSION % (0-300)** is a number which represents the percentage of light which travels through the reticle when the reticle is illuminated at the platen through the masking aperture blades. The reticle transmission value compensates for exposure time lens heating effects which may change system focus.

The Exposure Pass Options Screen Submenu

Located at the bottom of the Exposure Pass Options screen is a submenu that is used to return to the previous screen, or exit the JOB program. Move the cursor to the Exposure Pass Options screen submenu by pressing TAB. The Exposure Pass Options screen submenu selections are:

- PASSMENU returns to the previous Pass Specifications screen.

- SAVE displays the prompt **SAVE PASS (Y/N)?**, then returns to the previous menu.

- ABORT exits the JOB program, and returns to the system prompt.

The RMS Options Screen

Display the RMS Options screen from the Pass Specifications screen submenu by using the arrow keys to highlight the word RMS, then pressing RETURN.

NOTE: The RMS Options screen is only available if N was answered to the prompt **USE LOCAL ALIGNMENT** in the Pass Specifications screen.

The system then displays an RMS Options screen similar to the following example (Figure 7-15):

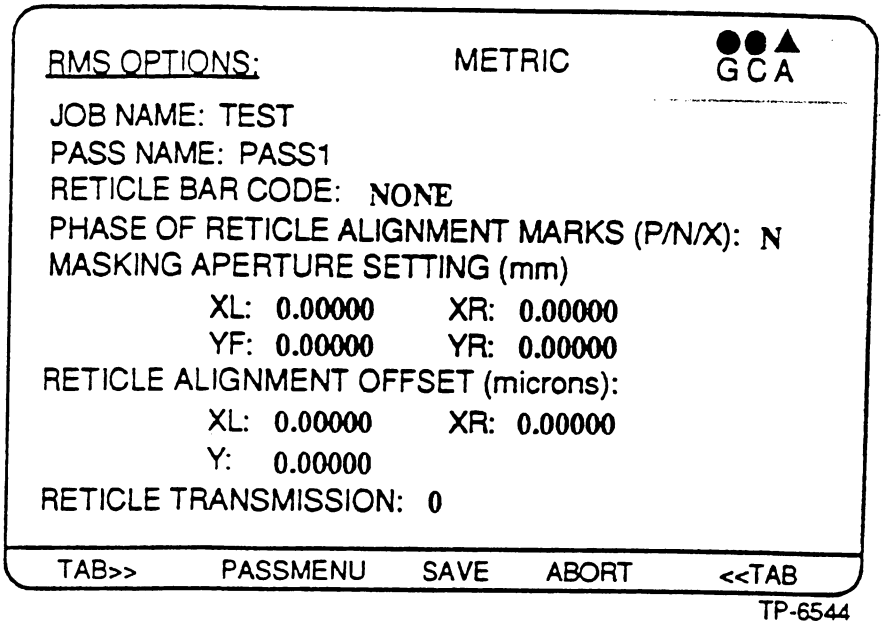

Figure 7-15
RMS Options Screen

The monitor displays the current job and pass names at the top of the screen. The RMS Options screen prompts are:

- **RETICLE BAR CODE** identifies the reticle number that is on the reticle being used for this particular pass.
- **PHASE OF RETICLE ALIGNMENT MARKS (P/N/X)** designates whether the mask is to be positive (P), negative (N), or whether there is to be no alignment (X).
- **MASKING APERTURE SETTING (mm) (XL, XR, YF, and YR)** determines the masking aperture blade settings. Each of the four masking aperture blades has full 100mm travel. To obtain the actual blade setting, the masking aperture setting is added to the offsets that were previously entered in MODE, and to the pass offsets that will be entered in the following prompt. Figure 7-16 shows how these masking aperture settings correspond to the actual marks on the aperture blade positions on the AUTOSTEP 200 system.

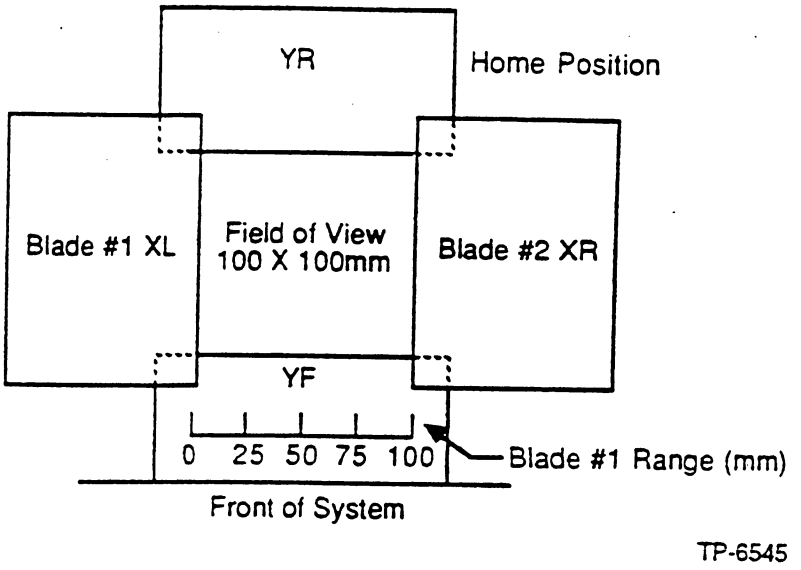

Figure 7-16
Orientation for Aperture Blade Settings

- **RETICLE ALIGNMENT OFFSET (microns) (XL, XR, and Y)** sets the values that are added to the X-left, X-right, and Y values entered in MODE, to position the reticle for an alignment offset.

- **RETICLE TRANSMISSION** identifies the transmission percent of the pass reticle. Percent is calculated by measuring the amount of clear area and dividing by 225mm^2. The value can range from -1 (off) to 100.

The RMS Options Screen Submenu

Located at the bottom of the RMS Options screen is a submenu that is used to return to the previous screen, or exit the JOB program. Move the cursor to the RMS Options screen submenu by pressing TAB. The RMS screen submenu selections are:

- **PASSMENU** returns to the previous Pass Specifications screen.

- **SAVE** displays the prompt **SAVE PASS (Y/N)?**, then returns to the previous menu.

- **ABORT** exits the JOB program, and returns to the system prompt.

The Pass Editor Display

Access the Pass Editor display in one of four ways:

- When accessing the display for viewing purposes only, from the Display Menu, select option 3 (either by typing 3, or using the arrow keys to highlight option 3), then press RETURN.
- When creating a job specification, from the Job Main Menu, select option 2, then press RETURN. Once the Job Specifications screen prompts have been entered, from the Job Specifications screen, press NEXT PAGE. Once the Pass Specifications screen prompts have been entered, from the Pass Specifications screen, press NEXT PAGE.
- When adding a pass to a job program, from the Edit Menu, select option 5, then press RETURN. Once the Pass Specifications screen prompts have been entered, from the Pass Specifications screen, press NEXT PAGE.
- When editing a pass, from the Edit Menu, select the particular pass' yellow option number, then press RETURN. Once the Pass Specifications screen prompts have been entered, from the Pass Specifications screen, press NEXT PAGE.

The system then displays a Pass Editor display similar to the following example (Figure 7-17):

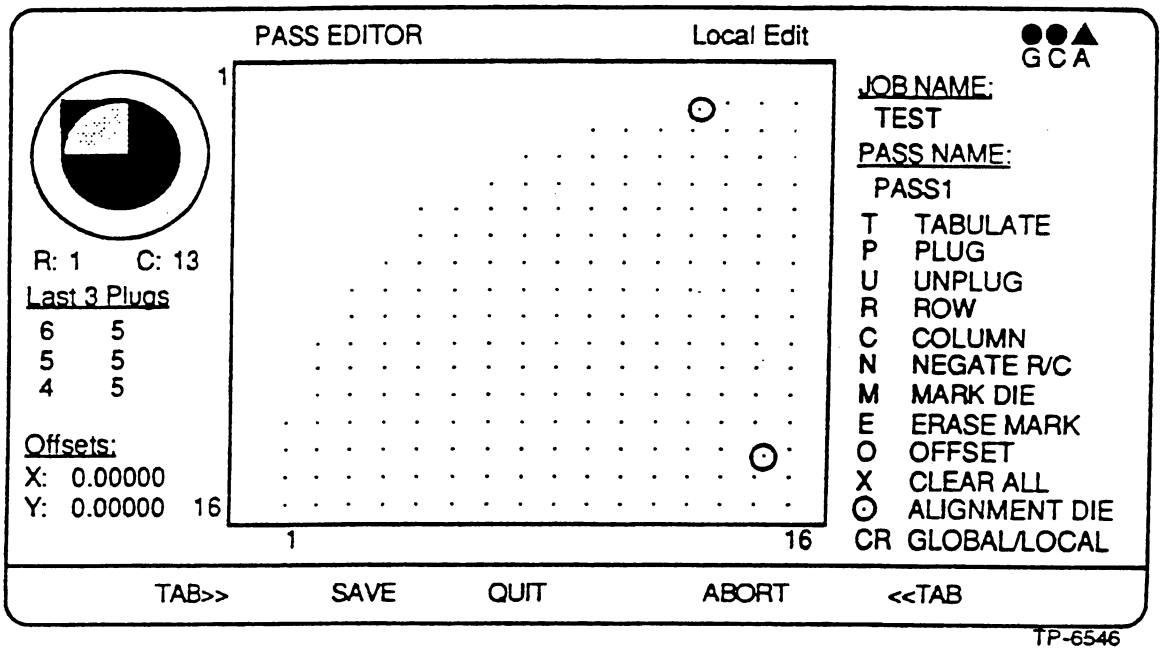

Figure 7-17
Pass Editor Display

Two modes are available when using the Pass Editor: global and local. The RETURN key toggles between the two modes. Use the following guidelines when toggling between modes.

- **Global mode** is used to select a particular section of the wafer to edit when an array contains more than 25x25 dropouts or plugs. A reduced version of the entire array is shown in the global window (located in the upper-left of the screen). A square cursor indicates the area of the wafer to be edited. A larger version of the area of the wafer is displayed in the local window (located in the middle of the screen).

- **Local mode** is used to edit a particular section of the wafer. When an array contains 25 or fewer dropouts or plugs, only the local mode is functional. The entire array is then displayed in the local window.

The Pass Editor display shows the layout of a particular pass. The pass can be edited by moving the cursor (using the arrow keys), and typing the following codes to adjust the plugs or dropouts at individual or groups of die locations. The Pass Editor display codes and symbols are:

- **T** displays the Tabulated Display screen which displays the job in a tabulated ASCII format.

- **P** plugs either a single die location, an entire row, an entire column, or a field.

- **D** drops either a single die location, an entire row, an entire column, or a field.

NOTE: Either the P or the D (described above) will appear, depending on the function of the Pass Editor at the time.

- **U** unplugs or removes (depending on the function of the Pass Editor at the time) either a single die location, an entire row, an entire column, or a field.

- **R** designates the mode ROW, that is used to edit entire rows die locations.

- **C** designates the mode COLUMN, that is used to edit entire columns of die locations.

- **N** (negate) disables the ROW or COLUMN mode.

- **M** marks a corner of a field to plug or drop. Two corners of a field must be marked to plug or drop a field.

- **E** erases the last marked corner.

- **O** (offset) allows plug offsets to be entered on plug passes. On multiple plugged dies, the offset is applied to all plugs.

- **X** (clear all) deletes all plugs and dropouts from the entire pass.

- indicates the location of the alignment die.
- CR - refers to the carriage return (RETURN) key. RETURN toggles between local and global edit.

The Pass Editor Display Submenu

When displaying a pass, or all passes, to exit the Pass Editor display, press the spacebar key. The system then returns to the previous screen.

Located at the bottom of the Pass Editor display is a submenu that is used to either save the pass and job, or quit the job. Move the cursor to the Pass Editor display submenu by pressing TAB. The Pass Editor display submenu selections are:

- **SAVE** displays a screen that is used to save the pass and/or job.
- **QUIT** quits the current Pass Editor display, deletes any data within the pass, and returns to the Pass Specifications screen. New information can then be entered for the pass.
- **ABORT** exits the JOB program without saving any changes to the current job, and returns to the system prompt.

Guide to Entering Data within the JOB Program

This subsection describes useful resources available when entering data within the JOB program.

Selecting the Option Numbers

When using the menus and screens within the JOB program, the option numbers are outlined in yellow. When selecting options, make sure that the number entered corresponds to the yellow option number. (Do not confuse the option number with pass numbers and other data on the menus and screens.)

Entering and Displaying the Data

During the JOB program, when prompts are displayed on the monitor, any current data corresponding to the prompt is also displayed. To retain the data displayed at the prompt, press RETURN. To change the data, enter the new value, then press RETURN. If the wrong key is hit accidentally, the up- and down-arrow keys restore the original value, providing RETURN had not been pressed yet.

If an out-of-range value is entered at a prompt, the system will not accept the entered value. The valid range will be displayed to the right of the selected prompt. For example, an out-of-range error will be displayed as follows:

```
HOW WIDE: 125                    << 0.0 to 119.0000
```

NOTE: All yellow questions within the Pass Specifications, Local Alignment Options, and RMS Options screens must be answered, before continuing with the Pass Editor display. If all yellow questions are not answered, the system then displays a warning message.

Saving the Data

Data is saved *only* when the following occurs:

- In the Edit mode: after the job or pass has edited, the user must select option 1 (Save/Main) or option 3 (Save/Abort).

NOTE: Even if the user responded Y to the prompt **SAVE PASS**, the pass is not saved unless the above occurs. For example, if the user selects option 2 (Quit/Main), the pass will not be saved.

- In the Create mode: the user responds Y to the prompt **SAVE JOB**.
- In the Defaults mode: the user responds Y to the prompt **SAVE THESE DEFAULTS** (within the Disk Drive and Area Defaults menu).

Using the Keys

The following keys are helpful when using the JOB program (Figure 7-18):

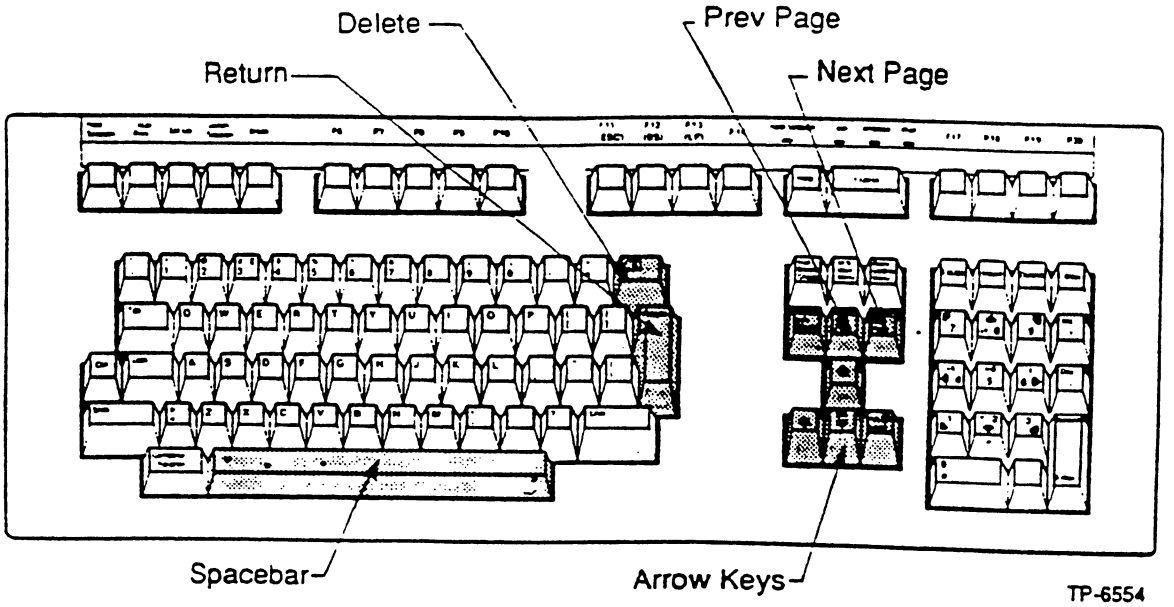

Figure 7-18
VT340 Keyboard

- **Return**: Inputs the newly entered data, or retains the current data
- **The arrow keys**: Select an option from a menu
- **<x]**: Deletes a character when entering or editing data
- **Prev Page**: Moves backward one screen when using the screens
- **Next Page**: Moves forward one screen when using the screens
- **Ctrl C**: Aborts the job without saving any current job
- **Tab**: Accesses the submenu options at the bottom of various screens

Using Help Screens

Help screens provide additional support when using the menus and screens within JOB. Help screens contain descriptions of key functions and data entry information. Help screens are available whenever user input is required, by pressing the HELP key.

Developing a Job Specification: An Example

This section describes how to develop a job specification file. This section is organized into the following categories (based on the typical order of these tasks during system operation and setup):

- Setting the Job Specification File Defaults
- Creating a Job Specification File
- Editing a Job Specification File
- Displaying a Job Specification File

Setting the Job Specification File Defaults

Defaults are used to set up the environment for the job specification file. Defaults are set to indicate the storage location of the user files, and to create templates for the job parameters and pass parameters used within the job specification file. Refer to Figure 7-19 for a flowchart showing the menus, screens, and displays used to set the job specification file defaults.

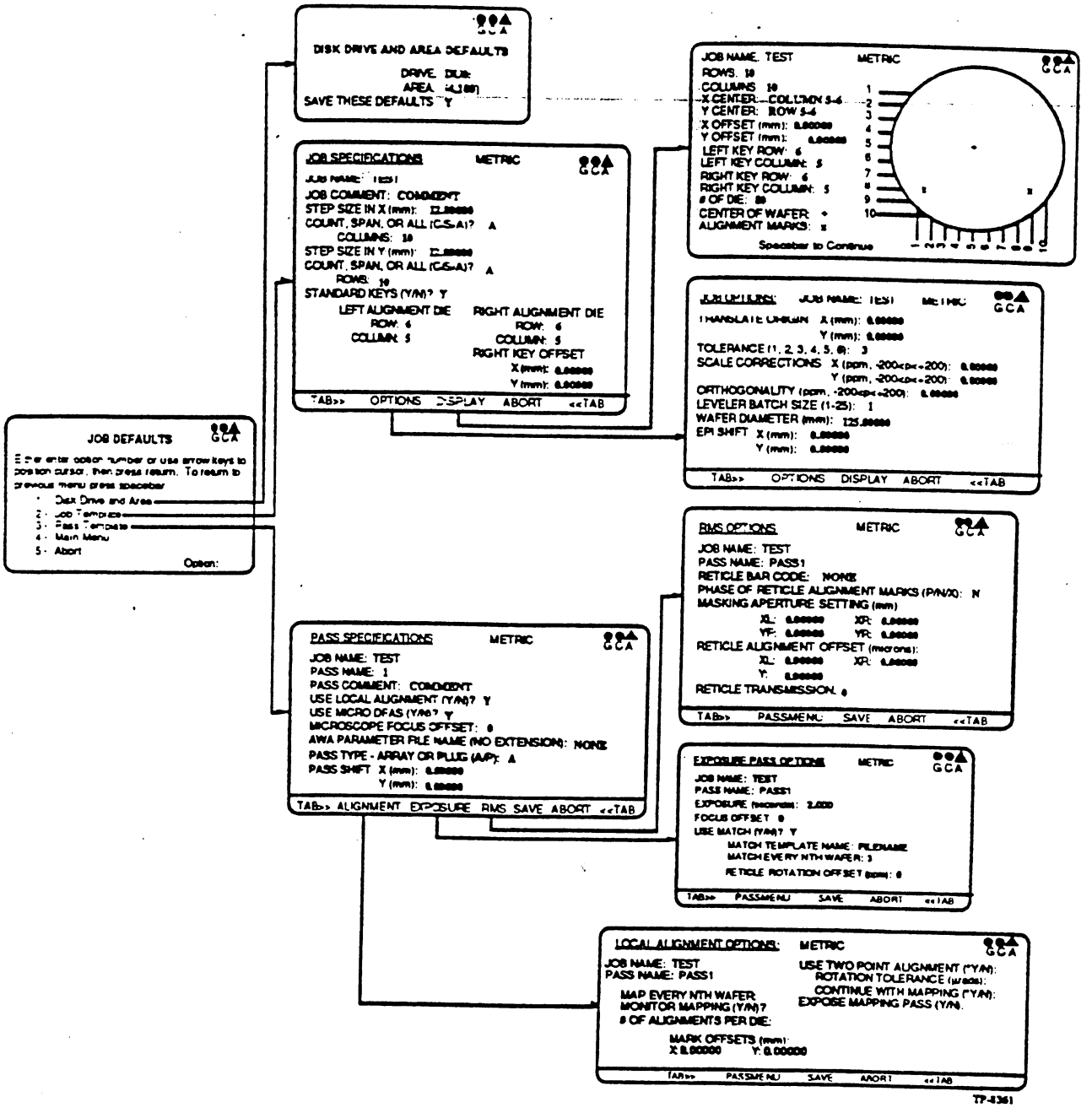

Figure 7-19
Flowchart of Job Specification File Defaults

Setting the File Storage Location Defaults

Set the file storage location defaults as follows:

1. From the Job Main Menu, select option 4 (Defaults), then press RETURN.

2. From the Job Defaults menu, select option **1** (Disk Drive and Area) then press RETURN.
3. At the prompt **DRIVE**, enter the desired hard-disk-drive default to store the job specification file (drive name options are **DU0:** and **DU1:**), then press RETURN.
4. At the prompt **AREA**, enter the desired default directory for the job specification file (in the form [x,y], where the values for x and y are between 10 and 377), then press RETURN.
5. At the prompt **SAVE THESE DEFAULTS**, perform one of the following:

   - To save the defaults just entered, enter **Y**, then press RETURN.
   - To return to the Job Defaults menu without saving the defaults just entered, enter **N**, then press RETURN.

Once file storage location defaults have been entered, the system returns to the Job Defaults menu.

Creating a Job Template

Create a job template by setting the job defaults, as follows:

1. From the Job Main Menu, select option **4** (Job Defaults), then press RETURN.
2. From the Job Defaults menu, select option **2** (Job Template), then press RETURN.

The monitor then displays the Job Specifications screen including the current job name and comment at the top of the screen.

3. At the prompt **STEP SIZE IN X (mm)**, enter the desired value, then press RETURN.
4. At the prompt **COUNT, SPAN, OR ALL (C/S/A)?**, perform one of the following:

   - To specify the number of columns, enter **C**, then press RETURN. At the prompt **COLUMNS**, enter the number of columns required for the array being exposed, then press RETURN.
   - To instruct the system to span a certain width in the X direction for the array, enter **S**, then press RETURN. At the prompt **HOW WIDE**, enter the desired width (the system will default to the maximum width), then press RETURN.
   - To allocate all of the wafer's usable width for the array being exposed, enter **A**, then press RETURN.

5. At the prompt **STEP SIZE IN Y (mm)**, enter the desired value, then press RETURN.
6. At the prompt **COUNT, SPAN, OR ALL (C/S/A)?**, perform one of the following:

- To specify the number of rows, enter C, then press RETURN. At the prompt **ROWS**, enter the number of rows required for the array being exposed, then press RETURN.
- To instruct the system to span a certain width in the Y direction for the array, enter S, then press RETURN. At the prompt **HOW WIDE**, enter the desired width (the system will default to the maximum width), then press RETURN.
- To allocate all of the wafer's usable height for the array being exposed, enter A, then press RETURN.

7. At the prompt **STANDARD KEYS (Y/N)?**, perform one of the following:

   - To specify automatic selection of the right and left alignment dies, enter Y, then press RETURN. The system then displays the standard left and right alignment dies, and the right key offset.
   - To manually select the right and left alignment dies, enter N, then press RETURN. The system then displays the following prompts:

     - **LEFT ALIGNMENT DIE (ROW AND COLUMN)**
     - **RIGHT ALIGNMENT DIE (ROW AND COLUMN)**
     - **RIGHT KEY OFFSET (X AND Y)**

     Enter the desired values, then press RETURN for each of the prompts above.

8. Press TAB to access the submenu at the bottom of the screen.
9. Use the arrow keys to highlight OPTIONS, then press RETURN. The system then displays the Job Options screen.
10. At the prompt **TRANSLATE ORIGIN**, enter the values for X and Y that are used to offset the array in X and Y on the wafer, then press RETURN.
11. At the prompt **TOLERANCE (1, 2, 3, 4, 5, 6)**, enter the desired value, then press RETURN.
12. At the prompt **SCALE CORRECTIONS**, perform one of the following:

    - If scale corrections are required, enter the values that increase or decrease the step size in X and Y, then press RETURN.
    - If no scale correction is required, press RETURN.

13. At the prompt **ORTHOGONALITY**, enter the value, then press RETURN.
14. At the prompt **LEVELER BATCH SIZE**, enter the desired value, then press RETURN.
15. At the prompt **WAFER DIAMETER**, enter the desired value, then press RETURN.
16. At the prompt **EPI SHIFT**, enter the desired value, then press RETURN.

17. Perform one of the following:

    - To display the job display, which illustrates the job defaults and lists the key values, perform the following:

      a. Move the cursor to the submenu at the bottom of the screen by pressing TAB.
      b. Use the arrow keys to highlight DISPLAY, then press RETURN.

    - To return to the Job Specifications screen, perform the following:

      a. Move the cursor to the submenu at the bottom of the screen by pressing TAB.
      b. Use the arrow keys to highlight OPTIONS, then press RETURN.

    - To save the template and return to the Job Defaults menu, press NEXT PAGE.

Creating a Pass Template

Create a pass template by setting the pass defaults, as follows:

1. From the Job Main Menu, select option 4 (Job Defaults), then press RETURN.
2. From the Job Defaults menu, select option 3 (Pass Template), then press RETURN.

The monitor then displays the Pass Specifications screen including the current job name, pass name, and pass comment at the top of the screen.

3. At the prompt **USE LOCAL ALIGNMENT (Y/N)?**, type either Y or N, then press RETURN.
4. At the prompt **USE MICRO DFAS (Y/N)?**, enter Y to use Micro DFAS, or enter N to use DFAS, then press RETURN.
5. At the prompt **MICROSCOPE FOCUS OFFSET**, enter the desired value, then press RETURN.
6. At the prompt **AWA PARAMETER FILE NAME (NO EXTENSION)**, enter the desired name, then press RETURN.
7. At the prompt **PASS TYPE - ARRAY OR PLUG (A/P)**, perform one of the following:

    - To expose all sites within the array, enter A, then press RETURN.
    - To expose only the user-specified sites within the array, enter P, then press RETURN.

8. At the prompt **PASS SHIFT**, enter the values for X and Y, then press RETURN.
9. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
10. Display the Local Alignment Options screen by using the arrow keys to highlight ALIGNMENT, then pressing RETURN.

The system then displays the Local Alignment Options screen including the current job and pass name at the top of the screen. Respond to the following prompts within the Local Alignment Options screen:

11. At the prompt **MAP EVERY NTH WAFER**, enter the desired value, then press RETURN.
12. At the prompt **MONITOR MAPPING (Y/N)?**, enter **Y** to monitor mapping, or enter **N** when it is not required to monitor mapping, then press RETURN.
13. At the prompt **# OF ALIGNMENTS PER DIE**, enter the desired value, then press RETURN.
14. At the prompt **MARK OFFSETS**, enter the values for X and Y, then press RETURN.
15. At the prompt **USE TWO POINT ALIGNMENT (*Y/N):**, enter the desired value, then press RETURN.

NOTE: The prompts in steps 16 - 18 will not appear if USE TWO POINT ALIGNMENT is disabled.

NOTE: GCA recommends that a rotation tolerance of 2 µrads be entered in step 16.

16. At the prompt **ROTATION TOLERANCE (µrads)**, enter the desired value, then press RETURN.
17. At the prompt **CONTINUE WITH MAPPING (*Y/N):**, enter the desired value, then press RETURN.
18. At the prompt **EXPOSE MAPPING PASS (Y/N):**, enter Y or N, then press RETURN.
19. Display the Exposure Pass Options screen as follows:

    a. Move the cursor to the Local Alignment Options screen submenu by pressing TAB.
    b. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.
    c. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
    d. Display the Exposure Pass Options screen by using the arrow keys to highlight EXPOSURE, then pressing RETURN.

The system then displays the Exposure Pass Options screen including the current job and pass name at the top of the screen. Respond to the following prompts within the Exposure Pass Options screen:

20. At the prompt **EXPOSURE (sec)**, enter the desired value, then press RETURN.
21. At the prompt **FOCUS OFFSET**, enter the desired value, then press RETURN.
22. At the prompt **USE MATCH (Y/N)?**, type either **Y** or **N**, then press RETURN.
23. At the prompt **MATCH TEMPLATE NAME**, enter the desired value, then press RETURN.

24. At the prompt **MATCH EVERY NTH WAFER**, enter the desired value, then press RETURN.
25. At the prompt **RETICLE ROTATION OFFSET (ppm)**, enter the desired value, then press RETURN.
26. Display the RMS Options screen as follows:

    a. Move the cursor to the Exposure Pass Options screen submenu by pressing TAB.
    b. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.
    c. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
    d. Display the RMS Options screen by using the arrow keys to highlight RMS, then pressing RETURN.

The system then displays the RMS Options screen including the current job and pass name at the top of the screen. Respond to the following prompts within the RMS Options screen:

27. At the prompt **RETICLE BAR CODE**, enter the desired reticle number, then press RETURN.
28. At the prompt **PHASE OF RETICLE ALIGNMENT MARKS (P/N/X)**, perform one of the following:

    - To designate a positive mask, type P, then press RETURN.
    - To designate a negative mask, type N, then press RETURN.
    - To designate no alignment, type X, then press RETURN.

29. At the prompt **MASKING APERTURE SETTING (mm)**, enter the desired values for XL, XR, YF, and YR, then press RETURN.
30. At the prompt **RETICLE ALIGNMENT OFFSET (microns)**, enter the desired values for XL, XR, and Y, then press RETURN.
31. At the prompt **RETICLE TRANSMISSION**, enter the desired value, then press RETURN.
32. Save the template and return to the Job Defaults menu by performing one of the following:

    - Press NEXT PAGE
    - Press TAB, use the arrow keys to highlight SAVE, then press RETURN.

Creating a Job Specification File

A job specification file is created on the system using the JOB program. The first step in creating a job program is to set the job parameters. Job parameters include the information that applies to all passes specified in the particular job. The second step in creating a job program is to set the pass parameters. Pass parameters specify the information that applies only to a particular pass, and any changes within the array that occur during execution of the pass. Once all job and pass parameters have been defined, the array is defined. Once the array has been set up as desired, the job is stored on the disk in a file having the specified job name.

Refer to Figure 7-20 for a flowchart showing the menus, screens, and displays used to create a job specification file.

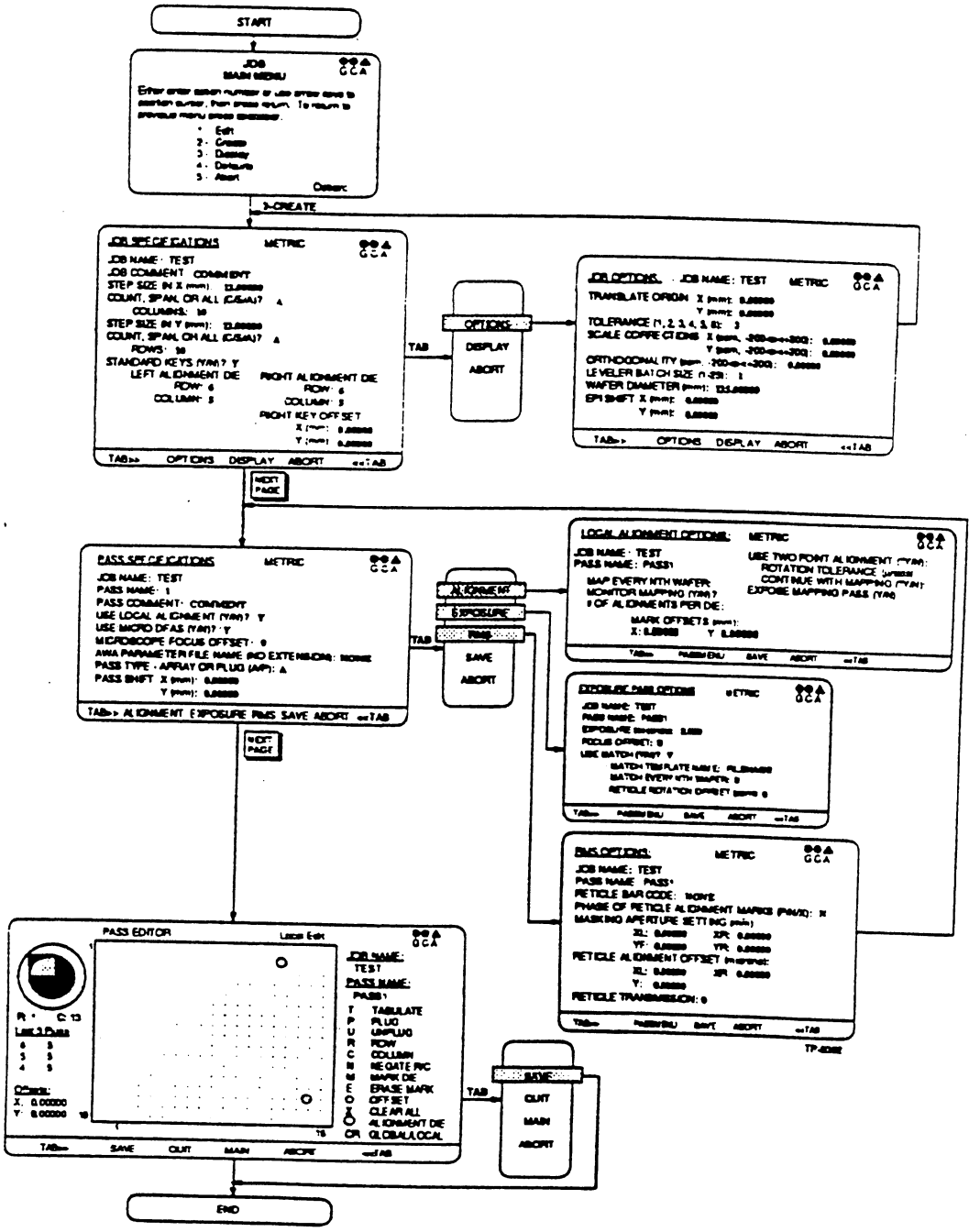

Figure 7-20
Flowchart of Creating a Job Specification File

Setting the Job Parameters

Set the job parameters as follows:

1. At the system prompt (:), enter **JOB**, then press RETURN.
2. At the Job Main Menu, select option **2** (Create), by performing one of the following:

   - Type **2**, then press RETURN.
   - Use the arrow keys to highlight option 2, then press RETURN.

   The system then displays the Job Specifications screen.

3. At the prompt **JOB NAME**, enter the desired job name, then press RETURN.
4. At the prompt **JOB COMMENT**, enter a job comment, then press RETURN.
5. At the prompt **STEP SIZE IN X (mm)**, enter the desired value, then press RETURN.
6. At the prompt **COUNT, SPAN, OR ALL (C/S/A)?**, perform one of the following:

   - To manually specify the number of columns, enter **C**, then press RETURN. At the prompt **COLUMNS**, enter the number of columns required for the array being exposed, then press RETURN.
   - To instruct the system to span a certain width in the X direction, enter **S**, then press RETURN. At the prompt **HOW WIDE**, enter the desired width (the system will default to the maximum width), then press RETURN.
   - To allocate all of the wafer's usable width for the array, enter **A**, then press RETURN.

7. At the prompt **STEP SIZE IN Y (mm)**, enter the desired value, then press RETURN.
8. At the prompt **COUNT, SPAN, OR ALL (C/S/A)?**, perform one of the following:

   - To manually specify the number of rows, enter **C**, then press RETURN. At the prompt **ROWS**, enter the desired value, then press RETURN.
   - To instruct the system to span a certain height in the Y direction, enter **S**, then press RETURN. At the prompt **HOW WIDE**, enter the desired width (the system will default to the maximum width), then press RETURN.
   - To allocate all of the wafer's usable height for the array, enter **A**, then press RETURN.

9. At the prompt **STANDARD KEYS (Y/N)?**, perform one of the following:

   - To specify automatic selection of the right and left alignment dies, enter **Y**, then press RETURN. The system then displays the standard left and right alignment dies, and the right key offset.
   - To manually select the right and left alignment dies, enter **N**, then press RETURN. The system then displays the following prompts:

- LEFT ALIGNMENT DIE (ROW AND COLUMN)
- RIGHT ALIGNMENT DIE (ROW AND COLUMN)
- RIGHT KEY OFFSET (X AND Y)

Enter the desired values, then press RETURN for each of the prompts above.

10. Move the cursor to the Job Specifications screen submenu by pressing TAB.
11. Display the Job Options screen by using the arrow keys to highlight OPTIONS then pressing RETURN.

The system then displays the Job Options screen including the current job name at the top of the screen. Respond to the following prompts within the Job Options screen:

12. At the prompt **TRANSLATE ORIGIN**, enter the desired values for X and Y, then press RETURN.
13. At the prompt **TOLERANCE (1, 2, 3, 4, 5, 6)**, enter the desired value, then press RETURN.
14. At the prompt **SCALE CORRECTIONS**, perform one of the following:

    - If scale correction is required, enter the values for X and Y, then press RETURN.
    - If no scale correction is required, press RETURN.

15. At the prompt **ORTHOGONALITY**, enter the desired value, then press RETURN.
16. At the prompt **LEVELER BATCH SIZE**, enter the desired value, then press RETURN.
17. At the prompt **WAFER DIAMETER**, enter the desired value, then press RETURN.
18. At the prompt **EPI SHIFT**, enter the desired value, then press RETURN.

Setting the Pass Parameters

Set the pass parameters as follows:

1. From the Job Specifications screen, press NEXT PAGE.

The system then displays the Pass Specifications screen including the current job name at the top of the screen.

2 At the prompt **PASS NAME**, enter the pass name, then press RETURN.
3. At the prompt **PASS COMMENT**, enter a comment, then press RETURN.
4. At the prompt **USE LOCAL ALIGNMENT (Y/N)?**, type either Y or N, then press RETURN.
5. At the prompt **USE MICRO DFAS [Y/N]?**, enter the appropriate response, then press RETURN.
6. At the prompt **MICROSCOPE FOCUS OFFSET**, enter the desired value, then press RETURN.

7. At the prompt **AWA PARAMETER FILE NAME (NO EXTENSION)**, enter the desired name, then press RETURN.
8. At the prompt **PASS TYPE - ARRAY OR PLUG**, perform one of the following:

   - To expose all sites within the array, enter **A**, then press RETURN.
   - To expose only the user-specified sites within the array, enter **P**, then press RETURN.

9. At the prompt **PASS SHIFT**, enter the values for X and Y, then press RETURN.
10. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
11. Display the Local Alignment Options screen by using the arrow keys to highlight ALIGNMENT then pressing RETURN.

The system then displays the Local Alignment Options screen including the current job and pass name at the top of the screen. Respond to the following prompts within the Local Alignment Options screen:

12. At the prompt **MAP EVERY NTH WAFER**, enter the desired value, then press RETURN.
13. At the prompt **MONITOR MAPPING (Y/N)?**, type either **Y** or **N**, then press RETURN.
14. At the prompt **# OF ALIGNMENTS PER DIE**, enter the desired value, then press RETURN.
15. At the prompt **MARK OFFSETS**, enter the values for X and Y, then press RETURN.
16. At the prompt **USE TWO POINT ALIGNMENT (*Y/N):**, enter the desired value, then press RETURN.

NOTE: The prompts in steps 17 - 19 will not appear if USE TWO POINT ALIGNMENT is disabled.

NOTE: GCA recommends that a rotation tolerance of 2 µrads be entered in step 16.

17. At the prompt **ROTATION TOLERANCE (µrads)**, enter the desired value, then press RETURN.
18. At the prompt **CONTINUE WITH MAPPING (*Y/N):**, enter the desired value, then press RETURN.
19. At the prompt **EXPOSE MAPPING PASS**, enter the desired value, then press RETURN.
20. Display the Exposure Pass Options screen as follows:

    a. Move the cursor to the Local Alignment Options screen submenu by pressing TAB.
    b. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.
    c. Move the cursor to the Pass Specifications screen submenu by pressing TAB.

d. Display the Exposure Pass Options screen by using the arrow keys to highlight EXPOSURE, then pressing RETURN.

The system then displays the Exposure Pass Options screen including the current job and pass name at the top of the screen. Respond to the following prompts within the Exposure Pass Options screen:

21. At the prompt **EXPOSURE (sec)**, enter the desired value, then press RETURN.
22. At the prompt **FOCUS OFFSET**, enter the desired value, then press RETURN.
23. At the prompt **USE MATCH (Y/N)?**, type either **Y** or **N**, then press RETURN.
24. At the prompt **MATCH TEMPLATE NAME**, enter the desired name, then press RETURN.
25. At the prompt **MATCH EVERY NTH WAFER**, enter the desired value, then press RETURN.
26. At the prompt **RETICLE ROTATION OFFSET**, enter the desired value, then press RETURN.
27. Display the RMS Options screen as follows:

    a. Move the cursor to the Exposure Pass Options screen submenu by pressing TAB.
    b. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.
    c. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
    d. Display the RMS Options screen by using the arrow keys to highlight RMS, then pressing RETURN.

The system then displays the RMS Options screen including the current job and pass name at the top of the screen. Respond to the following prompts within the RMS Options screen:

28. At the prompt **RETICLE BAR CODE**, enter the desired reticle number, then press RETURN.
29. At the prompt **PHASE OF RETICLE ALIGNMENT MARKS (P/N/X)**, perform one of the following:

    - To designate a positive mask, type **P**, then press RETURN.
    - To designate a negative mask, type **N**, then press RETURN.
    - To designate no alignment, type **X**, then press RETURN.

30. At the prompt **MASKING APERTURE SETTING (mm)**, enter the desired values for XL, XR, YF, and YR, then press RETURN.
31. At the prompt **RETICLE ALIGNMENT OFFSET (microns)**, enter the desired values for XL, XR, and Y, then press RETURN.
32. At the prompt **RETICLE TRANSMISSION**, enter the value that represents the desired percent, then press RETURN.

NOTE: All yellow questions within the Pass Specifications, Local Alignment Options, Exposure Pass Options, and RMS Options screens must be answered before continuing with the Pass Editor display (or a warning message appears).

Setting the Array Values

Set the array values using the Pass Editor display, as follows:

1. From the Pass Specifications screen, press NEXT PAGE. The system then displays the Pass Editor display, used to create the array.
2. Depending on the size of the array, perform one of the following:

   - If an array contains more than 25x25 dropouts or plugs, select the desired area of the wafer to edit as follows:

     a. Make sure that the global window is outlined in red. If it is not, press RETURN.
     b. Move the square cursor to the desired quadrant of the wafer using the arrow keys on the AWH and main menu function keypad of the VT340 keyboard. (When the desired area is highlighted, a larger version of the desired area is displayed in the local window.)
     c. Switch to the local mode by pressing RETURN. (The local window should now be outlined in red.)

   - If an array is smaller than 25x25, make sure that the local window is outlined in red. If it is not, press RETURN. The local window should display the entire array.

3. Using the Pass Editor display codes and symbols, edit the display until the desired array is created. The Pass Editor display functions are:

Plugging and Dropping Die Locations:

- Plug or drop a *single die location* by using the arrow keys to position the cursor at the desired location, then pressing **P** or **D** respectively.
- Plug or drop an *entire row* by using the arrow keys to position the cursor at the desired row, then pressing **R**, and then pressing **P** or **D** respectively.
- Plug or drop an *entire column* by using the arrow keys to position the cursor at the desired column, then pressing **C**, and then pressing **P** or **D** respectively.
- Plug or drop a *field* by performing the following:

a. Position the cursor at the upper left location of the desired field (using the arrow keys), then press **M**.
b. Position the cursor at the bottom right location of the desired field (using the arrow keys), then press **M**.

If an error is made when designating the corner marks, erase the incorrect mark by pressing **E**.

c. Press **P** or **D** respectively.

Unplugging and Removing Die Locations:

NOTE: When unplugging or removing a single die location, plugs or dropouts can only be unplugged or removing in the reverse order in which they were originally entered. The system displays the last 4 plugs or dropouts on the left-hand side of the Pass Editor display. Pressing **T** displays the Tabulated Display which also shows the order of plugs or dropouts.

- Unplug or remove a *single die location* by using the arrow keys to position the cursor at the desired location, then pressing **U**.
- Unplug or remove an *entire row* by using the arrow keys to position the cursor at the farthest left die location in the desired row, then pressing **R**, and then pressing **U**.
- Unplug or remove an *entire column* by using the arrow keys to position the cursor at the top die location in the desired column, then pressing **C**, and then pressing **U**.
- Unplug or remove a *field* by positioning the cursor at the upper left location of the desired field (using the arrow keys), then pressing **U**.

Creating Additional Passes within the Job Specification File

Create additional passes within the job specification file as follows:

1. From the Pass Editor display, perform one of the following:

   - Move the cursor to the submenu at the bottom of the display, by pressing TAB. Use the arrow keys to highlight SAVE, then press RETURN.
   - Press NEXT PAGE.

2. At the prompt **ANOTHER PASS (Y/N)?**, perform one of the following:

   - To add another pass to the job specification file, type **Y**, then press RETURN. At the prompt, **COPY FROM ANOTHER PASS (Y/N)?**, perform one of the following:

   - To copy from another pass, type **Y**, then press RETURN. At the prompt **ENTER PASSNAME TO COPY FROM**, enter the desired pass name to copy from, then press RETURN.
   - To create an entirely new additional pass, type **N**, then press RETURN. The system then displays the Pass Specifications screen.

   - To exit the job specification file, type **N**, then press RETURN. The system then prompts to save the job (see step 3 in Saving and Storing the Job Specification File in this section of the manual).

Saving and Storing the Job Specification File

Save and store the job specification file as follows:

1. From the Pass Editor display, perform one of the following:
   - Move the cursor to the submenu at the bottom of the display by pressing TAB. Use the arrow keys to highlight SAVE, then press RETURN.
   - Press NEXT PAGE.
2. At the prompt **ANOTHER PASS (Y/N)?**, type N, then press RETURN.
3. At the prompt **SAVE JOB (Y/N)?**, type Y, then press RETURN.
4. At the prompt **DRIVE**, enter the desired hard disk drive to store the job specification file, then press RETURN.
5. At the prompt **AREA**, enter the desired directory for the job specification file, then press RETURN.

Editing a Job Specification File

A job specification file is edited on the system using the JOB program. A pre-existing job program is edited by first specifying the jobname and the storage location of the file. Refer to Figure 7-21 for a flowchart showing the menus, screens, and displays used to edit a job specification file.

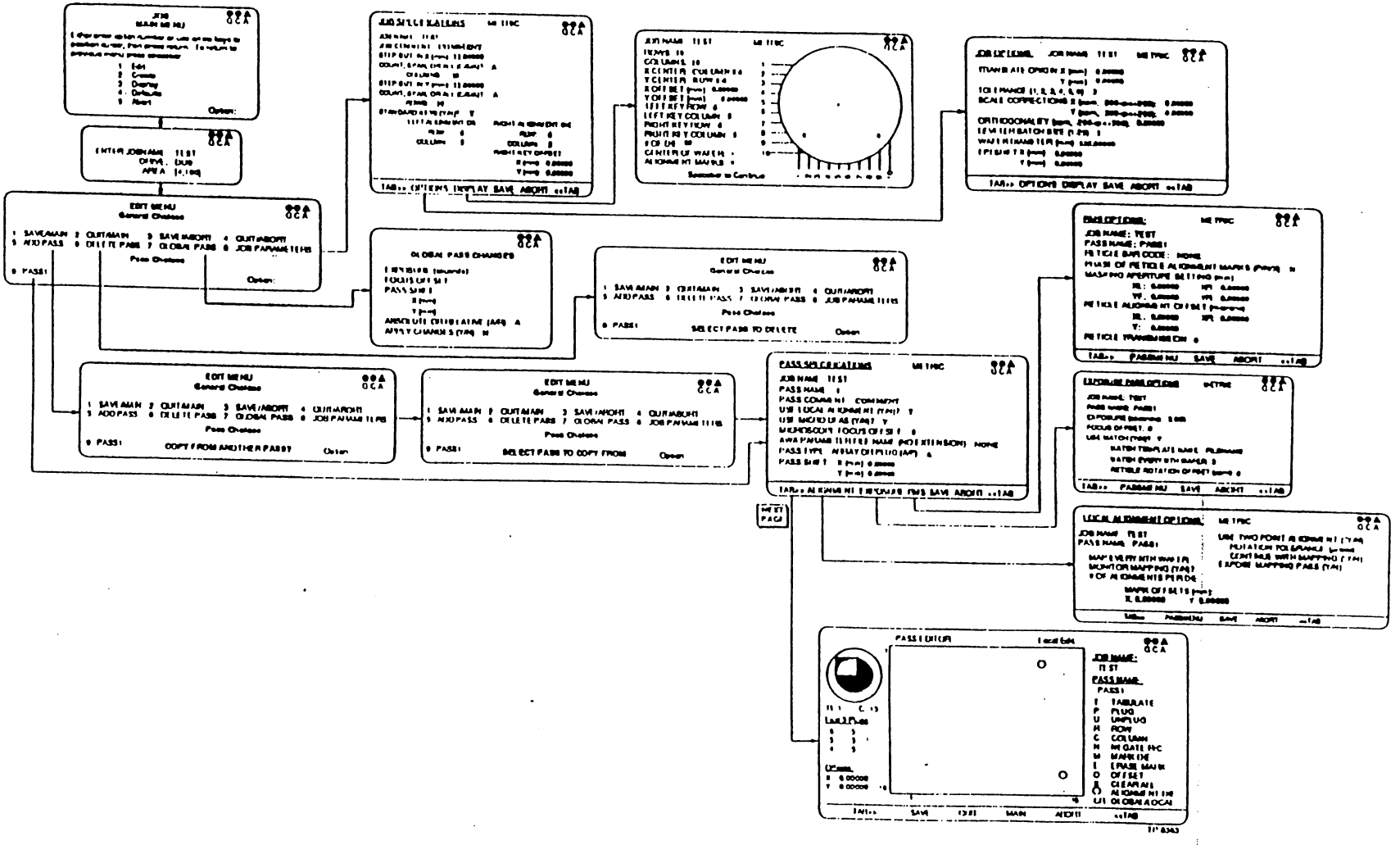

Figure 7-21
Flowchart for Editing a Job Specification File

Edit a job program as follows:

1. At the system prompt (:), enter **JOB**, then press RETURN.
2. From the Job Main Menu, select option **1** (Edit), then press RETURN.
3. At the prompt **ENTER JOBNAME**, enter the alphanumeric characters that represent the desired jobname and press RETURN.
4. At the prompt **DRIVE**, enter the disk drive where the desired job program is stored and press RETURN.
5. At the prompt **AREA**, enter the location of the desired job program and press RETURN. The system then displays the Edit Menu.

Adding a Pass to an Existing Job Specification File

Add a pass to the specified job program as follows:

1. From the Edit Menu, select option **5** (Add Pass), then press RETURN.
2. At the prompt **COPY FROM ANOTHER PASS?**, perform one of the following:

   - To copy from an existing pass, type **Y**, then press RETURN. At the prompt **SELECT PASS TO COPY FROM**, select the desired pass to copy from (displayed on the Edit Menu) by performing one of the following:

   - Use the arrow keys to highlight the desired pass number, then press RETURN.
   - Type the option number (option 9 or above) that represents the desired pass, then press RETURN.

   - To create a new pass from the existing pass template, type **N**, then press RETURN.

The system then displays the Pass Specifications screen, including any current data from the pass that was copied from, or the pass template.

3. Edit the selected parameters within the Pass Specifications screen, by performing one of the following:

   - To keep the current pass parameter value, press RETURN.
   - To change a particular pass parameter value, enter the new value, then press RETURN.

4. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
5. Display the Local Alignment Options screen by using the arrow keys to highlight ALIGNMENT, then pressing RETURN.

The system then displays the Local Alignment Options screen including any current data from the pass that was copied from, or the pass template.

6. Edit the selected parameters within the Local Alignment Options screen, by performing one of the following:

   - To keep the current pass parameter value, press RETURN.
   - To change a particular pass parameter value, enter the new value, then press RETURN.

7. Display the Exposure Pass Options screen as follows:

   a. Move the cursor to the Local Alignment Options screen submenu by pressing TAB.
   b. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.
   c. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
   d. Display the Exposure Pass Options screen by using the arrow keys to highlight EXPOSURE, then pressing RETURN.

The system then displays the Exposure Pass Options screen including any current data from the pass that was copied from, or the pass template.

8. Edit the selected parameters within the Exposure Pass Options screen, by performing one of the following:

   - To keep the current pass parameter value, press RETURN.
   - To change a particular pass parameter value, enter the new value, then press RETURN.

9. Display the RMS Options screen as follows:

   a. Move the cursor to the Exposure Pass Options screen submenu by pressing TAB.
   b. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.
   c. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
   d. Display the RMS Options screen by using the arrow keys to highlight RMS, then pressing RETURN.

The system then displays the RMS Options screen including any current data from the pass that was copied from, or the pass template.

10. Edit the selected parameters within the RMS Options screen, by performing one of the following:

    - To keep the current pass parameter value, press RETURN.
    - To change a particular pass parameter value, enter the new value, then press RETURN.

11. Move the cursor to the RMS Options screen submenu by pressing TAB.

12. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.

NOTE: All yellow questions within the Pass Specifications, Local Alignment Options, Exposure Pass Options, and RMS Options screens must be answered before continuing with the Pass Editor display. If all yellow questions are not answered, the system then displays a warning message.

13. Access the Pass Editor display by pressing NEXT PAGE.

The system then displays the Pass Editor display, including any current data from the pass that was copied from, or the pass template.

14. Edit the array using the guidelines in Setting the Array Values, in this section of the manual.
15. Access the prompts required to save the pass by performing one of the following:

    - Move the cursor to the submenu at the bottom of the Pass Editor display by pressing TAB. Use the arrow keys to highlight SAVE, then press RETURN.
    - Press NEXT PAGE.

16. At the prompt **PASS NAME**, enter the desired pass name.
17. At the prompt **SAVE PASS (Y/N)?**, type Y, then press RETURN.

The system saves the pass under the specified pass name, then displays the Edit Menu. The system then displays a message that the pass will not be updated unless the job is saved.

18. Save the job (which updates the pass information) using the procedure in Saving and Storing the Job Specification File in this section of the manual.

Deleting a Pass from an Existing Job Specification File

NOTE: A job specification file must contain at least one pass. If only one pass exists, the system will not allow you to delete that pass.

Delete a pass as follows:

1. From the Edit Menu, select option **6** (Delete Pass), then press RETURN.
2. At the prompt **SELECT PASS TO DELETE**, perform one of the following:

    - Use the arrow keys to highlight the pass number to delete, then press RETURN.
    - Type the option number (option 9 or above) that represents the pass number desired to delete, then press RETURN.

The system deletes the specified pass, then displays the Edit Menu.

Performing Global Pass Changes

Make changes to all passes within a specified job using the Global Pass option within the Edit Menu. Perform global pass changes as follows:

1. From the Edit Menu, select option 7 (Global Pass), then press RETURN.

The system then displays the Global Pass Changes screen.

2. At the prompt **EXPOSURE (seconds)**, enter the desired exposure value, then press RETURN.
3. At the prompt **FOCUS OFFSET**, enter the desired focus offset, then press RETURN.
4. At the prompt **PASS SHIFT (X and Y)**, enter the desired values for X and Y, then press RETURN.
5. At the prompt **ABSOLUTE OR RELATIVE**, perform one of the following:

   - To replace the current values with the ones specified, type A, then press RETURN.
   - To add the specified values to the current values, type R, then press RETURN.

6. At the prompt **APPLY CHANGES (Y/N)**, perform one of the following:

   - To apply the changes just made, type Y, then press RETURN.
   - To ignore the changes just made, press RETURN.

The system then returns to the Edit Menu.

Editing Job Parameters

Make changes to overall job parameters using the Job Parameters option within the Edit Menu. Edit job parameters as follows:

1. From the Edit Menu, select option 8 (Job Parameters), then press RETURN.

The system then displays the Job Specifications screen showing any current data for the specified job.

2. Edit the selected parameters within the Job Specifications screen, by performing one of the following:

   - To keep the current job parameter, press RETURN.
   - To edit a particular job parameter, enter the new value, then press RETURN.

3. Move the cursor to the submenu at the bottom of the Job Specifications screen by pressing TAB.
4. Display the Job Options screen by using the arrow keys to highlight OPTIONS, then pressing RETURN.

The system then displays the Job Options screen including any current data for the specified job.

5. Edit the selected parameters within the Job Options screen, by performing one of the following:

   - To keep the current parameter value, press RETURN.
   - To edit a particular parameter, enter the new value, then press RETURN.

6. To graphically view the edited job, perform the following:

   - Move the cursor to the submenu at the bottom of the Job Options screen by pressing TAB.
   - Access the job display by using the arrow keys to highlight DISPLAY, then pressing RETURN.

The system then graphically displays the job.

Editing a Specific Pass

A specific pass within a job can be edited using the Edit Menu. Edit a specific pass as follows:

1. From the Edit Menu, select the option that represents the desired pass, by performing one of the following:

   - Use the arrow keys to highlight the desired pass, then press RETURN.
   - Type the option number (option 9 or above) that represents the desired pass, then press RETURN.

The system then displays the Pass Specifications screen showing any current data for the specified pass.

2. Edit the selected parameters within the Pass Specifications screen, by performing one of the following:

   - To keep the current parameter, press RETURN.
   - To edit a particular parameter, enter the new value, then press RETURN.

3. When all parameters are edited as desired, move the cursor to the submenu at the bottom of the Pass Specifications screen by pressing TAB.
4. Display the Local Alignment Options screen by using the arrow keys to highlight ALIGNMENT, then pressing RETURN.

The system then displays the Local Alignment Options screen including any current data for the specified pass.

5. Edit the selected parameters within the Local Alignment Options screen, by performing one of the following:

   - To keep the current parameter, press RETURN.
   - To edit a particular parameter, enter the new value, then press RETURN.

6. Access the Exposure Pass Options screen as follows:

   a. Move the cursor to the Local Alignment Options screen submenu by pressing TAB.
   b. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.
   c. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
   d. Display the Exposure Pass Options screen by using the arrow keys to highlight EXPOSURE, then pressing RETURN.

The system then displays the Exposure Pass Options screen, including any current data from the pass that was copied from, or the pass template.

7. Edit the selected parameters within the Exposure Pass Options screen, by performing one of the following:

   - To keep the current pass parameter value, press RETURN.
   - To change a particular pass parameter value, enter the new value, then press RETURN.

8. Access the RMS Options screen as follows:

   a. Move the cursor to the Local Alignment Options screen submenu by pressing TAB.
   b. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.
   c. Move the cursor to the Pass Specifications screen submenu by pressing TAB.
   d. Display the RMS Options screen by using the arrow keys to highlight RMS, then pressing RETURN.

The system then displays the RMS Options screen, including any current data from the pass that was copied from, or the pass template.

9. Edit the selected parameters within the RMS Options screen, by performing one of the following:

   - To keep the current pass parameter value, press RETURN.
   - To change a particular pass parameter value, enter the new value, then press RETURN.

10. Move the cursor to the RMS Options screen submenu by pressing TAB.

11. Display the Pass Specifications screen by using the arrow keys to highlight PASSMENU, then pressing RETURN.

NOTE: All yellow questions within the Pass Specifications, Local Alignment Options, Exposure Pass Options, and RMS Options screens must be answered before continuing with the Pass Editor display. If all yellow questions are not answered, the system then displays a warning message.

12. Access the Pass Editor display by pressing NEXT PAGE.

The system then displays the Pass Editor display, including any current data from the pass that was copied from, or the pass template.

13. Edit the array using the guidelines in Setting the Array Values, in this section of the manual.
14. Display the prompts required to save the new pass by performing one of the following:

    - Press NEXT PAGE.
    - Move the cursor to the Pass Editor display submenu by pressing TAB. Use the arrow keys to highlight SAVE, then press RETURN.

The system then displays the current pass name.

15. At the prompt **SAVE PASS (Y/N)?**, type Y, then press RETURN.

The system saves the pass under the specified pass name, then displays the Edit Menu.

Displaying a Job Specification File

A job specification file can be graphically displayed on the system using the JOB program. A job specification file can be displayed in three forms:

- Job parameters only
- Specific pass parameters only
- Pass parameters for all passes (superimposed on one another)

Refer to Figure 7-22 for a flowchart showing the menus, screens, and displays used to display the job specification file.

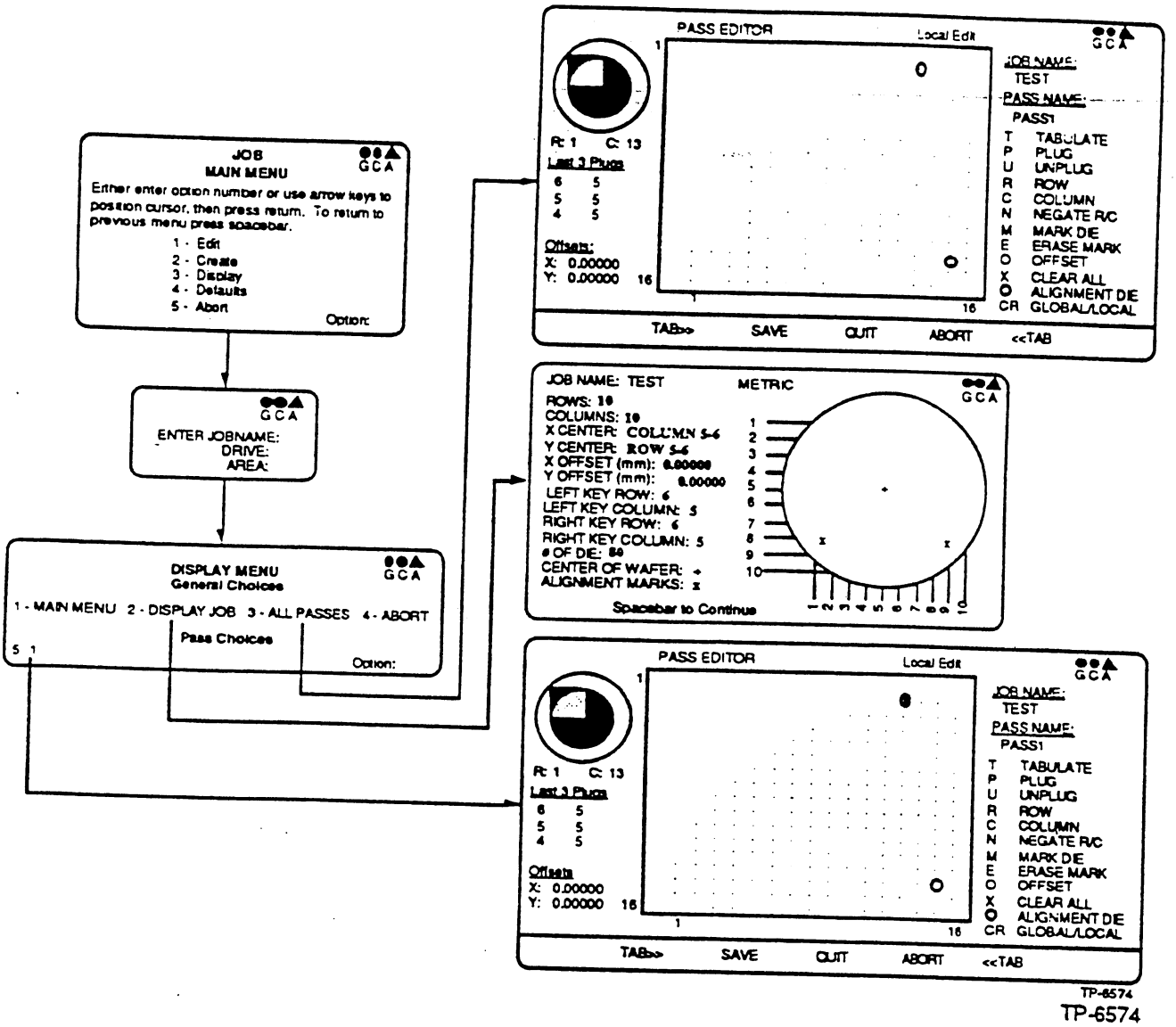

Figure 7-22
Flowchart for Displaying a Job Specification File

Displaying Job and Pass Information

1. From the Job Main Menu, select option 3 (Display), then press RETURN.
2. At the prompt **ENTER JOBNAME**, enter the desired job name, then press RETURN.
3. At the prompt **DRIVE**, enter the hard disk drive location where the job is stored, then press RETURN.
4. At the prompt **AREA**, enter the directory where the job is stored, then press RETURN.

The system then displays the Display Menu.

Section 8 - The SPEC Command: Developing a Job Specification

Job specifications can be created on the system using the SPEC command. Several prompts are displayed when the SPEC command is entered.

The first series of prompts request initial information that applies to all passes specified in the job. Once the initial information is entered, array and alignment parameters are entered. The third series of prompts specifies pass information. When all passes have been defined, the job is stored in a file on the disk having the user-specified job name.

Creating a Job Specification

To create a job specification file, at the system prompt (:), enter the command SPEC filename, where filename is a maximum of 9 alphanumeric characters that describe the job that is being created, then press RETURN.

NOTE: If a filename is not specified with the command, the system displays the prompt **ENTER DEVICE, UFD, AND FILENAME.** Enter the device name and account number where the file is to be stored, and then the filename (no extension is required). This becomes the jobname, and should be noted for future reference.

Defining Job Parameters

When the command SPEC is entered at the system prompt, the system displays the following series of prompts that define the job parameters.

NOTE: Depending on the response to various prompts, some of the following questions will not appear on the system monitor. Where appropriate, these questions have been noted.

1. At the prompt **UPDATE CREATION DATE? (*Y/N)**, enter Y to update the new date for the job being created, or enter N when an update is not required.
2. At the prompt **JOB COMMENT,** enter a line of text up to 80 characters long (including spaces) that will be displayed on the monitor when the job is executed.
3. At the prompt **TOLERANCE (1, 2, *3, 4, 5, 6)**, enter the desired value.

   Tolerance defines the range of acceptable speed and position values that the stages must fall within before the shutter opens. A value of 1 is three laser counts, and the default (3) is 7 laser counts.

4. At the prompt **SCALE CORRECTIONS X, PPM [-200.000-->+200.000] Y, PPM [-200.000-->+200.000]**, to change the scale corrections, enter the desired values between -200 and +200 in units of parts per million (ppm), or if no change in scale corrections is required, press RETURN.

Scale corrections are used to increase or decrease the step size in X and/or Y, to correct for expansion or shrinkage of the wafer due to processing, and to modify the accuracy of the stepper for the job being specified. These scale corrections are specific only to this particular job being entered, and are added to any existing corrections in MODE, during job execution. Entering a positive value increases the step size, while a negative value decreases the step size.

5. At the prompt **ORTHOGONALITY, PPM (-200.000-->+200.000)**, enter the desired value.

   Orthogonality is the ability of the X and Y stages to move perpendicularly to one another. This software correction adjusts the angle between the axes of the stages and, therefore, the angle between the rows and columns of exposures. The value entered here compensates for the stage motions, so that they move perpendicularly. When entered, this value is algebraically added to any orthogonality value entered in MODE. The value entered in MODE is typically used during matching to compensate for tolerances found on another wafer stepper system.

6. At the prompt **LEVELER BATCH SIZE [1-25]**, enter the desired value that specifies how often the automatic wafer leveler (AWL) is used during job execution. Enter **1** to level every wafer, **2** to level every other wafer, and so forth.
7. At the prompt **WAFER DIAMETER**, enter the wafer size in millimeters. If the value entered is invalid, the system displays an error message and prompts for another response.

   The wafer size defines the maximum area available for placing exposures on the wafer. Since the array is built from the wafer's center to the perimeter, any image whose center is outside of this specified parameter is not exposed. The wafer diameter entered here often corresponds to the chuck size previously entered in MODE.

Defining Array Parameters

Once the pass parameters have been entered, the system automatically displays the following:

<< ARRAY PARAMETERS >>

At this point, enter the array parameters using the following prompts.

1. At the prompt **STEP SIZE: X**, enter a value between 0 and the usable diameter of the wafer in millimeters. The step size is the distance between the centers of successive exposures within the array. The step size in X determines the stepping distance between the columns.
2. At the prompt ***C-OUNT, S-PAN, OR A-LL**, enter either C, S, or A using the following guidelines:

Enter C to count the number of columns. When C is entered, the system displays the prompt **HOW MANY COLUMNS**. At the prompt, enter the number of columns required for the array being exposed. The system verifies that all specified columns fit within the usable diameter of the wafer. The resulting array is then centered.

Enter S to instruct the system to span a certain width in the X direction. When S is entered, the system displays the prompt **HOW WIDE**. At the prompt, enter the number identifying the width of the array being exposed in millimeters.

Enter A to allocate all of the wafer's usable diameter for the array being exposed.

3. At the prompt **STEP SIZE: Y**, enter a height between 0 and the usable diameter of the wafer in millimeters. The step size is the distance between the centers of successive exposures within the array. Step size in Y determines the center-to-center stepping distance between rows of exposures.
4. At the prompt ***C-OUNT, S-PAN, OR A-LL**, enter either C, S, or A using the following guidelines:

   Enter C to count the number of rows. When C is entered, the system displays the prompt **HOW MANY ROWS**. At the prompt, enter a number between 0 and the usable diameter of the wafer in millimeters. The system then calculates and centers the maximum number of rows that will fit within the specified height.

   Enter S to instruct the system to span a certain height in the Y direction. When S is entered, the system displays the prompt **HOW HIGH**. At the prompt, enter the number identifying the height of the array being exposed in millimeters.

   Enter A to allocate all of the wafer's usable height for the array being exposed.

   The array is now adjusted so that it will be symmetrically placed on the wafer and contain the maximum number of images.

5. At the prompt **TRANSLATE ORIGIN (X and Y)**, either enter the desired X and Y values in millimeters, or enter **0** or press RETURN to instruct the system to center the array with the center of the wafer.

   Translation maximizes the number of whole die images when exposing a first pass. These values offset the array in X and/or Y on the wafer. If an origin translation causes any image center to fall outside the usable diameter of the wafer, the system displays an error message and prompts for another entry.

6. At the prompt **DISPLAY? (Y/*N)**, enter either Y or N using the following guidelines:

   Enter Y to display the array of exposures specified in the job. The asterisks (*) within the display indicate the location of exposures, while unexposed locations are left blank. Row and column reference numbers are printed down

and across the display, with row 1 and column 1 shown in the upper left corner of the display (Figure 8-1). The type of pass and total number of exposures appear above the array display. If the array exceeds the maximum 68-column display window, the program prints the display one section at a time.

Enter N to display the next prompt.

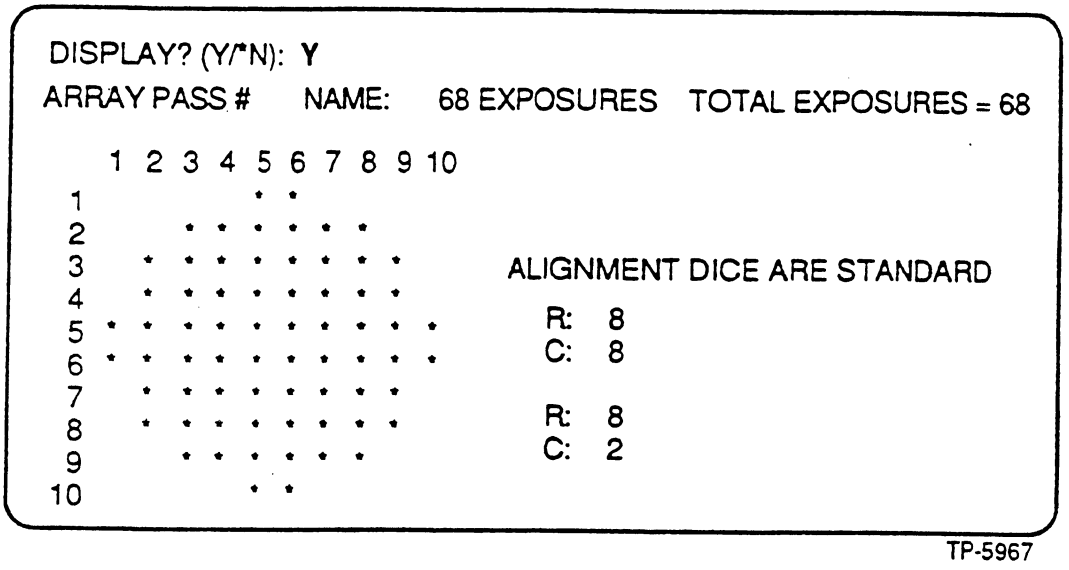

Figure 8-1
Display Screen

7. At the prompt **LAYOUT? (Y/*N)**, enter either Y or N using the following guidelines:

   Enter Y to first display the number of rows and columns and the coordinates of the array center, then the number of rows and columns and the coordinates of the first die in the array. For an even number of rows or columns, the array is centered between an adjacent pair. The distance from the array center to row 1, column 1 is displayed along with the origin translation. This position is at the upper left corner of the display, but does not necessarily mark an actual exposure. Calculate the X and Y distances as follows:

   X (Col. 1) = a - [(n - 1) / 2] * (X Step Size) + X Origin Translation
   Y (Row 1) = a - [(n - 1) / 2] * (Y Step Size) + Y Origin Translation

   where: a = the array center-line
   n = the number of columns (for X) or rows (for Y)
   step size = the value entered accordingly
   origin translation = the value entered accordingly

   Enter N to display the next prompt.

8. At the prompt **ADJUST? (Y/*N)**, enter either **Y** or **N** using the following guidelines:

   Enter **Y** to change the array size using the following prompts:

   At the prompt **ROWS (M-ORE/S-AME/L-ESS)**, enter either **M** to add one row at a time to the array, **S** to retain the size of the current array, or **L** to remove one row at a time from the array. (If the addition of a row causes the array to exceed the usable wafer diameter range, the system displays an **OUT OF RANGE** error message, then returns to the **ROWS** prompt.)

   At the prompt **COLUMNS (M-ORE/S-AME/L-ESS)**, enter either **M** to add one column at a time to the array, **S** to retain the size of the current array, or **L** to remove one column at a time from the array. (If the addition of a column causes the array to exceed the usable wafer diameter range, the system displays an **OUT OF RANGE** error message, then returns to the **COLUMNS** prompt.)

   When the columns have been adjusted as required, the system repeats all prompts within the job specification, starting with **TRANSLATE ORIGIN** and continuing through **ADJUST**, to allow for a quick verification of the job parameters previously entered.

   Enter **N** if the array needs no adjustment.

Defining Alignment Parameters

Alignment parameters specify the sites within the array and location of alignment targets within the sites. When the array parameters have been entered, the system displays the following:

<< ALIGNMENT PARAMETERS >>

At this point, enter the alignment parameters using the following prompts.

1. At the prompt **STANDARD KEYS? (*Y/N)**, enter either **Y** or **N** using the following guidelines:

   Enter **Y** to enable automatic selection of the right and left alignment dies, using the standard algorithm. When **Y** is entered, the system skips to the **RIGHT KEY OFFSET** prompt.

   Enter **N** to enter the rows and columns of the right and left alignment dies. When **N** is entered, the system proceeds to the **RIGHT ALIGNMENT DIE CENTER** prompt.

2. At the prompt **RIGHT ALIGNMENT DIE CENTER (R and C)**, enter the values that represent to coordinates that are used to identify the row and column of the right alignment die.

3. At the prompt **RIGHT KEY OFFSET (X and Y)**, enter the right key offset values as exact distances from the die center to the primary alignment key. Enter the values in millimeters.

   Key offset values position the alignment keys within view of the wafer alignment system. The key offset values are the distance from the alignment mark on the die to the center of the alignment die (Figure 8-2). When nonstandard alignment keys are being used, the system will also prompt for the left key offset.

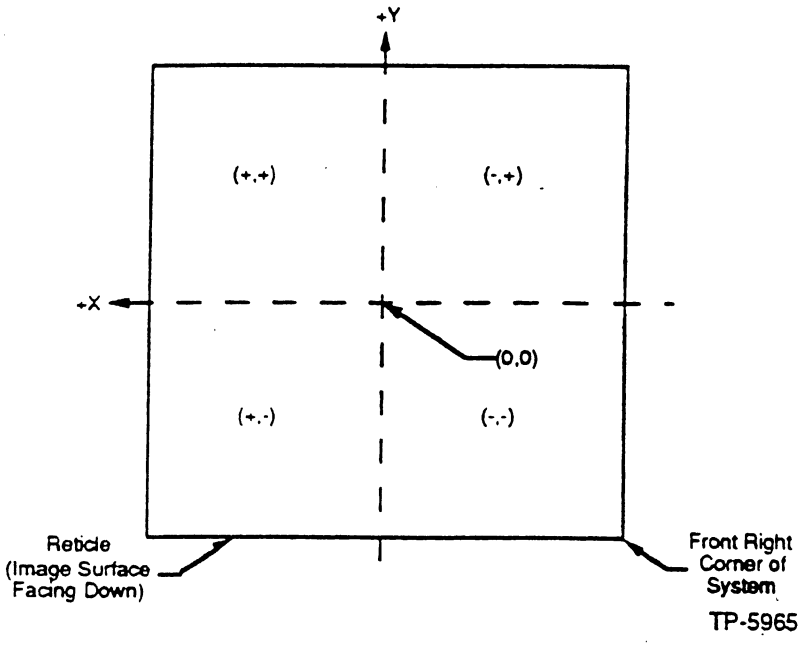

Figure 8-2
Offset Conventions

4. At the prompt **LEFT ALIGNMENT DIE CENTER (R and C)**,enter the values that represent to coordinates that are used to identify the row and column of the left alignment die.
5. At the prompt **LEFT KEY OFFSET (X and Y)**, enter the left key offset values as exact distances from the die center to the primary alignment key. Enter the values in millimeters.

   Key offset values position the alignment keys within view of the wafer alignment system. For second and higher level jobs, residual alignment keys from a previous level are used for wafer alignment.

6. At the prompt **EPI SHIFT (X and Y)**, enter the EPI shift values in millimeters. The EPI shift values shift the next exposure level to overlie a previously exposed epitaxial layer. Since epitaxial wafers "grow" at an angle, the top surface of an EPI layer shifts with respect to the substrate that the layer is grown on. Therefore, EPI shift corrections are required to make sure that the new layer is placed directly over the EPI layer. EPI has an acceptable range of ±0.005mm.

Defining Pass Parameters

Pass parameters provide information pertaining to a particular pass, and any changes within the array that occur during execution of that pass. When the alignment parameters have been entered, the system displays the following:

<< PASS >>

Refer to Figure 8-3 for a flowchart showing the prompts used to set the pass parameters.

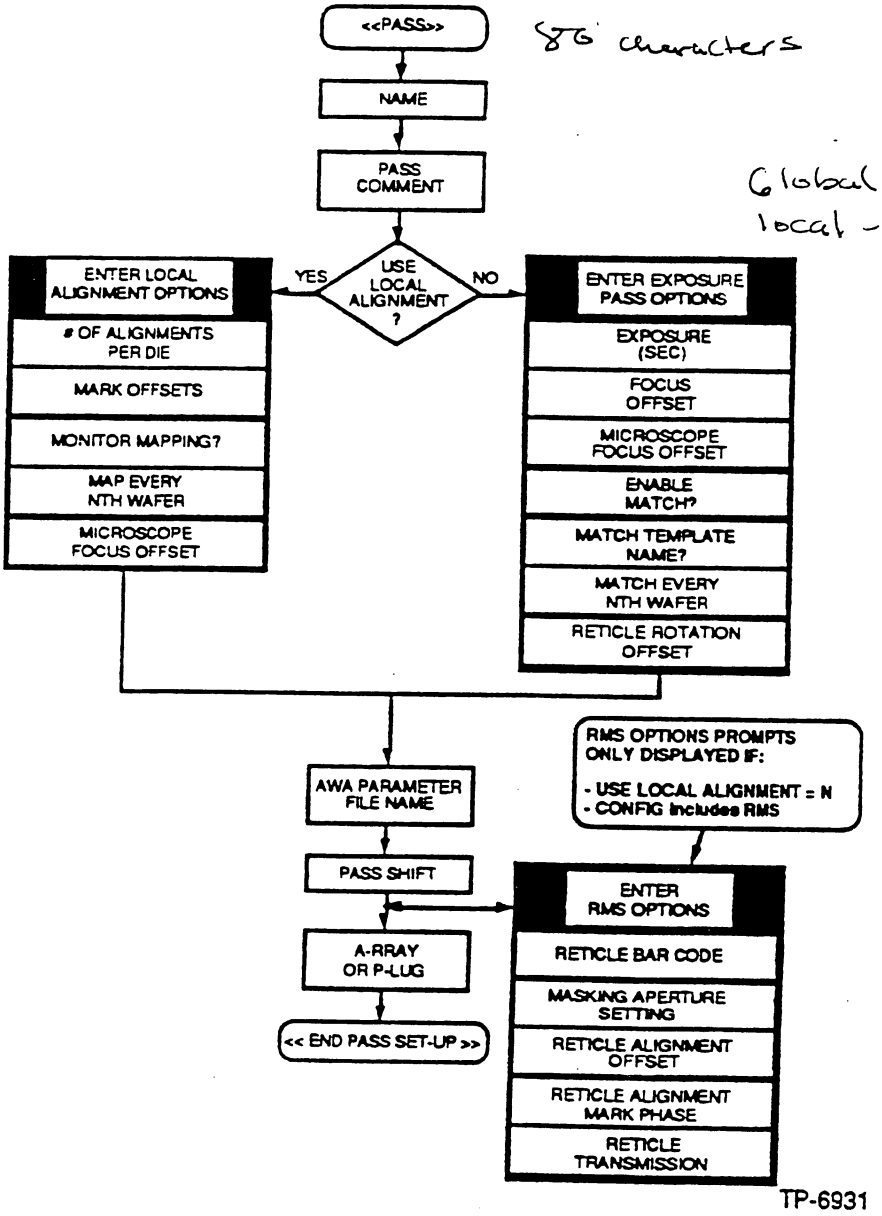

Figure 8-3
Flowchart of Pass Parameters Prompts

Pass Specifications Prompts

At this point, enter the pass parameters using the following prompts.

1. At the prompt **NAME (<CR> TO EXIT PASS SETUP)**, enter a unique name between 1 and 9 alphanumeric characters long that is used to identify the pass to be defined. If the name entered currently exists within the job, the message **NAME IN USE** appears, and the system prompts for another pass name.
2. At the prompt **PASS COMMENT**, enter a line of text up to 40 characters long (including spaces) that is to be displayed on the system monitor when the pass is executed.
3. At the prompt **USE LOCAL ALIGNMENT? (Y/*N)**, enter either Y or N. Enter Y if local alignment will be used during system operation. When Y is entered, the system displays a series of local alignment options prompts (see Figure 8-3). If Y is entered and the system's CONFIG file contains DFAS *and* Micro DFAS, the system continues with step 4. If Y was entered and the system is *not* configured with Micro DFAS, the system continues with step 1 of Local Alignment Options Prompts.

   Enter N if local alignment will not be used during system operation. The system then displays a series of exposure pass options prompts beginning with step 1 of Exposure Pass Options Prompts.

4. The **EXPOSE MAPPING PASS** prompt allows all dice within a mapping pass to be exposed using individual die alignment data. A wafer is loaded and globally aligned in the usual manner. Once the wafer is globally aligned, each die within the pass is aligned and the alignment data for each die is stored in a metrology data file. After all dies have been aligned, each die is exposed using the stored alignment correction for that die.

5. The **USE TWO POINT ALIGNMENT** prompt enables or disables the two point alignment function which is an enhancement to global alignment. Once the AWA has completed alignment and the expose button is pressed, the position of the global alignment dice are checked by Micro DFAS. If the rotation of the global alignment dice exceed that which is specified in the rotation tolerance prompt, than the wafer is rotated and the global alignment dice position are checked once again using Micro DFAS. This process is repeated until the rotation tolerance specification has been met.

NOTE: When this question is answered YES (enabled), the rotation tolerance and continue with mapping questions are presented.

- **ROTATION TOLERANCE** establishes the maximum rotation error allowed during two point alignment. A setting of 2µradians is recommended.

- **CONTINUE WITH MAPPING** allows the user to select one of two choices: if mapping should continue after two point alignment or direct wafer exposure should occur after two point alignment.

Local Alignment Options Prompts

1. At the prompt **NUMBER OF ALIGNMENTS PER DIE**, enter a value between 1 and 10 that represents the number of die alignment mark offsets to be used.
2. At the prompt **LOCAL ALIGNMENT MARK OFFSET (X and Y)**, enter the X and Y values for each die alignment mark offset to be used.
3. At the prompt **MONITOR MAPPING CORRECTIONS? (Y/*N)**, enter either Y to monitor the mapping as it occurs, or N when monitoring is not required. This question is typically only answered Y when the system is being installed or troubleshot.
4. At the prompt **MAP EVERY NTH WAFER**, enter a value that determines the frequency at which mapping is to occur within the batch. For example, if every second wafer is to be mapped, enter 2. In this case, the first wafer is mapped, the alignment file parameters are determined, and the wafer is exposed. The second wafer is exposed using the same parameters. The third wafer is loaded and mapped, to determine the new key parameters. The system then continues with step 1 of Additional Pass Specification Prompts.

Exposure Pass Options Prompts

1. At the prompt **EXPOSURE (SEC)**, enter the amount of time that the shutter remains open as a number between 0 and 128.000 seconds in increments of 1 millisecond (0.001). Any exposures longer than 4 seconds are performed using multiple shots of 4.000 seconds each.
2. At the prompt **FOCUS OFFSET [-50 -> +50]**, enter a number between -50 and +50 in tenths of microns (for example: 15 = 1.5µm). The focus offset is added to the system focus entered in MODE. This offset is used during job execution to compensate for the focus shift that is due to processing.
3. At the prompt **MICROSCOPE FOCUS OFFSET [-2000->+2000]**, enter the desired value in tenths of microns that compensates for focus changes when using different types of wafers. This value is added to MODE, and is displayed at the align position.
4. At the prompt **ENABLE MATCH? (Y/*N)**, enter either Y or N to indicate whether or not the MATCH utility is enabled during system operation. When Y is entered, the system continues with step 5. When N is entered, the system continues with step 2 of Additional Pass Specifications.
5. At the prompt **MATCH TEMPLATE NAME**, enter a name between 1 and 8 characters long (including spaces) that indicates the intrafield file located within the metrology software to be used as a template to align the wafer while the MATCH utility is in use. (An intrafield file must be established within the metrology software prior to MATCH utility execution.)
6. At the prompt **MATCH EVERY NTH WAFER**, enter a value between 1 and 25 that indicates how often Micro DFAS baseline is updated. The value entered indicates the number of wafers that are cycled through the system prior to the Micro DFAS baseline update.
7. At the prompt **RETICLE ROTATION OFFSET (ppm)**, enter a value between -40 and +40ppm that indicates the amount of offset to be sent to the RRS to rotate the reticle for this pass.

Additional Pass Specifications Prompts

1. At the prompt **MICROSCOPE FOCUS OFFSET [-2000->+2000]**, enter the desired value in tenths of microns that compensates for focus changes when using different types of wafers. This value is added to MODE, and is displayed at the align position.
2. At the prompt **AWA PARAMETER FILE NAME (NO EXTENSION) (NONE)**, enter the name of the AWA process parameter file to be allocated for the alignment parameters required (with no .SRX extension). When no file is to be used during system operation, press RETURN.
3. At the prompt **PASS SHIFT (X and Y)**, enter the X and Y values in millimeters. These values shift all exposures contained within the pass. These values are added to the values previously entered in TRANSLATE ORIGIN, and are used to correct for process-induced shifts or apparent movement in alignment marks to place a subsequent layer over a previous one. If a pass shift causes any image center to move outside of the usable wafer diameter, an error message is displayed and the system then prompts for another entry.

   NOTE: If Y had been answered to the prompt **USE LOCAL ALIGNMENT? (Y/*N)**, the system continues with step 1 of Remaining Pass Specifications Prompts.

RMS Options Prompts

1. At the prompt **RETICLE BAR CODE**, enter the reticle number that corresponds to the bar code on the reticle being used for this pass.
2. At the prompt **MASKING APERTURE SETTING (XL, XR, YF, and YR)**, enter the masking aperture settings for the pass (in millimeters) for the X-left and X-right blades, and the Y-front and Y-rear blades. Enter **0** if the blades are to be fully open.

   Each of the four masking aperture blades has full 100mm travel To obtain the actual blade setting, the masking aperture setting is added to the offsets that were previously entered in MODE, and to the pass offsets that will be entered in the following prompt. Figure 8-4 shows how these masking aperture settings correspond with the actual marks on the aperture blade positions on the wafer stepper system.

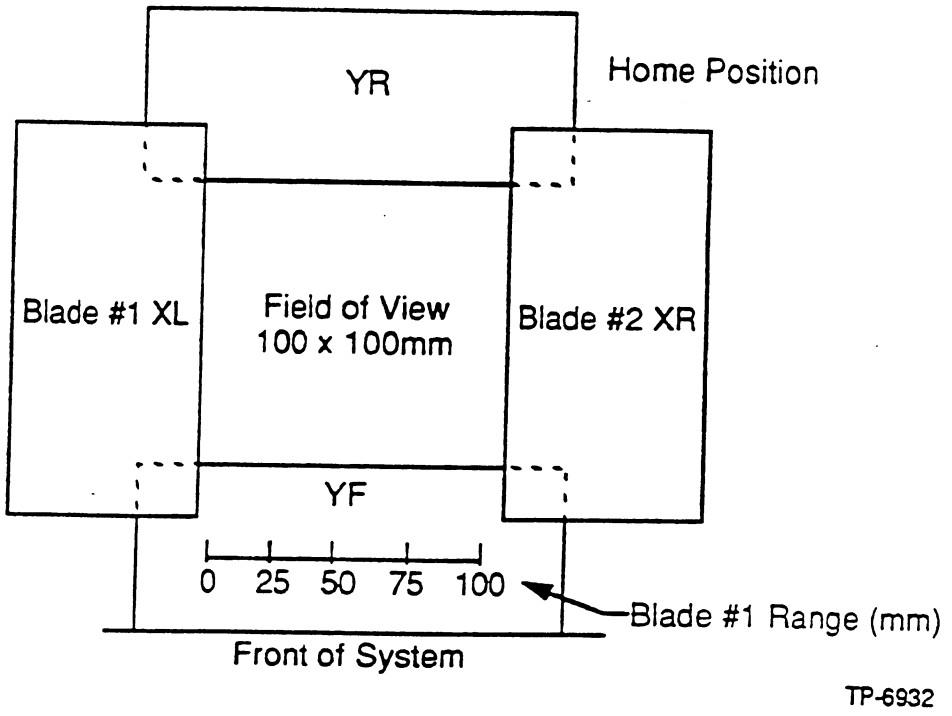

Figure 8-4
Orientation for Aperture Blade Settings

3. At the prompt **RETICLE ALIGNMENT OFFSET (MICRONS OR MILS) (XL, XR, and Y)**, enter the reticle alignment offset values that are added to the X-left, X-right, and Y-left values entered in MODE, to position the reticle for an alignment offset.
4. At the prompt **RETICLE ALIGNMENT MARK PHASE (P, *N, X)**, enter **P** for positive mask, **N** for negative mask, or **X** for no alignment.
5. At the prompt **RETICLE TRANSMISSION**, enter a value between -1 (off) and 100 that represents the transmission percent of the pass reticle. The percent is calculated by measuring the count of clear area and dividing by 225mm^2.

Remaining Pass Specifications Prompts

1. At the prompt **A-RRAY OR P-LUG**, enter either **A** or **P** according to the following guidelines:

   Enter **A** to expose all sites within the entire array (that was previously specified) during job execution. When **A** is entered, the system displays **DROPOUTS (R and C)**. At this prompt, remove either individual sites or entire areas within the currently-defined array as follows:

   - *To remove and individual site*, at the prompt **R** enter the site's row number, then at the prompt **C** enter the site's column number.
   - *To remove part of a row*, at the prompt **R** enter the row number to be removed, then at the prompt **C** enter the first and last column numbers to be removed, separated by a dash (-).

- *To remove an entire row*, at the prompt **R** enter the row number to be removed, then at the prompt **C** press the RETURN key.
- *To display a complete list of dropouts by their respective row and column numbers*, at the prompt **R** enter **V**.

After both the row and column numbers are entered, the system displays the prompt **R** again, waiting for the operator to enter additional dropout sites. When all sites have been entered, at the prompt **R**, press the RETURN key.

Enter **P** to expose only the user-specified sites within the array. When P is entered, the system displays **PLUGS (R, Y-OFFSET, C, X-OFFSET)**. At this prompt, enter the sites within the array that are to be exposed using the following guidelines:

- At the prompt **R** enter one of the following, then press RETURN:
  - The row number of the site to be exposed
  - **D** to display the array as it is currently defined, in addition to the alignment die locations (asterisks appearing on the display denote the exposure locations within the pass)
  - **V** to list the array as it is currently defined
  - **?** to delete the last entry
  - **^** to delete all entries
- At the prompt **Y-OFFSET**, enter a number that will offset the row specified in R, in millimeters.
- At the prompt **C**, enter the column number of the site to be exposed, then press the RETURN key.
- At the prompt **X-OFFSET**, enter a number that will offset the column specified in C, in millimeters.

NOTE: The system checks each site as it is entered, to make sure that the resulting exposure is within the usable diameter of the wafer. If the exposure is outside of the usable diameter of the wafer, the system displays an error message.

After both the row and column numbers are entered for the site, the system displays the prompt **R** again, waiting for the operator to enter additional exposure sites. When all sites have been entered, at the prompt **R**, press the RETURN key.

When all of the pass parameter prompts have been displayed, the system then displays the following:

<< END PASS SET-UP >>

Saving and Storing the Job

When all passes have been defined, the job is stored in a file on the disk having the job name previously specified. Save and store the job as follows:

1. At the prompt **SAVE PASS? (*Y/N)**, enter either **Y** or **N**.

   Enter **Y** to save the pass under the pass name previously specified within this section of the manual. The system then displays << PASS >>. Enter **N** when it is not required to save the pass. When N is entered, the pass is lost, and the system then displays the next prompt.

2. At the prompt **NAME (<CR> TO EXIT PASS SETUP)**, enter a unique pass name for the next pass to be specified. When all passes within a job have been defined, press RETURN. The system then continues with step 4. When RETURN is not pressed, the following prompt is displayed.
3. At the prompt **COPY? (Y/*N)**, enter either **Y** or **N** using the following guidelines: Copying a pass saves time. When a few changes occur between passes, the most effective way to define a new pass is to copy the old one. Once the pass is copies, it can be modified using the EDIT command, once the job specification is completely defined.

   Enter **Y** to copy the pass. The system then displays the prompts **<<PASS>>**, and then **PASS COMMENT**, and waits for the operator to specified the pass to be copied from.

   Enter **N** when there are many changes to make, or when an entirely new pass must be defined. The system then proceeds through the pass parameters section, starting with the prompt **NAME (<CR> TO EXIT PASS SETUP)**.

4. At the prompt **WRITE TO DISK? (*Y/N)**, enter **Y** to save the job under the name previously specified. Enter **N** to delete all parameters entered during the past job specification session.
5. At the prompt **PURGE EDITED FILES? (*Y/N)**, enter **Y** or press RETURN to purge the edited files. Enter **N** when it is not required to purge the edited files.

Editing a Job Specification File

To change the job specification files that are currently on the system disk, use the command **EDIT**. When EDIT is entered, all prompts are displayed as in the SPEC command, except that all parameters currently entered in the job are displayed following each prompt. Use the following two guidelines when updating information using the EDIT command:

- To change the parameter that is displayed, enter the new parameter.
- To leave the parameter as is, press the RETURN key.

Listing Job Information

To list the information about a particular job currently on the system, use the command LIST. Enter the command LIST, along with the name of the job for which information is to be displayed. When LIST 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 particular job's comments
- The order, names, and comments of all passes, and the array type (plug or array)

Displaying Pass Information

To list pass information from a particular job, enter the command DISPLAY **jobname\pass**. When DISPLAY is entered, the system displays the array being exposed during the pass specified. Asterisks (*) within the display represent the specific die locations.

Section 9 - Setting the Process-Dependent Alignment Parameters

Introduction

There is not a single algorithm that can align equally well to every different product. Alignment is sensitive to different contrasts, types of layers, and background noise. Parameters that affect the analysis of the target bodies and reference marks need to be set for each alignment system. Some of these parameters are machine-dependent and are determined empirically during system installation and calibration. Others are process-dependent and must be set for each new process level. This section describes the process-dependent alignment parameters that are typically set by the process engineer or the user.

This section is organized into the following four categories:

- Process Parameter Files describes what process parameter files are, how they are specified within the job, and how they are stored within the system.
- The Menus and Screens within the IASDBG Program describes the location and function of the menus and screens within the IASDBG program that are used to select the data for the process parameter files.
- Guide to Entering Data within the IASDBG Program describes an overview of the keyboard functions used within the IASDBG program, and any additional useful or helpful information regarding the IASDBG program.
- Setting the Process-Dependent Alignment Parameters: An Example describes how to set the process-dependent alignment parameters which includes creating a process parameter file, selecting a global mask, determining the global threshold, selecting a reference mask, selecting the best fine algorithm table entry, testing the process parameters, and determining the alignment offset.

Process Parameter Files

No algorithm can align equally well to every different product level and test wafer. Different substrates and thin film stacks require their own set of alignment parameters for best results. Different process parameter files are then created, which specify the alignment tolerances, process-dependent offsets, and alignment algorithms for each specific product level or test wafer. The IASDBG program is used to select many of the values for the process parameter files.

A process parameter file is specified by name within the job: each pass can have its own process parameter file, or the same file can be shared between jobs and passes. The files are stored in the MICROPDP-11/53 computer until the job pass in which they are specified is run, at which time the information in the file is downloaded to the integrated alignment system (IAS).

The Menus and Screens within the IASDBG Program

Figure 9-1 shows a flowchart of the IASDBG menus and screens.

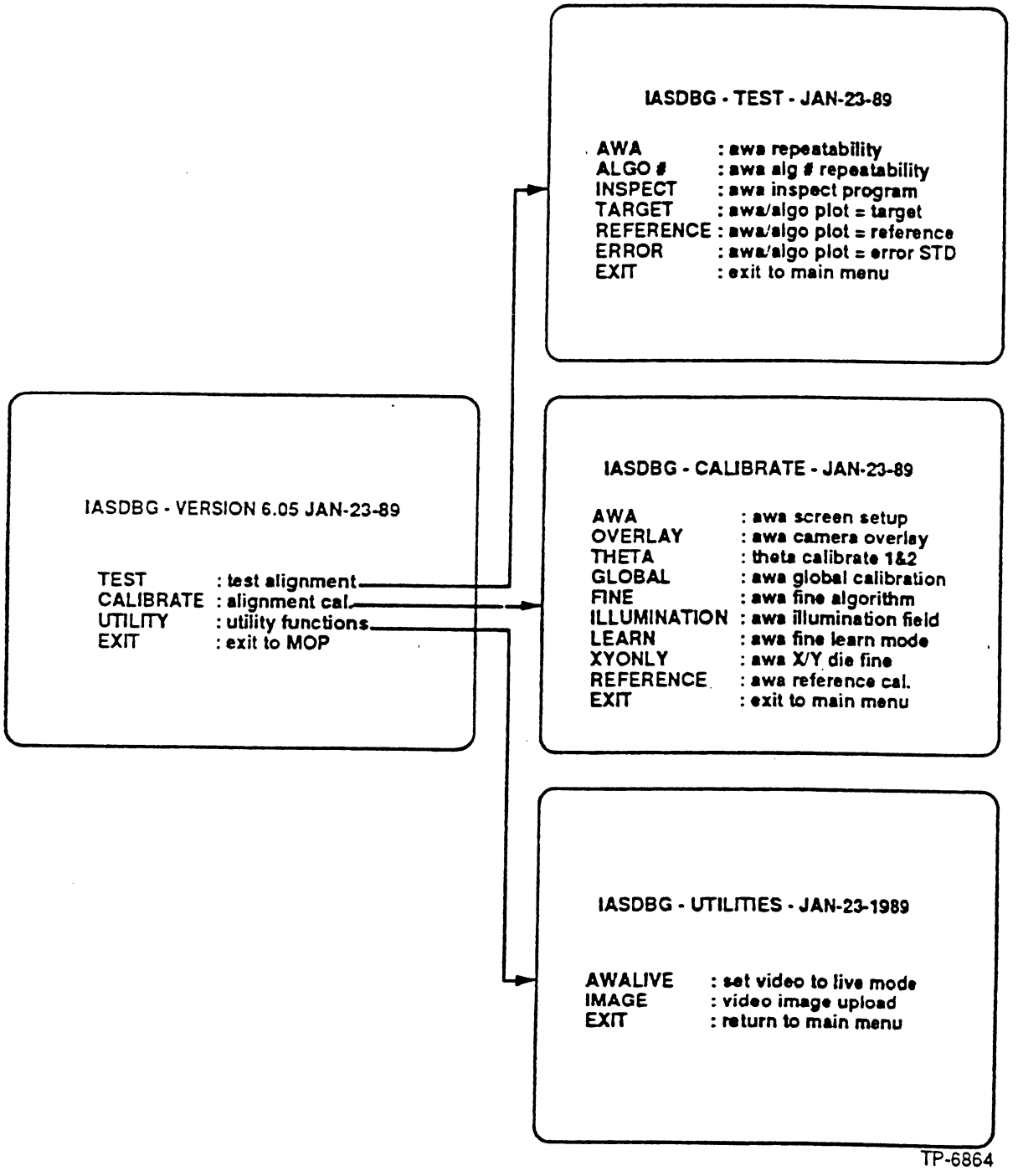

Figure 9-1
Flowchart of IASDBG Program Menus and Screens

The IASDBG Main Menu

To display the IASDBG main menu, perform the following:

1. Run a job using the command **ALIGN jobname\pass** (instead of **EXEC jobname\pass**).
2. When the wafer moves up to the align position, type **B**.

The system then displays the IASDBG main menu (Figure 9-2).

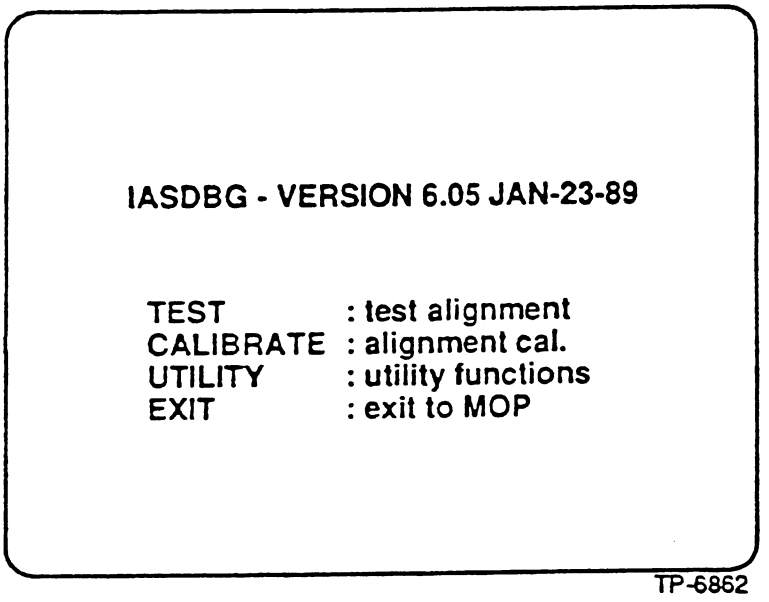

Figure 9-2
IASDBG Main Menu

The IASDBG main menu selections are:

- **TEST** displays the IASDBG Test menu that allows the user access to the routines used for checking the alignment repeatability of the fine scan algorithm table entries on a given alignment target. It also allows the user access to the INSPECT program, which has commands for viewing the masks to be used on the alignment marks and reference fiducials.

- **CALIBRATE** displays the IASDBG Calibrate menu that allows the user to perform the initial system setup tests, determine the best fine scan table sets, and check the screen illumination for saturation of the IAS digitizer.

- **UTILITY** displays the IASDBG Utilities menu that allow the user to set the video to a live image, or to save an image on the monitor to a file for later analysis.

- **EXIT** exits the IASDBG program and returns to the system prompt.

The IASDBG Test Menu

Display the IASDBG Test menu from the IASDBG main menu by entering TEST, then pressing RETURN. The system then displays the IASDBG Test menu (Figure 9-3).

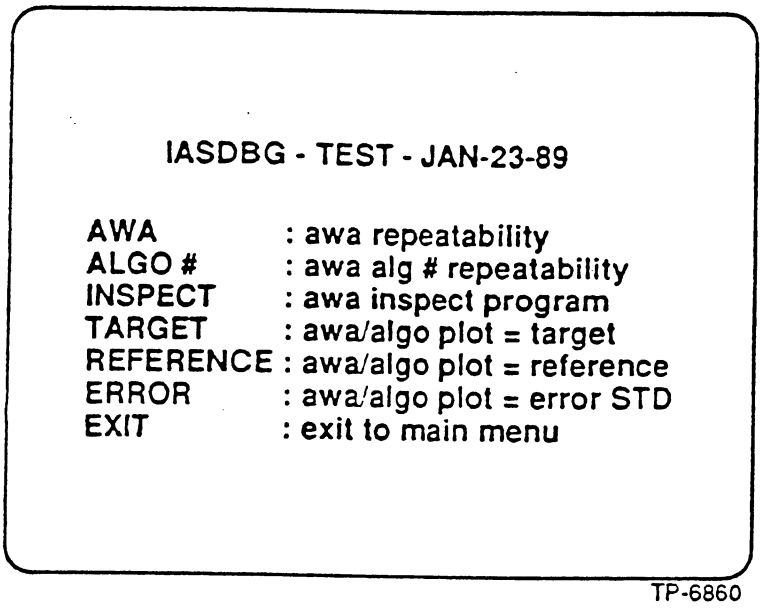

Figure 9-3
IASDBG Test Menu

The IASDBG Test menu selections are:

- **AWA** runs an alignment repeatability test on the target being analyzed using the algorithm table entry set currently in memory. This is not real alignment, because the stage does not move. The test measures how well the fine scan table entry set can repeatably determine the center of the target. The system performs a (user-selected) number of alignments on the stationary targets, each time measuring the difference between the calculated center of the alignment targets and calculated center of the reference fiducials. The results are plotted and summarized at the end of the routine.

- **ALGO #** performs an alignment repeatability test on a given target, using the user-selected algorithm. The results of several table entry sets are checked without having to exit to the system prompt, change the value in the process parameter file, re-executing the job, and downloading the new value into IAS memory. The system performs a (user-selected) number of alignments as with the AWA option.

- **INSPECT** displays a menu used to display and select the target and reference masks for global capture. This option also allows the user to control some of the parameters associated with the mask analysis.

- **TARGET** changes the AWA and ALGO # test analysis so that the target center is measured against the absolute reference center and not the reference fiducial center as in the ERROR mode.

- **REFERENCE** measures and records the system's ability to determine the reference fiducial center accurately and repeatedly with respect to the absolute reference center.

- **ERROR** is the default mode under which the system operates, unless one of the above modes is toggled on. In this mode, the chosen table entry set is used to determine the location of the target center and the reference mask is used to determine the location of the reference fiducial center. The difference between the two centers is then measured and recorded.

- **EXIT** exits the IASDBG Test menu and returns to the IASDBG main menu.

The IASDBG Calibrate Menu

Display the IASDBG Calibrate menu from the IASDBG main menu by entering **CALIBRATE**, then pressing RETURN. The system then displays the IASDBG Calibrate menu (Figure 9-4).

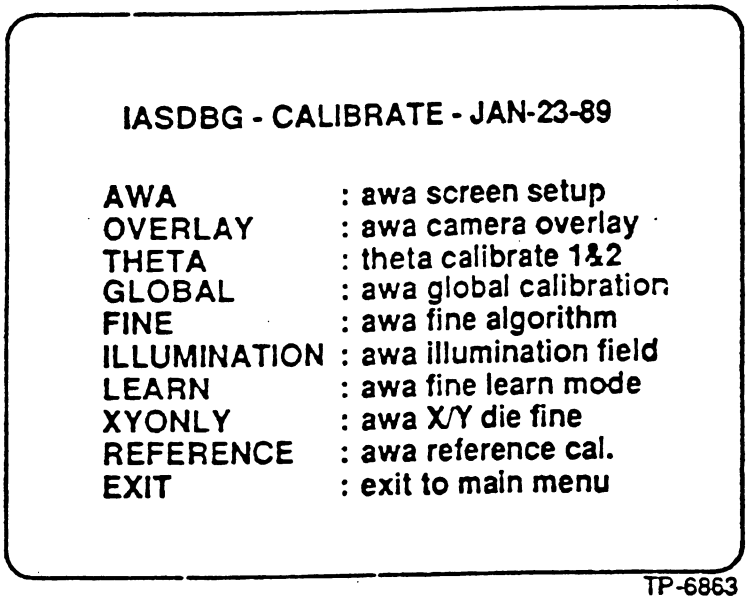

Figure 9-4
IASDBG Calibrate Menu

The IASDBG Calibrate menu selections are:

- **AWA** defines the screen boundaries and exclusion zones for AWA/D operation. The AWA screen parameters are set during system installation and should be rechecked after every time the camera or TV system is worked on, or any IAS hardware is replaced.

- **OVERLAY** ensures that the camera is set up properly for the best AWA performance. This option is used during initial system setup.

- **THETA** is only used for systems with Theta I or Theta II stages.

- **GLOBAL** determines the threshold level between the target signal and background noise. The threshold value depends on the process level and is stored in the process parameter file. The larger the threshold number, the more contrast between the alignment target and the background. Typical threshold values are 200 on metal levels and 40 for latent images in resist.

- **FINE** picks an algorithm table entry set that provides the most accurate and repeatable final positioning of the alignment target to the reference fiducial. An algorithm table entry set is a combination of mark enhancement algorithms and alignment algorithms. Of the 43 table entries available, the fine command runs 11 (41, 42 0, 1, 2, 4, 5, 7, 13, 15, and 18) which were picked because they consistently performed better on a majority of product levels.

- **ILLUMINATION** displays the light being reflected off the wafer as seen by the IAS. The scale is from 1 to 10, with 0 to 4 being black, and 9 to 10 being saturation of IAS digitizer. Use this routine to check that the reflection off a substrate (such as aluminum) is not saturating the IAS digitizer. Any setup or adjustment to the illumination should be done with an oscilloscope.

- **LEARN** performs the same type of analysis as the FINE command except that it runs all 43 table entry sets from 0 to 42. The results of the test are put into the file AWALEARN.DAT in the supervisor's directory. Refer to the AUTOSTEP 200 System Administrator's Supplement (P/N 069422) for additional information.

- **XYONLY** runs the same 11 exclusive table entry sets as in the FINE command, but performs the analysis only on the right (X/Y) side of the screen. This command is useful for characterizing a wafer with nonstandard alignment keys in which only one key is visible at a time.

- **REFERENCE** picks out an appropriate mask for the reference fiducial. For additional information on this option, see Choosing a Global Mask in this section of the manual.

- **EXIT** exits the IASDBG Calibrate menu and returns to the IASDBG main menu.

The IASDBG Utilities Menu

Display the IASDBG Utilities menu from the IASDBG main menu by entering **UTILITY**, then pressing RETURN. The system then displays the IASDBG Utilities menu (Figure 9-5).

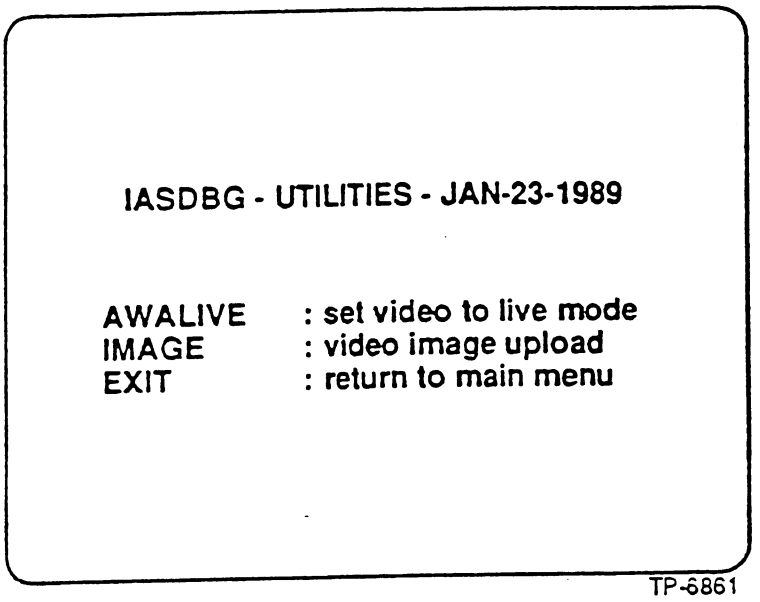

Figure 9-5
IASDBG Utilities Menu

The IASDBG Utilities menu selections are:

- AWALIVE unfreezes a digitized picture that may remain on the monitor during the running of one of the setup routines. The AWALIVE command returns the user to live mode in order to adjust focus or realign the alignment targets.

- IMAGE allows the user to define an area of the monitor to save the pixel information (such as a picture of a difficult alignment target) to a file on the hard disk. This file can then be transferred to a floppy disk and sent to GCA for analysis. When selected, the system prompts the user for the upper-left row and column position and the bottom-right row and column position of the screen. The portion of the screen defined is then saved in the file IMAGEUPLD.HEX in the supervisor's directory.

  The size of the monitor screen is 768 pixels in the X direction and 512 scan lines in the Y direction. Location 0,0 is the upper-left corner of the screen.

- EXIT exits the IASDBG Utilities menu and returns to the IASDBG main menu.

Guide to Entering Data within the IASDBG Program

Within the IASDBG program, menu options are selected by entering the command name that is associated with the selected option.

When prompts are displayed on the screen, the system also displays the default value, acceptable value range, and present value. To retain the current value, press

RETURN. To change the data, enter the new value (within the acceptable range), then press RETURN.

The following keys are helpful when using the IASDBG program:

- RETURN: Inputs the newly entered data, or retains the current data
- DELETE: Deletes a character when entering or editing data

Setting the Process-Dependent Alignment Parameters: An Example

Process parameter files are created using the AWASPEC command, and edited using the AWAEDIT command. The parameters defined in this file are determined or adjusted through the wafer inspection utilities.

Setting the process-dependent alignment parameters involves the following tasks:

- Creating a process parameter file that characterizes the target to be aligned. Initially create AWA process parameter files (for example, for a new level), using the default settings. When the final parameter values have been determined, edit the process parameter file accordingly.
- Selecting global masks that help define the location of the alignment mark during the initial scan. A mask is a signal-processing pattern; several preset masks are used by the system software.
- Determining the global threshold that is used to detect a target body during global scans. This process involves a repeatability test that modifies the threshold to reduce extraneous video signals.
- Selecting a reference mask to be used. This process involves a repeatability test that scans for the location of the reference fiducial cross, with several preset reference masks.
- Selecting a fine algorithm table entry for fine alignment. This process involves initially selecting several algorithms for further analysis, and testing them to find the best one.
- Testing the AWA performance by running various tests, such as the AWA and ALGO scatter plot tests, around-the-world test, and the Micro DFAS metrology test..
- Editing the process parameter file by entering the new parameter values in the file.
- Determining and saving the global alignment offset for the shift between manual and automatic alignment.

To determine the best process-dependent alignment parameters for a job, use the following procedures.

Creating a Process Parameter File

The first step in setting process-dependent parameters is to create a file to hold these parameters. Process parameter files are created using the AWASPEC command. The initial parameter values entered should be the default values, or those values known from experience. Once the actual parameter values are determined (through the wafer inspection utility), the process parameter file is then updated using the AWAEDIT command.

Create a process parameter file as follows:

1. Turn off the automatic AWA mode by performing the following:
   a. At the system prompt (:), enter the command **MODE**. (Refer to **Section 6 - The MODE Command: Setting Parameters and Subsystems** for information about the MODE command.)
   b. At the prompt **IS THE AWA TO BE USED? (Y/N)**, enter **N**. This takes the system out of automatic AWA mode and allows the AWA to be started manually during system operation.
   c. Complete the MODE data, and exit from the command.
2. At the system prompt (:), enter the command **AWASPEC filename**, where filename is a maximum of 9 alphanumeric characters that describe the process level being analyzed.

NOTE: Throughout the following prompts, accept the default values unless prior experience suggests otherwise.

3. At the prompt **AWA OPERATION CONTROL VALUE (default = 2), ==> RANGE: [0-5] PRESENT VALUE: <2>**, enter the desired value according to Table 9-1, then press RETURN. The default value is 2. For latent imaging, enter 0.

Table 9-1
AWA Operation Control Values

Control Value	Precision	Alignment Tolerance	No. of Global Passes	No. of Frames Averaged/Pass
0	Highest	2µin (0.05µm)	2	16
1	Higher	2µin (0.05µm)	2	8
2	Normal	3µin (0.08µm)	2	4
3	Low	4µin (0.10µm)	2	2
4	Lower	6µin (0.15µm)	1	0
5	Lowest	8µin (0.20µm)	1	0

This value controls the fine alignment tolerances, the number of global passes, and the frame averaging, used to eliminate noise from the video. The alignment tolerance value specifies the maximum difference between the calculated center of the alignment mark and the calculated center of the

reference fiducial allowed for successful alignment. Choosing a higher precision and more frames per pass, increases the alignment time (which increases alignment accuracy while reducing throughput).

4. At the prompt **REFERENCE SCAN TECHNIQUE (1=compact fiducial 2=exploded fiducial), ==> RANGE: [1-2] PRESENT VALUE: <1>**, either enter **1** to use the compact fiducial, or **2** to use the exploded fiducial, then press RETURN. The default is 1.

   The compact fiducial is a small cross centered between the four arms of the target cross, and is used with the target size of 130µm. The exploded fiducial is a set of four oblique lines on either side of the target, and is used with the target sizes of 65µm or 80µm.

5. At the prompt **REFERENCE SCAN MASK INDEX # +/- NO 0, ==> RANGE: [0-12] PRESENT VALUE <3>**, enter the desired value, then press RETURN. The default is 3.

   This number is used to determine the centers of the reference fiducial arms during fine alignment. From this information, the system interpolates the center of the reference fiducial, which represents the final position for fine alignment. The best mask for the reference fiducial is chosen using the REFERENCE option from the Calibrate menu. The user can also use the **dr** command from the Inspect menu to display the fit of a mask with the reference fiducial.

6. At the prompt **GLOBAL SCAN MASK INDEX # /- (NO 0 & NA 10, 11, 12), ==> RANGE: [-17 - 17] PRESENT VALUE: <60>**, enter the desired mask for the global scan, then press RETURN. The default is 4.

   This number specifies the mask to be used during the global scan of the alignment target. The mask is used to identify the alignment target and approximate its center so that it can be moved into the fine alignment zone for final positioning. An appropriate mask is chosen using the **am** and **dt** commands from the Inspect menu (described later in this section of the manual under the heading Selecting Global Masks).

7. At the prompt **AP GLOBAL SCAN THRESHOLD, ==> RANGE: [10-500] PRESENT VALUE: <60>** , enter the desired value, then press RETURN. The default is 100.

   This value specifies the contrast level between the alignment target and the background noise. Thresholding is applied only during global scan. The threshold is set correctly when there are no global scan failures and the global alignment consistently brings the crosses within the fine scan range. When this threshold is not set correctly, the system cannot identify the alignment target center during the global scan and issues the error message **GLOBAL-SCAN FAILURE.**

   Threshold values are chosen through the commands CALIB and GLOBAL (described later in this section of the manual under the heading Determining the

Global Threshold). Typical numbers are 40 for latent imaging, 100 through 150 for most levels, and 200 for metal. If the wafer is very dark, a higher threshold may be required. If the target cross is very faint, a lower threshold (such as 50) can be required.

8. At the following prompts, enter each desired value, then press RETURN. The defaults are 0.

```
RIGHT (X-Y) X AWA/D-MANUAL CONVERSION (PIXELS/100)
==> RANGE: [-2000-2000] PRESENT VALUE: <0>

RIGHT (X-Y) Y AWA/D-MANUAL CONVERSION (PIXELS/100)
==> RANGE: [-2000-2000] PRESENT VALUE: <0>

LEFT (THETA) X AWA/D-MANUAL CONVERSION (PIXELS/100)
==> RANGE: [-2000-2000] PRESENT VALUE: <0>

LEFT (THETA) Y AWA/D-MANUAL CONVERSION (PIXELS/100)
==> RANGE: [-2000-2000] PRESENT VALUE: <0>
```

These values change the AWA/D's final alignment position of the AWA/D to match an operator's manual alignment. These values do not affect the repeatability of the AWA/D alignments. These numbers are calculated by the AWAOFFSET program, and are updated automatically into *filename* with the AWASAVE command.

9. At the prompt **ABSOLUTE REFERENCE POSITIONS X-Y & THETA (ON=1), ==> RANGE: [0-1] PRESENT VALUE: <0>**, enter **0** to disable, **1** to enable the absolute reference position option, then press RETURN. The default is 0.

   This parameter enables and disables the absolute reference position option. When enabled, this option eliminates the reference fiducial scan during fine alignment and uses instead the reference center pixel locations (lcx, lcy, rcx, rcy) defined during AWA screen setup. This option, when enabled, improves throughput at the cost of alignment accuracy.

10. At the prompt **ALGORITHM TABLE ENTRY (NUM=TABLE SET; 0=UAA, 41=UAB), ==> RANGE: [0-42] PRESENT VALUE: <0>**, enter the desired value that sets the algorithm for fine alignment, then press RETURN. In most cases, 0 works best.

    This parameter specifies the table set to be used during fine alignment. The table set contains the fine alignment algorithm table entry number (0 to 42), which defines several parameters used to enhance the target signal and alignment algorithm. Algorithm table entry sets are chosen entering FINE, LEARN, or XYONLY from the Calibrate menu (described later in this section of the manual under the heading Selecting a Fine Algorithm Table Entry).

11. At the system prompt (:), enter the command **EDIT jobname**, where jobname is the corresponding job and pass number.

12. Edit the job file to include the name of the AWA process parameter file just created.
13. At the prompt **AWA PARAMETER FILENAME**, enter the filename chosen earlier through the command AWASPEC filename. If no name is entered here, the filename default is AWATEST.

Selecting Global Masks

Select global masks as follows:

1. At the system prompt (:), enter the command **ALIGN jobname\pass**, where jobname\pass is the corresponding job and pass for the process level being analyzed.
2. Load and manually align a wafer of the level being set up.
3. Type **B**, then press RETURN. The system then displays the IASDBG main menu.
4. Enter TEST. The system then displays the IASDBG Test menu.
5. Enter INSPECT. The system then displays the inspect screen (Figure 9-6). This screen can be redisplayed at any later time by typing HELP. Refer to **Appendix D - Inspect Screen Commands**, for a descriptive list of the commands displayed on the Inspect screen.

```
IAS.VT>
The following commands are available:
   dir   - directory of masks
   con   - display continuous contrast plot
   dv    - display variables
   help  - display this list
   li    - live mode
   gf    - grab frame
   quit  - return to IAS.VT

The following commands are available:
   sv <varname> <integer-value> - set variable
   am <number of masks> - analyze masks 1 through N (N is arg)
   dt <maskname-integer> - display target signal convolved with mask N
   dr <maskname-integer> - display reference signal convolved with mask N
```

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Figure 9-6
Inspect Screen

6. From the inspect screen, perform one of the following:

   - To analyze all positive target masks from 1 to 22 (for wafers with a light background and a dark alignment cross), enter **AM 22**.
   - To analyze all negative target masks from 1 to 22 (for wafers with a dark background and a light alignment cross), enter **AM -22**.

Entering this command displays the 22 global masks convolved with an output scan across the target arm. A line across the upper left target arm shows where the signal is being scanned. Only 1 line is scanned in this command. An intensity profile of this line is shown above the cross. On the left-side of the display are shown 22 plots of the same signal, but processed with each of masks 1 though 22. Refer to Figure 9-7 for a display of the AM 22 command.

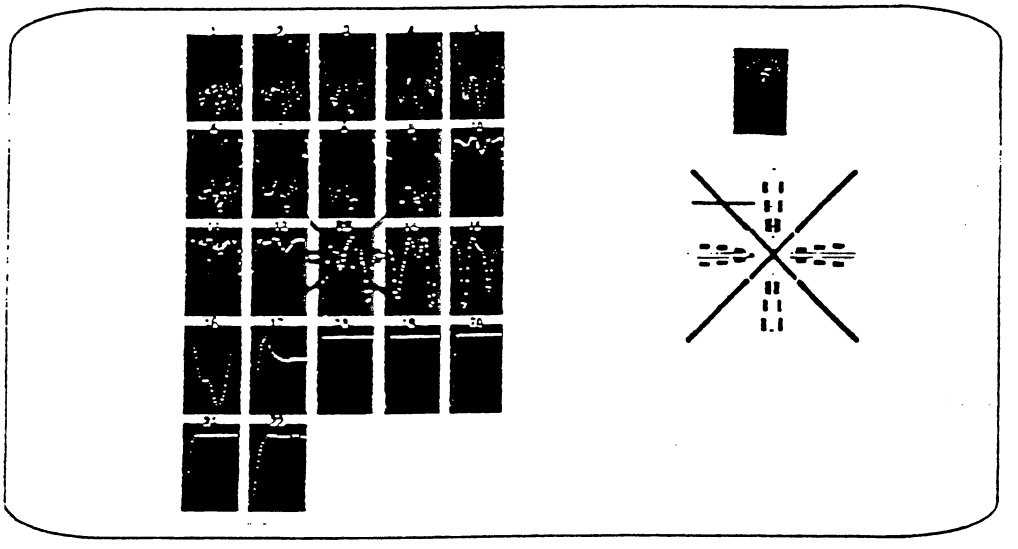

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Figure 9-7
Display of AM 22 Command

7. Select one or several good masks based on their appearance, and record their mask numbers for later testing.

   A good mask shows the center of the alignment mark as a sharp, well-defined, downward spike. The masks are numbered from left to right starting with mask 1 in the upper-left corner.

8. Return to the IASDBG main menu by simultaneously pressing the **Ctrl** and **Z** keys twice.

Determining the Global Threshold

NOTE: The OPER/TEST switch on the front of the IAS chassis must be in the OPER position to run this procedure. To stop the test, switch the OPER/TEST switch TEST, then at the prompt **PROCEED OR QUIT**, type **Q**.

Determine the global threshold as follows:

1. From the IASDBG main menu, enter **CALIBRATE**. The system then displays the IASDBG Calibrate menu.
2. Enter **GLOBAL**. This initiates the global threshold routine.
3. At the prompt **ENTER TRIAL GLOBAL-MASK NUMBER**, enter the global mask number (chosen in the procedure Selecting Global Masks in this section of the manual), then press RETURN. Make sure that the OPER/TEST switch on the IAS chassis is in the OPER position.
   The system then runs a repeatability test at several threshold values, starting at 20 and ending at 300, in increments of 20 (this procedure takes about 3 minutes). During the repeatability test, the system displays various test data on the monitor. When the test is complete, the system displays a table that shows the results of the repeatability test (Table 9-2).

Table 9-2
Example of Global Mask Threshold Test Summary

```
Trial/Current global-mask number and threshold: 5/4 60

Thresh  20  TIR (lx,ly,rx&ry) = 1.93, 1.60;  0.00, 0.00: 1.60 #
Thresh  40  TIR (lx,ly,rx&ry) = 0.00, 0.00;  0.00, 0.00: 0.00 #
Thresh  60  TIR (lx,ly,rx&ry) = 0.00, 0.00;  0.00, 0.00: 0.00 #
Thresh  80  TIR (lx,ly,rx&ry) = 0.00, 0.00;  0.00, 0.00: 0.00 #
Thresh 100  TIR (lx,ly,rx&ry) = 0.00, 0.00;  0.00, 0.00: 0.00 #
Thresh 120  TIR (lx,ly,rx&ry) = 0.00, 0.00;  0.00, 0.00: 0.00 #
Thresh 140  TIR (lx,ly,rx&ry) = 0.00, 0.00;  0.00, 0.00: 0.00 #
Thresh 160  TIR (lx,ly,rx&ry) = 0.64, 0.80;  0.00, 0.00: 0.80 #
Thresh 180  TIR (lx,ly,rx&ry) = 1.93, 1.60;  0.00, 0.00: 1.60 #
Thresh 200  TIR (lx,ly,rx&ry) = 1.93, 1.60;  0.65, 0.80: 3.05 #
Thresh 220  TIR (lx,ly,rx&ry) = 0.00, 0.00;  0.65, 0.80: 1.45 #
Thresh 240  TIR (lx,ly,rx&ry) = 0.00, 0.00;  0.00, 0.80: 0.80 #
Thresh 260  TIR (lx,ly,rx&ry) = 0.64, 0.80;  0.00, 0.00: 0.80 #
Thresh 280  TIR (lx,ly,rx&ry) = 0.64, 0.00;  0.00, 0.00: 0.00 #
Thresh 300  TIR (lx,ly,rx&ry) = 0.64, 0.00;  0.00, 0.00: 0.00 #
```

The top line of the summary screen identifies the global mask that the test was run with (in this example, the mask number was 5), and the global mask and threshold that are currently in memory (4 and 60). The threshold values are then printed out with their corresponding X and Y scatter numbers (TIR), and the sum of the lx, rx, and ry scatter. The smaller the sum of the lx, rx, and ry scatter, the more repeatable the global scan is for that threshold value.

4. Select the best global threshold and record the number.

   To select the best global threshold, find the columns on the table for which all 4 numbers (left X and Y, right X and Y) are zero: these present the threshold with the most repeatability. When there are several, select the the threshold value as the average of the largest range (in the example, 40 through 140 show good repeatability, so select their average, which is 90).

5. Return to the IASDBG Calibrate menu by simultaneously pressing the **Ctrl** and **Z** keys.
6. Return to the IASDBG main menu by entering **EXIT**.

Selecting a Reference Mask

This is an automatic routine that convolves masks 1 through 12 with the output video signal of several scans taken across taken across the reference fiducials. For each mask, 10 convolutions are performed with the system calculating the center of the reference fiducial with the absolute reference position and determines the deviation for each trial. At the end of the routine, the masks are ranked from those having the smallest scatter TIR (most repeatable) to those having the largest scatter TIR. Select a reference mask as follows:

1. From the IASDBG main menu, enter the command **CALIBRATE**.
2. From the IASDBG Calibrate menu, enter the command **REFERENCE**.

   The system then runs a repeatability test of the 12 reference masks (this procedure takes about 2 minutes). During the repeatability test, the system displays various test data on the monitor. When the test is complete, the system displays a table that shows the results for each reference mask (Table 9-3).

Table 9-3
Example of Reference Mask Test Summary

```
Current reference mask number: 3
Recapitulation:

Mask   4  TIR (lx,ly,rx&ry) = 0.06, 0.04; 0.02, 0.04: 0.10 #
Mask   3  TIR (lx,ly,rx&ry) = 0.14, 0.02; 0.10, 0.06: 0.18 #
Mask   5  TIR (lx,ly,rx&ry) = 0.15, 0.04; 0.11, 0.07: 0.22 #
Mask   2  TIR (lx,ly,rx&ry) = 0.10, 0.06; 0.10, 0.06: 0.22 #
Mask   1  TIR (lx,ly,rx&ry) = 0.08, 0.09; 0.11, 0.05: 0.26 #
Mask   8  TIR (lx,ly,rx&ry) = 0.15, 0.07; 0.13, 0.11: 0.31 #
Mask   9  TIR (lx,ly,rx&ry) = 0.03, 0.06; 0.17, 0.09: 0.32 #
Mask   6  TIR (lx,ly,rx&ry) = 0.15, 0.10; 0.11, 0.13: 0.34 #
Mask  10  TIR (lx,ly,rx&ry) = 0.06, 0.05; 0.16, 0.14: 0.35 #
Mask  12  TIR (lx,ly,rx&ry) = 0.23, 0.16; 0.13, 0.14: 0.44 #
Mask   7  TIR (lx,ly,rx&ry) = 0.18, 0.12; 0.30, 0.17: 0.59 #
```

The system summary includes for each mask, the TIR numbers for left X, left Y, right X, right Y, and the sum of those TIR numbers. The summary also displays the masks in the order from best to worst. Any mask that has a TIR sum of over 100.00 is not shown on the summary display. A TIR sum of over 100.00 indicates a scan error occurred during this test, and the mask is not suitable for use (for example, mask 11 reported 100's for the scatter TIR).

3. Select and record the best reference mask.

   To verify the best reference mask, make sure that all 4 numbers (left X and Y, right X and Y) are the lowest and most uniform, and the last number has the lowest TIR (in the example, mask 4 is the best mask).

4. Return to the IASDBG Calibrate menu by simultaneously pressing the **Ctrl** and **Z** keys.
5. Return to the IASDBG main menu by entering **EXIT**.

Selecting a Fine Algorithm Table Entry

The IAS contains many different algorithms which have proved useful for AWA analysis. Selecting the appropriate target algorithm table entry is aided by the use of the IASDBG function called FINE. The FINE routine automatically analyzes a wafer target with 11 of the most commonly used algorithms and displays the results for inspection.

Select a fine algorithm table entry as follows:

1. Place a wafer in the AWH.
2. Enter the job using the align command as **ALIGN jobname\pass.**
3. Bring the test wafer out to the AWA align position and type **B.**
4. From the IASDBG main menu, enter **CALIBRATE.**
5. From the IASDBG Calibrate menu, enter **FINE.** This command runs a repeatability test on 11 preselected fine-scan algorithms (41, 42, 0, 1, 2, 4, 5, 7, 13, 15, and 18). This procedure takes about 3 minutes. When the test is complete, the system displays a table that shows the results of the test (Figure 9-4 is a partial summary table).

Table 9-4
Example of Fine Algorithm Table Entry Test Summary

```
    SET 42:#
42: (lx&y) (rx&y) dev:sca =  (0.12,  0.04)  (0.14,  0.05)  1.86  : 0.23 #
    SET 4:#
 4: (lx&y) (rx&y) dev:sca =  (0.09,  0.11)  (0.11,  0.07)  2.03  : 0.29 #
    SET 41:#
41: (lx&y) (rx&y) dev:sca =  (0.17,  0.07)  (0.14,  0.09)  2.06  : 0.30 #
    SET 2:#
 2: (lx&y) (rx&y) dev:sca =  (0.16,  0.06)  (0.15,  0.11)  1.81  : 0.32 #
```

The summary includes for each table set that was run, the average results of the 25 frames analyzed with the table set. This includes the average TIR numbers for left X, left Y, right X, and right Y, the sum of the average deviations of ly, rx, and ry, and the sum of the scatter of ly, rx, and ry in units of microns.

The summary also displays the table sets in the order typically from best to worst based on the sum of the ly, rx, and ry scatter values.

6. Record all algorithms whose scatter value is less than 0.3µm on Table 9-5. These are the algorithms that show the most repeatability.

Table 9-5
Fine Algorithm Table Entry Test Result Matrix

		#1	#2	#3
F	+3µm	alg #	alg #	alg #
O				
C	BF	alg #	alg #	alg #
U				
S	-3µm	alg #	alg #	alg #

7. Return to the system command by simultaneously pressing the Ctrl and Z keys twice. The system displays the message **ALIGNING...COMPLETE.**
8. Change the AWA focus by approximately 3µm either up or down.
9. Repeat steps 3 through 7.
10. Change the AWA focus by approximately 3µm in the opposite direction from the original position.
11. Repeat steps 3 through 7.
12. Repeat steps 1 through 11 for 2 more wafers that are chosen randomly from the process lot.

From the accumulated information, tabulate the different algorithms that appear promising and the frequency with which they occurred. Typical data might look as follows (Figure 9-8):

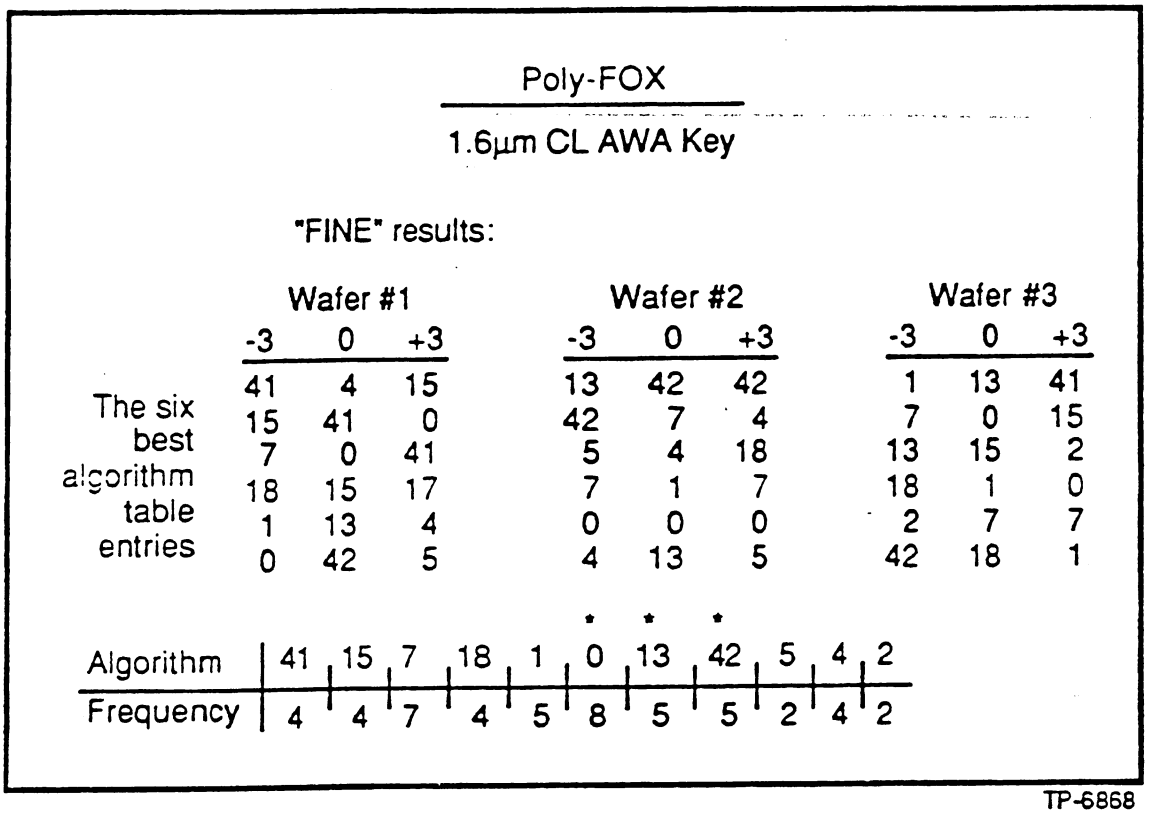

Figure 9-8
Example of FINE Test Results

The algorithm that occurs most frequently through the range of different test conditions is probably the best one. Experience dictates that several of the table sets should be put through one or more performance tests before the final choice is made. This is also true if several table sets appeared with equal frequency.

Testing the AWA Performance

There are several test methods used for testing the performance of the IAS setup. The following methods are discussed in this section:

- AWA and ALGO Scatter Plot Tests
- Around-the-World Test
- Micro DFAS Metrology Test

AWA and ALGO Scatter Plot Tests

The AWA and ALGO test procedures verify the algorithm table entries chosen by the FINE, LEARN, or XYONLY commands. The commands perform a user-defined number of alignments (the stages never move) on the alignment marks, and then calculate how repeatably the algorithm determines the center of the alignment marks. Test the algorithm table entries using the following procedure:

1. Enter the command **ALIGN jobname\pass**, where jobname\pass is the corresponding jobname and pass for which the process parameters are being defined.
2. Load, then manually align the wafer being tested.
3. Type **B**. The system then displays the IASDBG main menu.
4. Enter **TEST**. The system then displays the IASDBG Test menu.
5. From the IASDBG Test menu, perform one of the following:

   - To test the algorithm currently specified in the process file, perform the following:

     a. Enter the command **AWA**.
     b. At the prompt **ENTER CYCLE COUNT**, enter a number greater than 10, followed by a comma (for example, enter **25,** for 25 repetitions).
     c. To exit the task, press RETURN.

   - To test any algorithm, perform the following:

     a. Enter the command **ALGO n**, where n is the table entry set number to be analyzed.
     b. At the prompt **ENTER ALIGNMENT COUNT**, enter a number greater than 10 that represents the number of repetitions to be performed, followed by a comma (for example, enter **25,** for 25 repetitions).
     c. To exit the task press RETURN.

     After the last alignment is performed, the system then displays a scatter plot diagram and a numerical summary of the alignment statistics similar to the following (Figure 9-9):

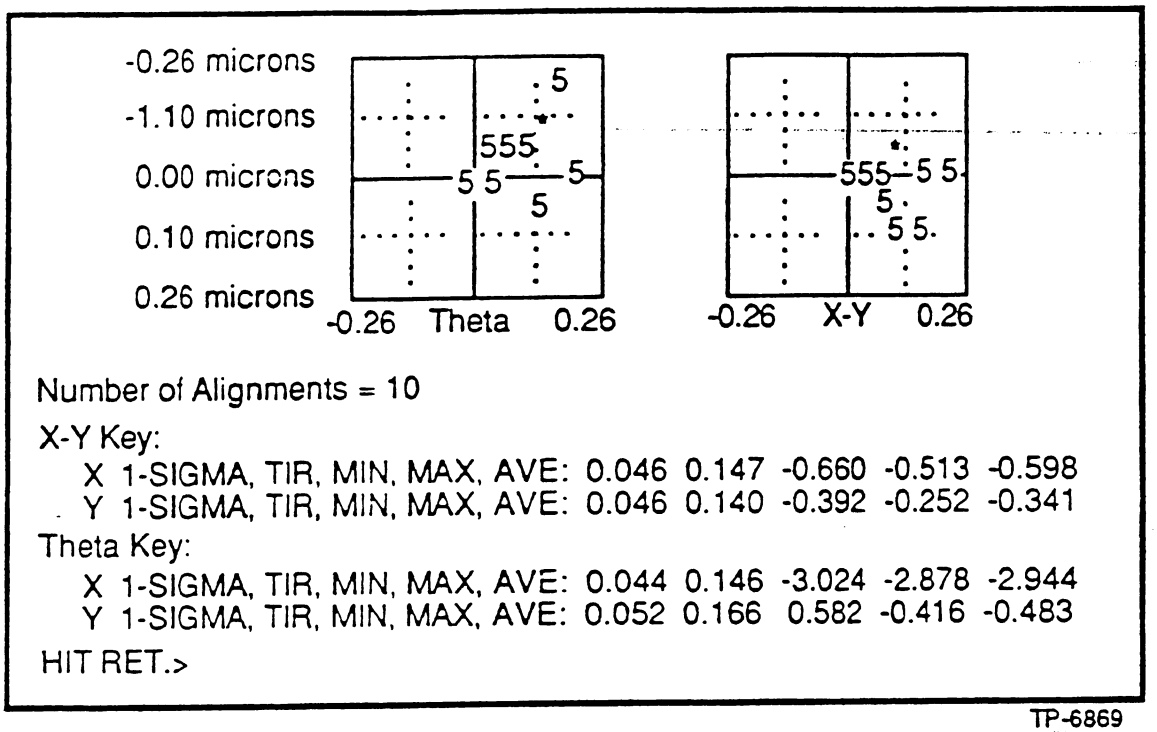

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Figure 9-9
Example of Scatter Plot Diagram and Numerical Summary

The Scatter Plot Diagram gives the user a graphic representation of the repeatability of the fine algorithm alignments. The first alignment measures the offset from the calculated center of the reference fiducial and is plotted in the center of the above graph at position 0,0. Subsequent alignments also measure the offset from the reference fiducial center but plot the difference of this offset from the first alignment offset.

The diagram also displays the distribution of the alignment scatter by depicting the relative number of hits at any location with either an asterisk, or a number. The asterisk represents the maximum number of hits on the screen, and the numbers represent a percentage of the maximum. In the example, on the theta (left) side, a total number of 10 hits has been recorded. These are made up of the asterisk = 2 hits, and the eight 5's = 50% of 2, or 1 hit each for a total of 10 hits.

The Numerical Summary breaks up the information into the X and Y components for the X/Y alignment side and the theta alignment side. The numerical data displayed are (from left-to-right): the 1-sigma of the scatter, the TIR of the scatter, and the minimum, maximum, and average numbers for the offsets from the absolute reference positions. Typical test results are as follows (Figure 9-10):

AWA SCATTER PLOT: Algorithms #0, 7, 13 at Best Focus; 25 trials

Wafer #1		X/Y Key		Theta Key	
		1 SD	TIR	1 SD	TIR
0)	x:	0.041µm	0.161µm	0.032µm	0.114µm
	y:	0.030	0.125	0.022	0.093
7)	x:	0.047	0.181	0.045	0.176
	y:	0.032	0.133	0.039	0.124
13)	x:	0.036	0.160	0.034	0.136
	y:	0.025	0.095	0.029	0.129

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Figure 9-10
Example of AWA Scatter Plot Test Results

This test can be repeated on several different wafers form the lot, although it is probably not necessary unless significant wafer-to-wafer variation was noted during the FINE test. Choices can be made based simply on the best average 1-sigma value *and* the best average TIR. In this case, mask 0 and 13 both have average sigma values of 0.03µm but the average TIR for mask 0 is slightly better: 0.12µm versus 0.13µm. This is a very slight distinction and both algorithms may work equally well. An additional method of sorting, is to look for the table set which shows the least variations in sigma and TIR.

6. Record the best algorithm.
7. Perform one of the following:

   - To return to the IASDBG main menu, simultaneously press the Ctrl and Z keys.
   - To abort the ALIGN program, enter the command **EXIT**, simultaneously press the **Ctrl** and **C** keys, then type **A**.

Around-the-World Test

The around-the-world test is similar to the AWA scatter test, except that the wafer is being moved to various points on the AWA screen before alignment is performed. This adds the variable of stage motion to the alignment equation which provides a more realistic test. The test requires that the wafer be moved to 8 different positions around the fiducial with alignment being performed after each move. When alignment is complete, the stage X/Y positions are noted. A TIR done on the 8 values is an indicator of alignment precision. Typically, in the best case (i.e. developed resist images) the TIR value is ≤ 0.15µm. The actual TIR

depends on the table entry set and target characteristics. One drawback to this test is that it does not measure theta alignment performance and repeatability.

1. Enter the command **AWAEDIT filename**, where **filename** is the process parameter file created to hold these parameters being defined.
2. Edit the file to include the masks, the global threshold, and the fine scan algorithm table entry chosen.
3. Execute the job corresponding to the process being tested by entering **EXEC jobname\pass**.
4. To automatically align the wafer, type B (typing B again will stop the alignment). If a global failure occurs, either the global mask or the global threshold needs changing in the process parameter file.
5. Note the X and Y alignment position (for example, X: 1227, Y: 594).
6. Move the alignment crosses away from the center of the fiducial (Figure 9-11).
7. To align the wafer again, type **B**.
8. Record the X and Y values. Note the scatter of these results. These values are displayed in microns/100 (for example, 4475 means 44.75microns).
9. Repeat steps 6 through 8 eight times. Typical results of an around-the-world test are shown in Figure 9-12.
10. To abort the job, simultaneously press the **Ctrl** and **C** keys.

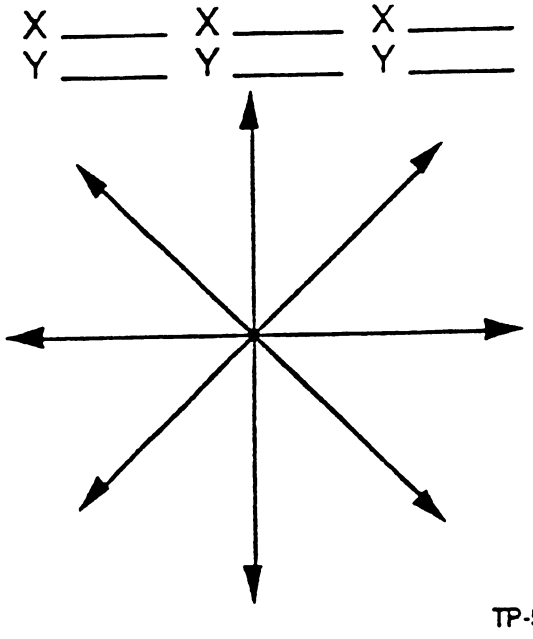

Figure 9-11
Alignment Cross Directions of Movement

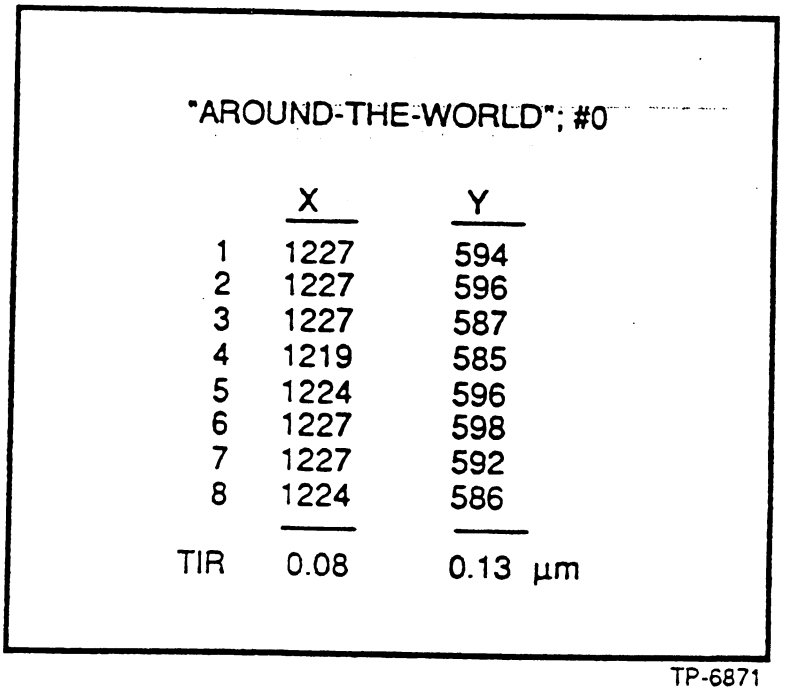

Figure 9-12
Example of Around-the-World Test Results

When the around-the-world test is complete, enter the new values in the process parameter file by performing the procedure in Editing the Process Parameter File in this section of the manual.

Micro DFAS Metrology Test

The Micro DFAS alignment system can be used as the metrology tool to test set selection and AWA performance. Assuming acceptable DxD alignment performance on the process level of interest, a job can be run that maps every die on the wafer with no exposure. After the wafer is mapped, grid parameters of X/Y baseline and AWA microscope rotation as well as wafer/stage scale and stage orthogonality are output on the Micro DFAS monitor.

With the chosen AWA process parameter file in place, the metrology job is executed. The wafer being analyzed is brought up under the AWA alignment microscope and aligned. When the EXP button is pressed, the wafer is mapped by Micro DFAS. Each AWA/D alignment and mapping generates a measurement of X/Y baseline and wafer rotation. The variation seen from alignment to alignment is exactly analogous to the AWA repeatability performance on the process level.

Editing the Process Parameter File

Once all the parameters have been determined for the process parameter file, edit the process parameter file by performing the following:

1. From the system prompt (:), enter the command **AWAEDIT filename** where filename is the process level just analyzed.
2. Edit the file by entering the new parameter values as determined in the preceding paragraphs.
3. Choose the best algorithm as the one with the lowest change in X and Y alignment numbers in the table of step 6. If the accuracy is similar between two or more masks, the best mask would be the one that best aligns the cross in the fiducial. If the cross does not align perfectly, alignment offsets can be added later using the AWAOFFSET program (described later in this section of the manual under the heading Determining and Saving the Global Alignment Offset).
4. At the system prompt (:), enter the command **AWAEDIT filename.**
5. At the prompt **ALGORITHM CONTROL,** enter the table entry number of the algorithm chosen.

Determining and Saving the Global Alignment Offset

The AWAOFFSET routine measures the difference between the AWA/D alignment and an operator's manual alignment. The command AWASAVE is then used to upload this difference to the appropriate process parameter file. Determine and save the global alignment offset by performing the following:

1. From the system prompt (:), enter the command **AWAOFFSET jobname\pass,** where jobname\pass is the jobname and pass corresponding to the process level being defined.
2. Load, then manually align a wafer.
3. Type **B.** This initiates the AWAOFFSET routine.
4. Align the wafer in X, Y, and theta, then type **B.**

The system measures the difference between the AWA/D alignment and the operator's alignment, and then moves the targets out of alignment.

5. Align the right (X/Y) side, then type **B.**
6. Repeat step 5 three times.
7. Manually align the left (theta) side key in both X and Y, then type **B.**
8. Repeat step 7 three times.
9. At the message **AWAOFFSET ANALYSIS COMPLETE,** abort the job by simultaneously pressing the **Ctrl** and **C** keys, then typing **A.**
10. From the system prompt (:), enter the command **AWASAVE filename** where filename is the name of the corresponding process parameter file.