
Palomar Technologies, Inc.
Model 3500-II



Automatic Component Assembly Cell

Operations Manual Part # MAWD20330- 8 Rev -

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Chapter 4 - Calibration

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4.1 Introduction

Once the system has been booted properly and the main menu appears, click on the Setup button to initialize the hardware. Proper calibration of the bonder's hardware is necessary if the system is to run accurately. Components such as the cameras and their lens, tools and their operation, axis movements and accessory setup can be calibrated from this screen. Once the accuracy of the calibration has been verified, the system can run in the necessary manner to complete the required tasks. This area of the software ensures the accuracy of the equipment during proper program execution. The features that will be affected are:

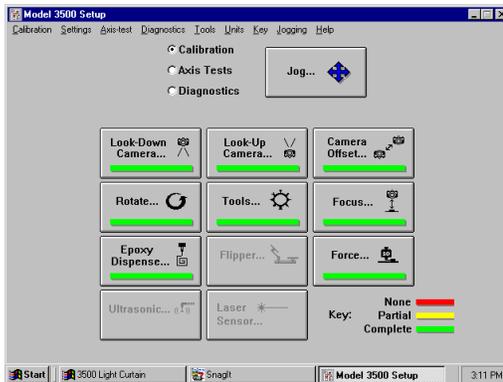


Figure 49 : Calibration Main Window

When the equipment calibration is being accomplished, it must be processed in the order that they are shown. Each calibration technique depends upon the other, starting from the look-down camera. When a lower level calibration is changed, all of the other calibrations must be redone prior to the machine usage. When looking at the pull-down menu at the top of the setup dialogue box, all items with a check mark next to them are completed.

The Setup menu allows the user to select between Calibration, Axis Test, and Diagnostic by clicking the radio button next to the selection. Handler calibrations are not shown and must be pulled down from the setup bar. Unless they are running the latest software (above version 4.1), the red, yellow and green colors only show that the calibration has been done. It does not necessarily mean that everything is RIGHT. The later software requires the calibration to be within a Pass/Fail window. The color bars indicate: red – none, yellow – partial, green - complete.

- ⇒ The calibration information is contained in a binary file (c:\3500\files\ 3500.cal). When calibration is completed and tested successfully, a backup of this file must be saved in a separate location prior to initial use. Whenever the calibration file is changed (or restored from the backup), it should be verified through the diagnostics routines prior to execution.

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When completing the calibration process, it can be divided into two categories: seldom change and biggest impact. Unless something in the lens-camera assembly is changed (like if you change the theta belt), the pixel size and lens position in the theta head doesn't really change. Likewise, unless the flexure pivots are damaged, the force repeatability for most applications doesn't vary. They should still be done as part of the recommended preventative maintenance programs. Camera offset is probably the most vital calibration, as Rotate, Tools and Focus depend on its accuracy. An accuracy test is also recommended before using the machine.

Caution: If the lens is in proper alignment with the camera, it is possible to move the lights to different positions in the field of view and maintain an undistorted image throughout it.

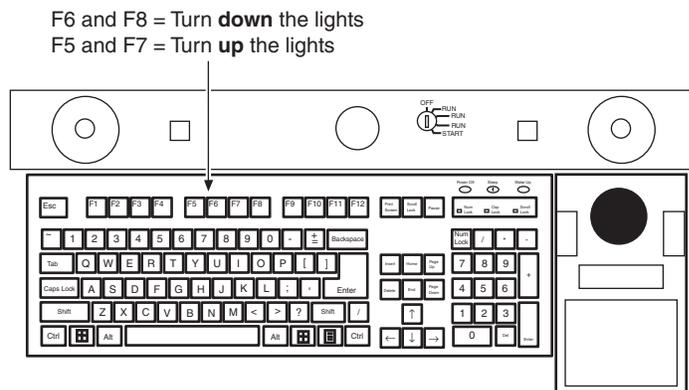
4.2 Jogging

When the calibration is in process, it will be easy to use the jogging feature to find the component positions in the target screen. The jog menu allows the user to select between the look-down and look-up camera so the settings can be established for correct positioning and execution. It controls magnification and lighting to find the best target location. The left mouse button toggles between Z-theta & X-Y, however the pointer has to be in the active jog window for this option to work. Absolute positions for X, Y and Z can be input in this window.

The Jog Options are used for measurement and tool selection. The Mark Position button resets the measurements of the X, Y and Z so the final position can be calculated by viewing the delta of the current position and the new value. Also note that the actual value for vacuum (sealed or unsealed) is displayed. This can be used to quickly determine if the tool is plugged. Manual theta cannot be used in this screen.

Note: Using the drag method for head position (using the mouse) always ensures that the head will be at the home position, not the clearance height. Moving the individual axis in specific directions by using the elevator will not raise the head. As there is no fail-safe for detecting obstructions, extreme care must be exercised.

Figure 50: Keyboard
Function Keys



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4.5 Camera offset

This calibration establishes the relationship (offset) between the look-down camera (Mag #1) and the look-up camera. The look-down #1 lens represents the true XY positions. It also establishes the relationship (offset) between both look-down lens (Mag #1 & Mag #2). The camera offset calibration is important as it can be used as a quick gauge for checking accuracy before tools are calibrated or programs are written.

The fixture is manually positioned over the look-up camera and a fixed object is located on it. Mag #1 is brought into focus and pattern recognition is used to calculate the center of the hole using both cameras. The XY location of the bond head is plotted and used to determine the offset between Mag #1 and Mag #2.

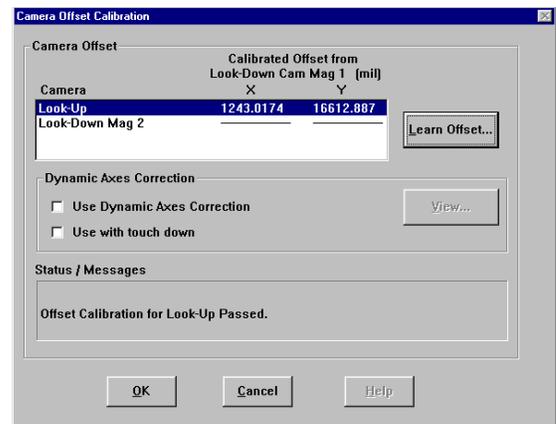
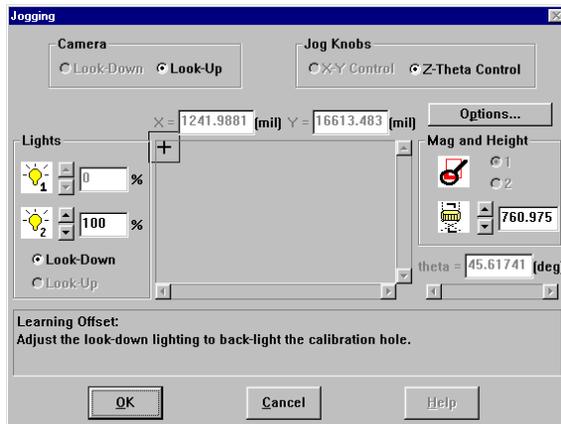
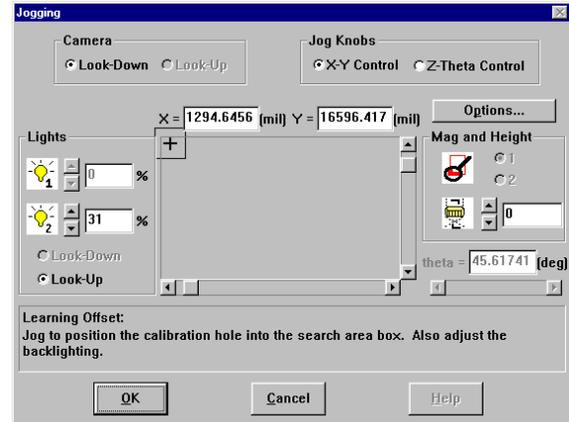
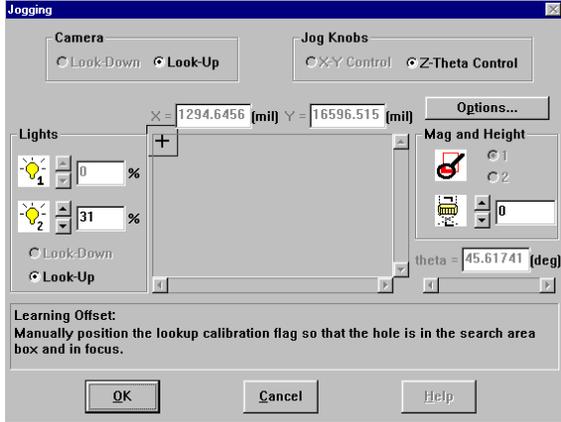
Camera Offset procedures:

1. Click the Setup button in the 3500 Main Menu.
2. Select the Calibration radio button from the top of the Setup menu.
3. Click on the Camera Offset button.
4. Select the look-up camera and click on the Learn Offset button.
5. Position the look-up flag so the fixed object is visible in the search area of the look-up camera.
7. Using the jog window, center the flag in the pattern recognition monitor. Bring down Z until the image is in focus.
8. Click on the OK button to capture the PR image of the fixed object. It will focus three times to learn the image.
9. Repeat steps 4 through 8 for the look-down camera Mag #2.
10. Click on OK to exit and replace the calibration data with the new coordinates.



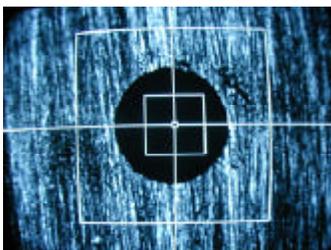
Figure 54: Camera Offset Calibration

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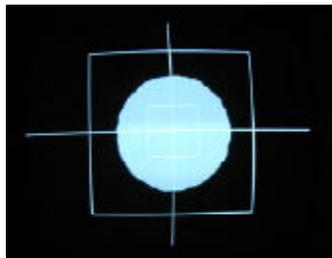


The same windows will appear for the camera offset look-down camera Mag 2. It is important to remember that only the Z height can be moved. If X or Y are moved, then the calibration must be redone or the positioning will be inaccurate.

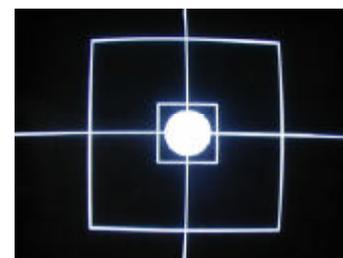
Manual Position of Flag



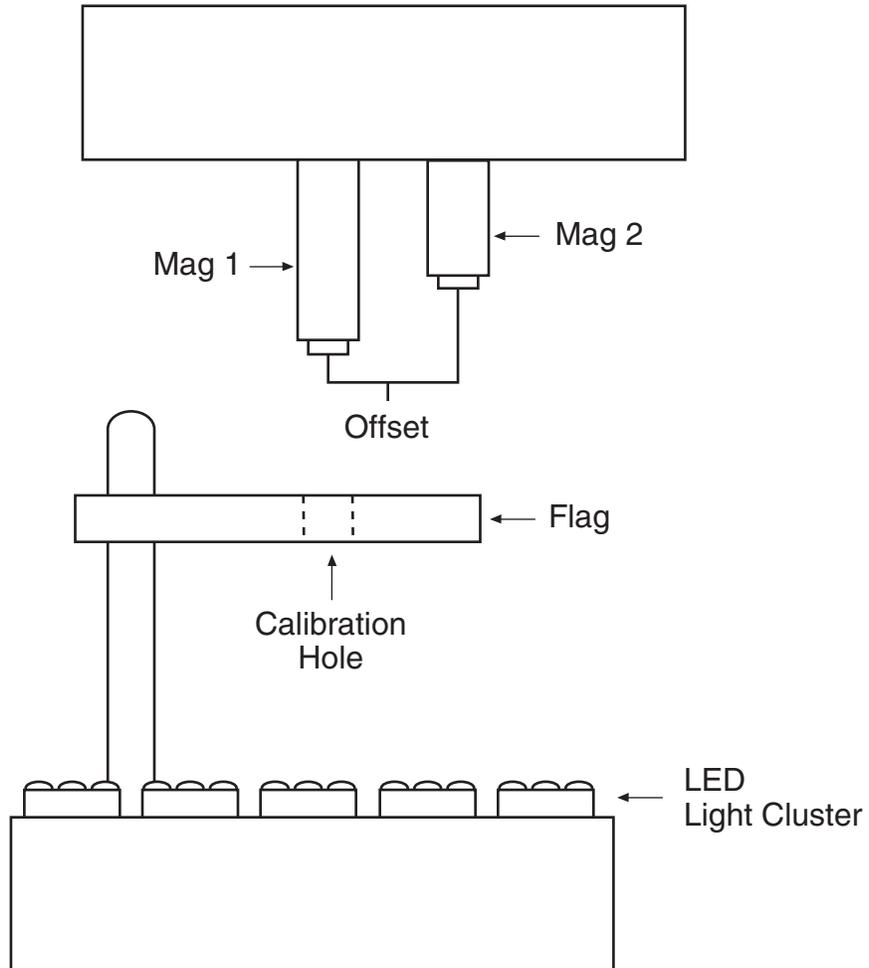
Look-down Mag 1



Look-down Mag 2



Chapter 4 - Calibration



Chapter 5 - Programming

Chapter 5 - Programming

5.1 Introduction

The 3500-II Die Bonder is a component assembler that uses a coordinate system to locate a component on its intended target. In order to complete this task, three forms of data must be entered to form a program foundation: types and objects definitions and procedure calls. As the user becomes more proficient with the bonder, programming can become more simplified with the developing knowledge. The types and objects are the basic building blocks of all programs, with a component beginning as a type. A type definition consists of classifications, physical descriptions, alignment options and reference information. This information describes an instance of a component or collection of components. The pickable and place definitions are the simplest descriptions that define the dies and the die place sites. The Collection is a special type definition that forms the parent/child relationships. Since the child must be a type definition, a collection can contain multiple collection definitions as children. As these definitions are created, a complex hierarchy develops between the data.

When a type is referenced to an origin, it becomes an object. The Object definition consists of one or more elemental fields. Each element field describes where a type's reference fiducial(s) are found. There are two methods in creating an object:

1. A type is referenced to the 3500's origin, thus creating an object in the workspace. This method is known as a **Top Level Object**.
2. A collection is formed with a child, in which the child is reference to the collection's origin. **Note:** Multiple objects can share a common type definition by varying the location of the object reference fiducials.

Once the workspace is defined, a procedure is established among the pickable objects and the place site objects. There are three procedures that can be established:

1. Pick and place;
2. Epoxy dispense at a place site;
3. Insert a comment into the program.

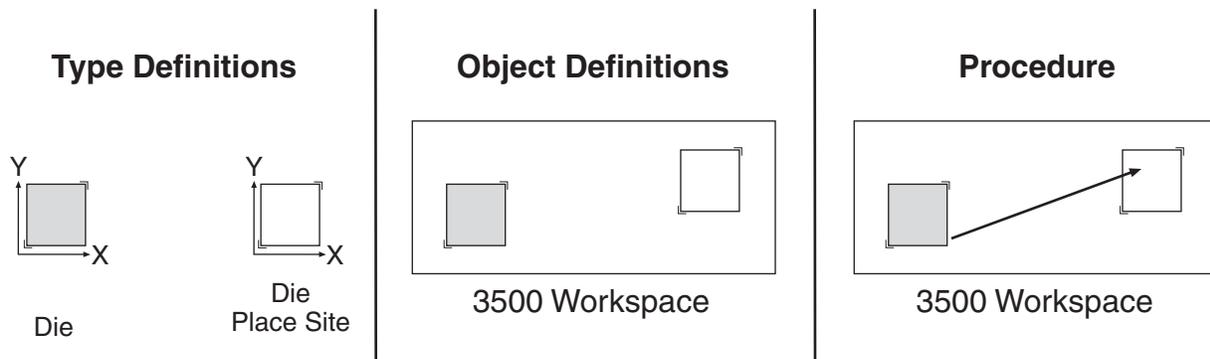


Figure 74: Programming Flow

Chapter 5 - Programming

When creating a program, it is necessary to address three basic questions: 1) “What is it?”, 2) “Where is it?”, and 3) “How do I do it?”. There are two methods to enter a program into the 3500-II database. The first method (bottom-up) is the long way, in which the types, objects and procedures screens are used. The second method (top-down) is a shortcut using the materials window. For the new user, the long method should be used to get a better understanding of the system basics. Once these basics are acquired, the materials window can be used. If it is used, any modifications to the program must be made through the individual Types and Objects windows. This section will cover both programming methods and discuss the differences between them.

Typically, programming is done in a top-down fashion: globals, references, collections and finally the die. The 3500 must be programmed in the reverse order, starting with the die. First the machine is taught a single die or single place site. Then the collection (usually a waffle pak or substrate) and finally the action can be taught.

5.1.1 Programming Concepts

Entering a new program:

1. Click the Prog button from the 3500-II Main Menu.
2. Select New from the File pulldown menu to create a new file, or Open to modify an existing program.
3. Three elements are needed for the program: Types, Objects and Procedures.
 - Program each element to build the program.
 - Create programs using system defaults in the Materials window.

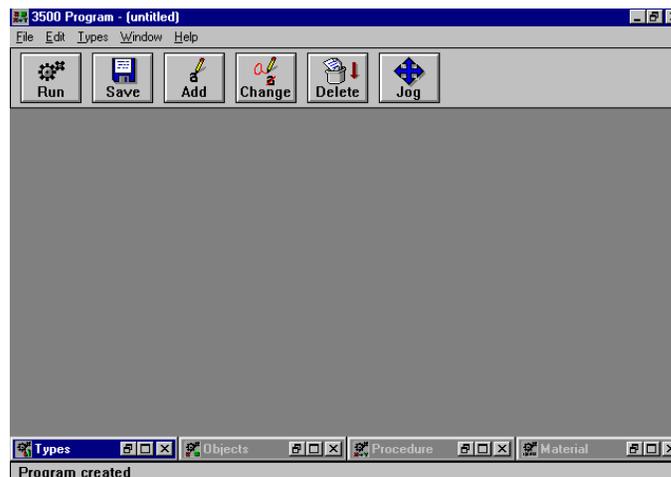


Figure 75: Main Program Window

Chapter 5 - Programming

5.1.2 Programming Flow

The logical flow of a program starts with the creation of the component descriptions (Types), continues with the teaching of component placement on the work surface (Objects), and ends with the description of the actions to be performed with the components (Procedure). The basics of creating a program are:

1. Set up the system and work area.
 - Verify that systems are properly calibrated through the Diagnostics module.
 - Arrange the work area with substrates and waffle packs.
 - Verify the components are in the correct orientation for final assembly.
2. Create new databases and/or new program files.
3. Define the lowest level component types.
 - Define Pickable (Die) types.
 - Define Place types.
4. Define Collection types.
 - Define Waffle Pak types (Collections of Pickables).
 - Define Substrate types (Collection of Place sites).
 - Define Workholder types (Collection of Substrates).
5. Declare top level Objects.
 - Waffle Packs and Substrates (and workholders, if applicable).
6. Create the Procedures.
 - Define the Procedure statements.
 - Define Procedure Action parameters.
7. Run the Program.
 - Modify the action parameters and type definitions for process optimization and speed improvements.

The following chapters will describe the programming process in detail. **Note:** A single program should be associated with each database, as the programs cannot be saved on an individual basis. By doing so, a necessary program will not be lost when a database is being restored.

Chapter 5 - Programming

When creating a new program, the first step is to create a database that will hold the program information necessary to run and obtain information for reports.

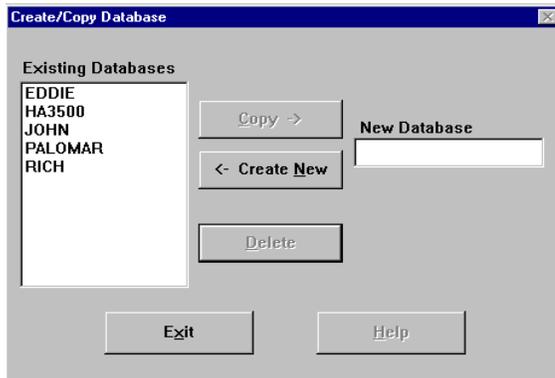


Figure 76: Database Pulldown Menu

1. Select the Maint button from the 3500-II Main Menu.
2. When the maintenance window opens, click on the database pulldown menu and select Create/Copy to create a new database.
3. Once the Create/Copy Database window opens, enter the desired database name in the New Database cell on the right side of the window. Click the <- Create New button to enter the database into the 3500-II system. Click the Exit button to save the changes and exit the screen.

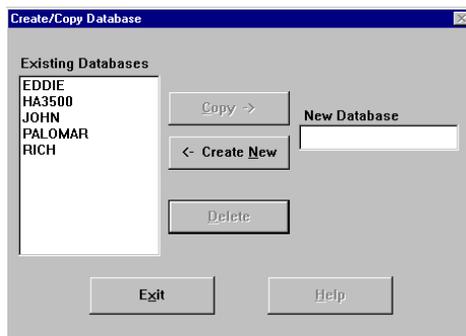


Figure 77: Creating New Database

4. Once the database name is saved, return to the Maintenance window and select Login from the Database pulldown menu. Choose the desired database and click on OK to exit the dialogue box.
5. From the 3500-II Main Menu, click the Prog button to enter or modify the program.
6. When the program screen appears, click on File/New to create a new program, or File/Open to open an existing program. The resulting window is shown on page 90. Four screens located at the bottom of the window can be chosen: types, objects, procedures and material. To enter a new program, it is necessary to input the information sequentially as each section builds upon the previous input.