Chapter

3

Calibration

Chapter Contents

Summary

This chapter provides instructions on the calibration procedures designed to maintain the accuracy and safety of the system during its life span.

_____

_____

3.1   Introduction

Note: Section 3.1 to 3.4 in this Chapter apply to the SJ-10, SP-1 and GS-1 Systems. All other sections relate to one or more of the systems and are clearly marked.

In order to maintain the accuracy of the system, it is necessary to perform a number of calibration procedures regularly. It is suggested that these procedures be carried out on a monthly basis.

- Potentiometer Adjustment
  - ⇨ This is necessary to compensate for the variation in light output from the LED rings over their life span.
- Focusing the Camera
  - ⇨ This should be performed after moving the camera on its slides or adjusting the aperture. Focus should be checked regularly to ensure the image is sharp.
- Scaling the System
  - ⇨ This step allows the system to establish the scaling factor between the pixels, which comprise the image and real world distances.
- Position in View Calibration
  - ⇨ To counteract the possibility of optical distortion affecting the accuracy of the system, position in view calibration is available for all algorithm types (Not for SP-1).
- R&R tests
  - ⇨ These tests serve a variety of useful purposes: They allow the user to select the optimum running speed for the system; to obtain information on the repeatability of the system; and to monitor system performance over time.

Calibration and Maintenance should only be carried out by trained personnel.

_____

_____

3.2   Focusing the Camera

1. Put the system into Soft Stop.
2. Load a PCB onto the conveyor.
3. Click on the Tools Button and select Camera.
4. Select the Focus option.
5. Turn off the XY Table using the on/off switch at the front of the system.
6. Remove side panel of the system
7. Loosen the lens-locking clamp and focus the camera. Place the camera over an area of the board with good surface detail (e.g. solder paste pads, board markings etc.). It is important to use board level details to evaluate image sharpness and not component features, such as text on top of a SOIC.
8. When the camera has been focused correctly retighten the lens lock and put the side panel back on.
9. Press the E-Stop and turn the XY table back on.
10. Clear the e-stop and home the XY Table.
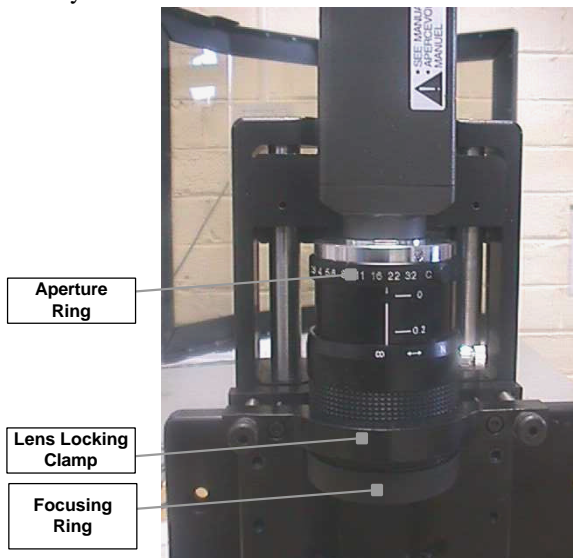11. Rescale the system.

Figure 3.1 - System Camera Layout

_____

_____

3.3   Changing the Camera Aperture Setting

The camera aperture setting determines how bright the image is. In facilities with several systems, it is recommended that all machines be set to the same aperture value. This allows for greater ease of programming and transfer of inspection templates between machines.

1. Use a piece of Kodak grey card. (Where multiple machines are being calibrated, the same grey card should be used to set the aperture setting on all machines).
2. Load an empty PCB into the system.
3. Place the grey card on it so that it fills the field of view.
4. Click on the Tools Button and select Camera and Set Aperture.
5. Manually set the aperture to between F5.6 and F11 (ideally F8).

The air purge should be running at all times during these calibrations. If not the heat will cause shimmer and the readings will be inaccurate.

3.4   Scaling the System

The system should be rescaled after the camera lens is moved, focused, or the aperture adjusted.

Manually Scaling the System

The systems should only be manually scaled if it is way out of scale.

1. Place the system into Softstop and load a PCB into the system.
2. Go to a view that has a large number of components in it by pressing "CTRL+n" (goto next view).
3. Go to the manual scaling option in the calibration menu (Tools-Camera-Manual). The system will ask if the fiducials have been properly trained. Press "Yes" if they score above 700.
4. Click on Small, Medium or Large so that the system is scaled by 10, 50 or 500 microns respectively.
5. Click on expand or contract modes so the at the camera view will do so when scaling.
6. Exit the screen and then 'remake' the inspection template (Ctrl+r).
7. Perform an automatic scaling of the system.

Automatically Scaling the System

1. Note the Fiducial presence scores before scaling the system.

_____

_____

2. Go to the automatic scaling option in the calibration menu (Tools-
    Camera-Automatic). Once "Automatic" is clicked the system will go
    through some routines which should take less than a minute to run.
3. Exit Autoscaling and recheck the Fiducial scores. If the score has
    dropped retrain them.
4. Scale the system again just to be sure.
5. Exit the calibration screen and remake the CAD (Ctrl+r).
6. Run local inspection by clicking on the "Inspect" button.

3.5   Position In View Calibration

Note: This is not used for the SP-1 or SP-2

This is used to improve the accuracy of the system across the whole field of
view. Click on the "*2D Calibration*" folder in the "*Category*" panel to bring up
the associated options. The procedures for carrying out the 2D calibration
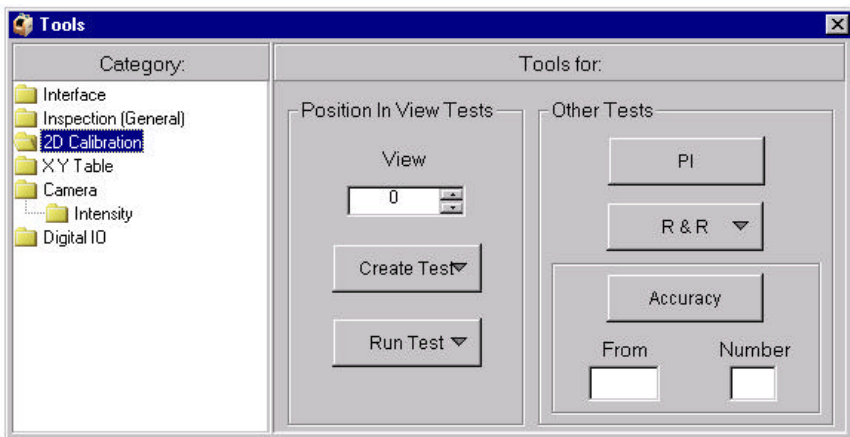options are explained below.

**Figure 3.2 - 2D Calibration tools options**

_____

_____

Position In View Tests

The position in view test is used to improve the accuracy of the system across the whole field of view. This is required because the position of deposits located near the edge of the field of view may be calculated slightly offset because of camera distortion. The PIV test accommodates for this distortion.

View

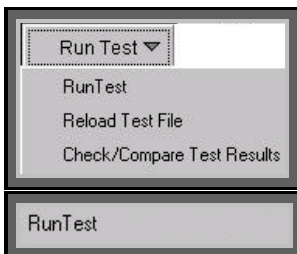This is the view number in which the PIV will be performed in.

Create Test
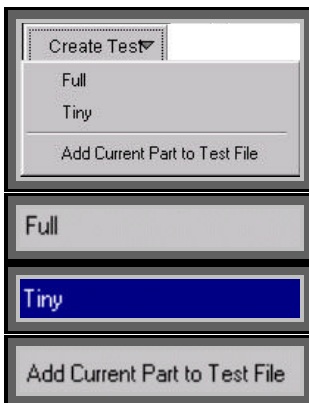
Clicking on the "*Create Test*" button allows the user to create and customize the PIV test to be run.

This will perform the test using a 5 x 5 point test.
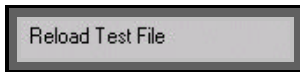
This will perform the test using a 9 x 9 point test.

This option allows you to add extra components to the previously selected test file.

Run Test

Clicking on the "*Run Test*" button provides the user with options for running and completing the PIV test.

Select this option to run the first PIV test.

_____

_____

Reload Test File	Select this option to re-run the PIV test once the board has been re-loaded into the machine.
Check/Compare Test Results	Select this option to compare the results of the first and second PIV tests. These results will be displayed in a console window.

3.6   *Optimizing the X-Y Table speed.*

The goal is to run the system quickly enough to meet production throughput, and run the XY table at a speed that gives good GR&R results. The best GR&R results do not necessarily happen at the lowest speed.

Determine the correct speed and acceleration for the system. This is found by running a Huge GR&R test. A huge GR&R test measures the systems performance for nine cycles of a set of accelerations.

1. To run the Huge GR&R test, go to the 2D Calibration Screen from the Tools Button.
2. Select a script from the list of choices shown (e.g. 'rr6a', 'rr6b' or 'rr6c'). A script can be viewed and the accelerations edited if necessary.+
3. Run the script by pressing "Enter".
4. At the end of the test, select a result with a GR&R result under 20 microns, while trying to keep the X & Y accelerations high (perhaps 5 for X and 3 for Y). If a slow speed is selected, the system throughput will be slowed down.
5. Once the desired acceleration is determined, it needs to be set for the system. Go to the XY Table screen (Tools - XY table) and enter the two values into the boxes shown.

If you get bad R&R results (> 20 microns or so) check the following:

⇨ Check the fiducial scores. Try to get them > 900.

⇨ Check that the air purge is on and that the lamp is being cooled.

⇨ Check that the camera is firmly bolted in and the lens lock is tight.

⇨ Check that the system is level.

⇨ Check that the system is not vibrating or rocking (If the floor is not solid, it will not be possible to run the system at maximum speed).

_____

_____

⇨ Run a huge R&R test and check if you are running the system at the wrong speed. You should be able to get it to run at over 3 moves per second at less than 10 microns GR&R for X and Y on a large dense board [with > 40 views].

3.7 Lighting Head Calibration

The lighting rings must be calibrated so that there is an even lighting intensity from all of the rings. Once the system has been set up initially by an MVT engineer, note the Lighting Head Calibration reading. These readings will be used to reset the system's lighting intensity in the future.

How to check the lighting intensity readings.

1. Load a sheet of Kodak grey card (reflection indices of 18%) into the system. Ensure that it fills the full field of view of the camera.
2. Go to the Aperture Lighting screen (Tools-Camera-Lighting)
3. Select the LED ring to be calibrated by clicking in the check-box. For 2D SP-1 use the 15 and 80-degree rings. Set desired brightness level using potentiometer.
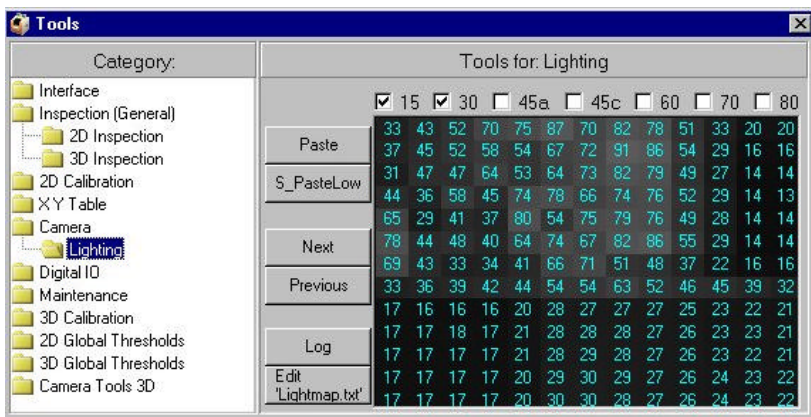

Fig. 3.3 - Lighting Evenness Screen

4. Go back to the Display Mean Screen (Tools-Camera-Display Mean) and take note of the mean value that is given. This will become the target specification for that ring in future.

_____

_____

How to Reset the Lighting Intensity

Periodically the user should check that the lighting intensity hasn't changed too much since it was originally set. Use the Aperture and Lighting Evenness Screens as before.

1. Select a lighting ring and check its mean intensity reading as before.
2. If it varies from the original score adjust the LED ring potentiometers until it equals the original score. To locate the LED potentiometers, open the front hood of the machine and remove the front internal panel. The six LED potentiometers are located beside the terminal block and arranged as shown:
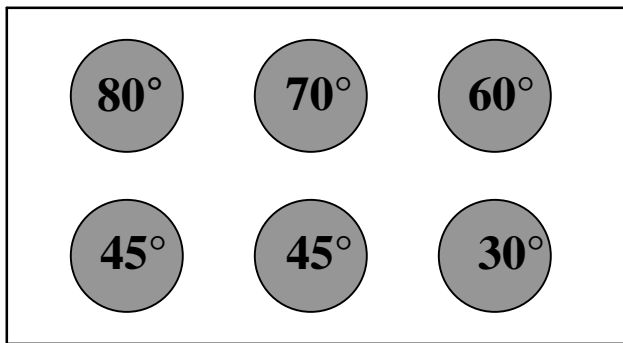

Fig. 3.4 - LED Potentiometer Panel

3. Load a Kodak Grey Card.
4. Go to the Lighting Evenness Screen again and select a new LED ring to be checked and repeat process until all LED rings have been calibrated.
5. When complete save the values and settings by pressing "Log" on the Lighting Evenness Screen. The system will ask if you want to save images for all LEDs. Answer '**n**' for no. This will save the values to a file called PR1_grey_map.txt. This file can be use to calibrate future machines.
6. (For paste inspection only) Once the potentiometer levels are set, go to Tools - Camera - Do Calibration Grid. And then restart software.

_____

_____

If a system has already been calibrated the values should be used in other
systems on other lines. The values can be read from the file
data/PR1_grey_map.txt.

Lighting setups for different applications

In the Lighting Eveness Screen it is possible to toggle between the different
applications (i.e. between paste, pre, post, wave, etc.) by clicking on the top left
button (set as "Paste" in fig. 3.2).
Also, it is possible to toggle between the different lighting setups within the
application by clicking on the second from top left button(set as "Fiducial" in fig.
3.2).. The user can check what the components images look like with different
LED profiles.

_____

3.8   SP-1 Calibration

Note: The following sections in 3.8 <u>only</u> apply to the SP-1 System.

Calibrating the 3D imaging system

Calibration involves four main steps that must be performed in the order in which they are presented in the diagram below.
The four steps require that the calibration software is loaded on the camera.
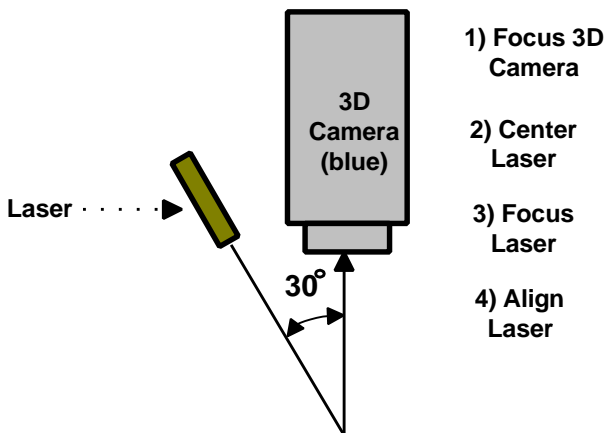

Figure 3.5 - 3D Camera Schematic

Focusing the 3D Camera

1. Load a board in the SP-1 at operational height. This may mean counteracting the E-stop by removing a side panel. Turn the XY table OFF if you do this.
2. Turn on the lower ring light image (Main Screen View Menu - Bottom Light Image)

_____

_____

3. Access the 3D Camera Tools (Tools - Camera Tools 3D) and click on the "Increase" button to increase camera exposure until the PCB features are visible.
4. Loosen the 'Focus Mount Locking Screw' with a 2.5-mm allen wrench.
5. Adjust the 'Focusing Ring' until a "sharp" image is obtained. Focus on a board feature like a pad or text. Do not focus on the top of a component or a board connector.
6. Tighten the camera 'Focus Mount Locking Screw' while maintaining the sharp image.
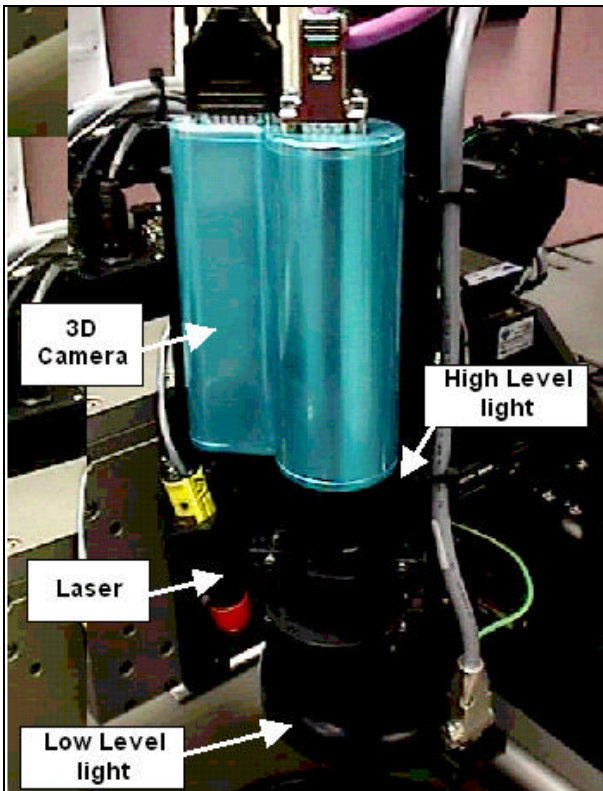7. Set the 3D Lens Aperture to max. open.

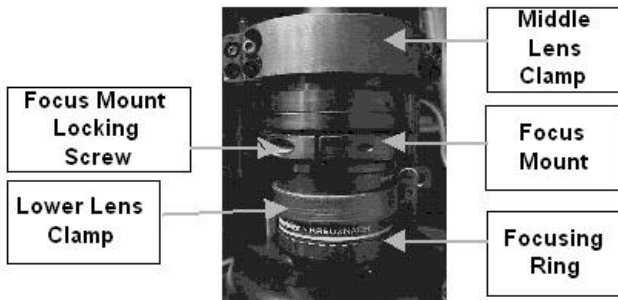

Figure 3.6 - 3D Camera Components

_____

_____

Figure 3.7 - 3D Camera Focussing System

Center the laser in the field of view

1. Load a board in the SP-1 at operational height. This may mean counteracting the E-stop by removing a side panel. Turn the XY table OFF if you do this.
2. Turn on the lower ring light. (Main Screen View Menu - Bottom Light Image).
3. Access '3D Camera Tools'.
4. Loosen the 'Rotational Locking Screws' of the laser mounting brackets (see below) with a 2-mm allen wrench.
5. Rotate laser until it is centered in the camera's field of view.
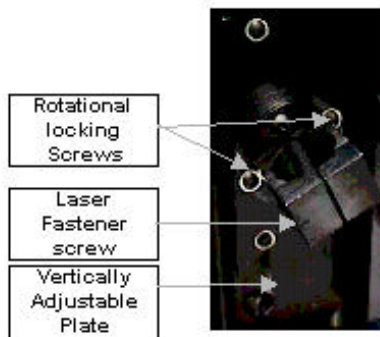6. Re-tighten the screws until the laser is firmly fixed.

Figure 3.8 - Laser Tilt Mechanism

_____

_____

Focusing the Laser

Access the 3D Camera Tools screen (Tools - Camera 3D Tools). Decrease exposure fully.
Load a board into the SP-1 at operational height. This may mean counteracting the E-stop by removing the side panel. Turn the XY table OFF if you do this.

If non-fixed focus laser, perform the following steps:
1. Using the 'Allen Key', take the line generating optics ('Laser Head') off the top of the laser by loosening the 'Head Locking Screw'.
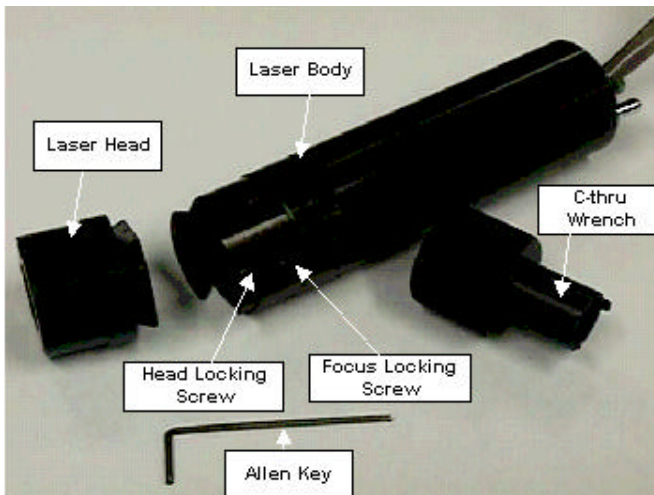

Figure 3.9 - Laser with Laser Focussing Equipment.

2. Place the 'Allen Key' on the laser body and loosen the 'Focus Locking Screw'.
3. Use the 'C-Thru Wrench' to focus the laser to as small a spot as you can. Either use the laser spot on the board or, if things are aligned correctly already, the spot size in the Align LIVE picture.
4. Once you get the spot small, de-focus it by a SMALL amount as the line generating optics alters the optical path and therefore changes the focus point. This takes trial, error and patience.

_____

_____

5. Remove the 'C-Thru Wrench' and put the 'Laser Head' back on, ensuring that the laser line has a uniform brightness along its length. If the optics is misplaced, then the line will have a bright spot at one end or the other.
6. Tighten the 'Focus Locking Screw'.

If fixed focus laser, perform the following steps:
1. Loosen the 'Laser Fastener Screw'.
2. Move the laser up and down in the 'Fastener' until the line is as thin as possible.
3. Tighten the 'Laser Fastener Screw'.

Be careful not to touch the glass surfaces of the laser, as fingerprints will blur the final image.

Aligning the Camera Image

1. Access the 3D Camera Tools screen (Tools - Camera 3D Tools)
2. Click on the "Increase Exposure" Button if the image is not bright enough. Alternatively click on the "Decrease Exposure" button option if the image is too bright.
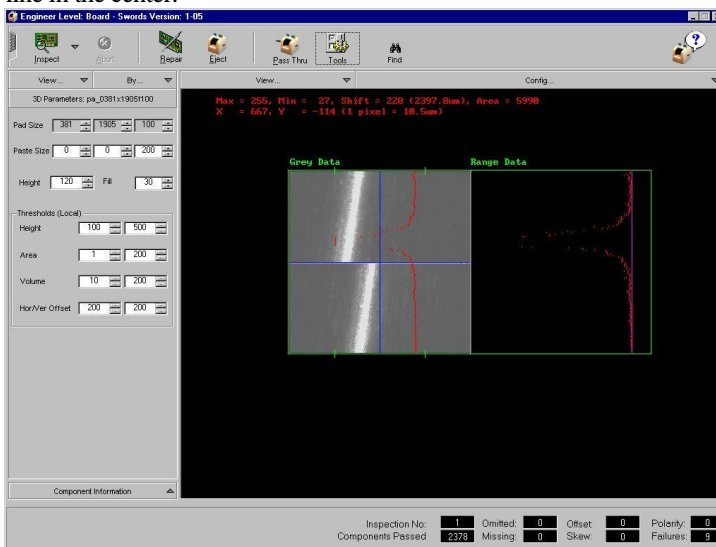3. Click on "Align Laser" button. This will split the screen view of the laser line in the center.

Figure 3.10 - The 'Align Laser' menu option

_____

_____

4.   If the laser is not lined up, loosen the 'Laser Fastener Screw' (see Fig. 3.9)
      with a 2.5-mm, allen wrench. Rotate the laser until the images align as (see
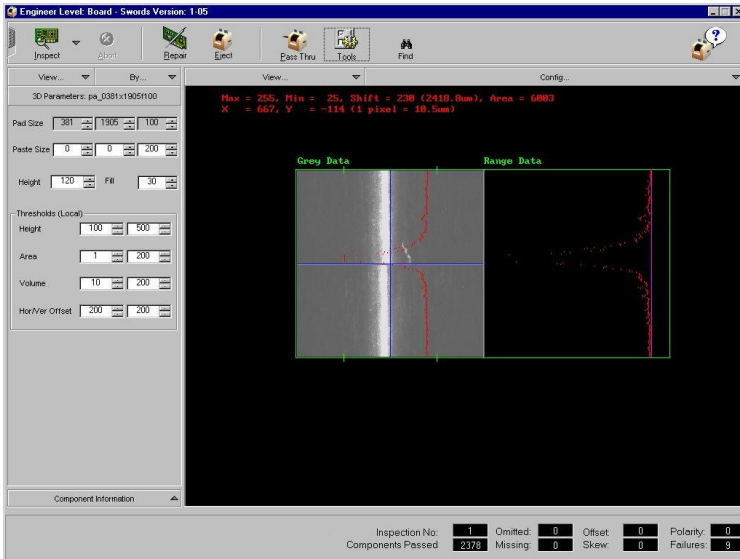   the above diagrams). Then retighten the clamp.

Figure 3.11 - After rotating the laser in its holder

3D Camera Software Calibration

The 3D camera has to be calibrated for X/Y Offset, Pixel size and Paste Height.
These require the use of a Calibration Plate (2001-0525). This is a plate with 6
inserts that simulate solder paste deposits of differing known heights (50-
300µm)..
For best results, they should be done in the order listed here.

X/Y Offset Calibration

This calibration measures a 'deposit' on the Calibration Plate in 4 directions (+ X
& Y and – X & Y). It compares these results and calculates the offset between
the 2D and 3D cameras.
Steps:
1.   Adjust the conveyor rails to accept the calibration plate.

_____

2.   Select X/Y Offset inspection template from the Boards List. The template is
      called **CalXY.**
3.   Put the system into soft stop and insert the calibration plate. Check that the
      correct template and deposit is selected, (Main Screen View Menu - Scan
      Selector).
4.   Once the system has been clamped perform a 3D-Only Inspection. This will
      help to check that the correct template has been used and that the system
      works correctly. The target pin on the Calibration plate is the 3rd on the left.
      If the laser is running across a different pin then edit the manual X,Y offset
      fields in 'Tools' (3D Calibration) and reinspect the plate. Repeat procedure
      until the laser is running across the correct pin on the Calibration plate and
      the pin appears close to center in the graphics window.
5.   Once that has been established, click on Tools - 3D Calibration to go to the
      Calibration Menu.
6.   Click on "Camera Offsets". The camera will then perform the 4 scans and
      will display the 4 scanned images in the graphics screen.
7.   The deposit must be initially offset by no more than 1mm. It can be altered
      using the X and Y keys.
8.   At the end of the scans, the X and Y offset results for each scan will appear
      on the console window.
9.   Repeat steps 6-8 until the scan results are all less than 50μm.
10.   When the desired offset is achieved recalibrate, the X/Y Offsets a couple of
      more times. The four offsets displayed should reduce to single or double
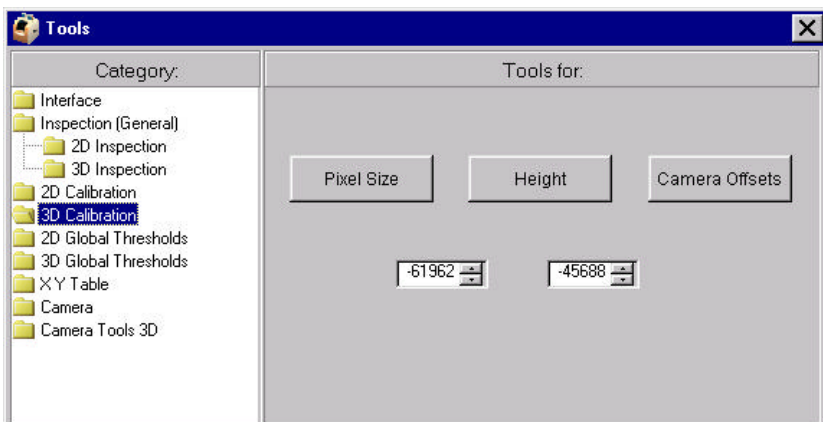   figures.

Fig. 3.12 - 3D Calibration Screen

_____

_____

Pixel Size Calibration

The purpose of this calibration routine is to calculate the pixel size. It selects a 'deposit' on the calibration plate and scans it in 4 directions. As it travels a defined distance and the deposit is of a defined size, it can easily calculate the amount traveled per pixel.

Steps:
1. Adjust the conveyor rails to accept the calibration plate.
2. Select Pixel Size inspection template from the Boards List. The template is called **CalXY.**
3. Put the system into soft stop and insert the calibration plate. Check that the correct template and the deposits are selected, (Main Screen View Menu - Scan Selector).
4. Once the system has been clamped perform a 3D-Only Inspection. This will help to check that the correct template has been used and that the system works correctly. Calibrate the X,Y Offsets if necessary (see previous section).
5. Once that has been established, click on Tools - 3D Calibration to go to the Calibration Menu.
6. Click on "Pixel Size". The system will then go through its routine and recalibrate the pixel size. Check that the images of the 'deposits' appear in the center of the search box on the graphics screen. This should be automatic once the X/Y offsets are set. The Console Output displays the change in the pixel size. Repeat the calibration until the pixel size is changing by very small amounts.

Paste Height Calibration

This routine measures the height of the 'deposits' on the calibration plate and compares them to the results that system achieves in its current set-up. It will subsequently adjust its software so that the software measurements match the actual measurements.
1. Adjust the conveyor rails to accept the calibration plate.
2. Select the Paste Height Inspection template from the 'Set PCB Type' screen. The template is called **Cal3D.**
3. Put the system into soft stop and insert the calibration plate. Check that the correct template and the deposits are selected, (Main Screen View Menu - Scan Selector). Calibrate X,Y Offset and Pixel size if necessary.

_____

_____

4.   Once the system has been clamped perform a 3D-Only Inspection. This will
     help to check that the correct template has been used and that the system
     works correctly.
5.   Once that has been established, click on Tools - 3D Calibration to go to the
     Calibration Menu.
6.   Click on "Height". The system will then go through its routine and
     recalibrate the paste height measurement.

Check the results

You can check the results by reading the file c:/cpi/data/spi.txt. This contains the
parameters that have been set in the previous calibration.
The ones to look out for are X, Y, P and H.
X & Y: these are 4 sets of values for the X/Y Offset.
X values should be between –60k and –65k.
Y values should be between –40k and –46k.
P: Pixel size. There are four values and they should be between 8.5 and
9.5 µm.
H: Paste height has two values. We are only interested in the first one.
            The first value should be between 0.05 and 0.65.

Loading New Software to 3D Imaging Head

MVT personnel load the 3D-calibration software onto the camera at their facility
before the system is shipped. However, in the unlikely event that this has to be
repeated.

Loading new software into the 3D-imaging head requires:

- A DB9 female to DB9 female cable with pins 2-3, 3-2, and 5-5
  connected.
- Hyper Terminal Software.
- Software for the 3D head - "Boot.hex".
- New Software for the 3D head - call it "SP-1-1-02a.hex.

The steps are:
1.   Exit the SP-1 software.
2.   Connect the 9 pin cable to the open Com port on the computer, and to the
     open connector on the 3D head.

_____

_____

3.   Launch Hyper Terminal -Settings: Com 1,115000 baud, 8 Data bits, no
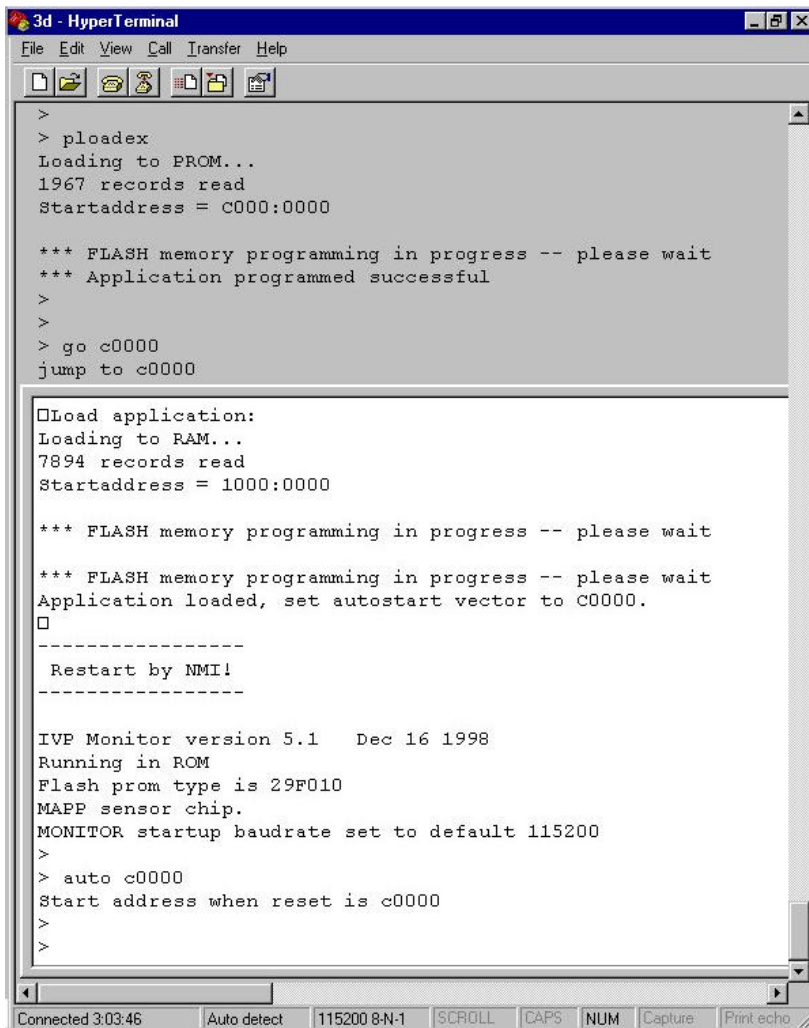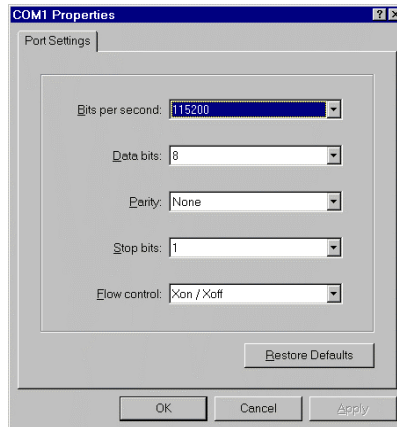   Parity, 1 Stop Bit, Xon/Xoff flow control.

Fig 3.13 – COM1 Properties

From Hyper Terminal:
4.   Press the "x" to stop the program.
5.   Enter "ploadex".
6.   From the pull down menu, select Transfer, Send Text File "Boot.hex" to the
      3D head.
7.   Enter "go c0000". This prepares the 3D head to receive new PROM
      software.
8.   From the pull down menu, select Transfer, Send Text File "SP-1-
      1.02a.hex".
9.   Enter "auto c0000", or whatever the new address is. This makes the new
      software restart every time the power is reset.

The cable may now be disconnected, and HyperTerminal can be stopped.
The power cable should also be termporarily disconnected from the 3D head to
restart the software.

_____

_____

Fig 3.14 – IVP HyperTerminal

3.9   SP-2 Calibration

> **Note: The following sections <u>only</u> apply to the SP-2 System.**

Calibrating the 3D imaging system

Calibration involves four main steps that must be performed in the order in which they are presented in the diagram below.
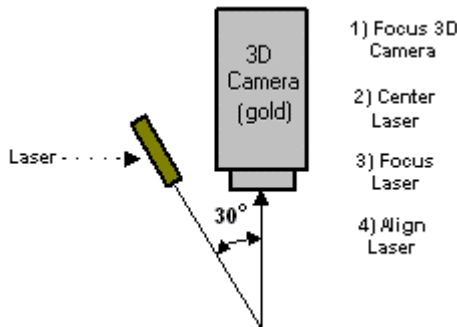The four steps require that the calibration software is loaded on the camera.

Figure 3.15 - 3D Camera Schematic

Focusing the 3D Camera

1. Load a board in the SP-2 at operational height. This may mean counteracting the E-stop by removing a side panel. Turn the XY table OFF if you do this.
2. Loosen the 'Focus Mount Locking Screw'and 'Camera Lens Lock' with a allen wrench.
3. Rotate the lens until a "sharp" image is obtained. Focus on a board feature like a pad or text. Do not focus on the top of a component or a board connector. Use a flashlight to illuminate the area where the camera is looking.

_____

4.   Tighten the camera 'Focus Mount Locking Screw' and '3D Camera Lens
     Lock' while maintaining the sharp image.
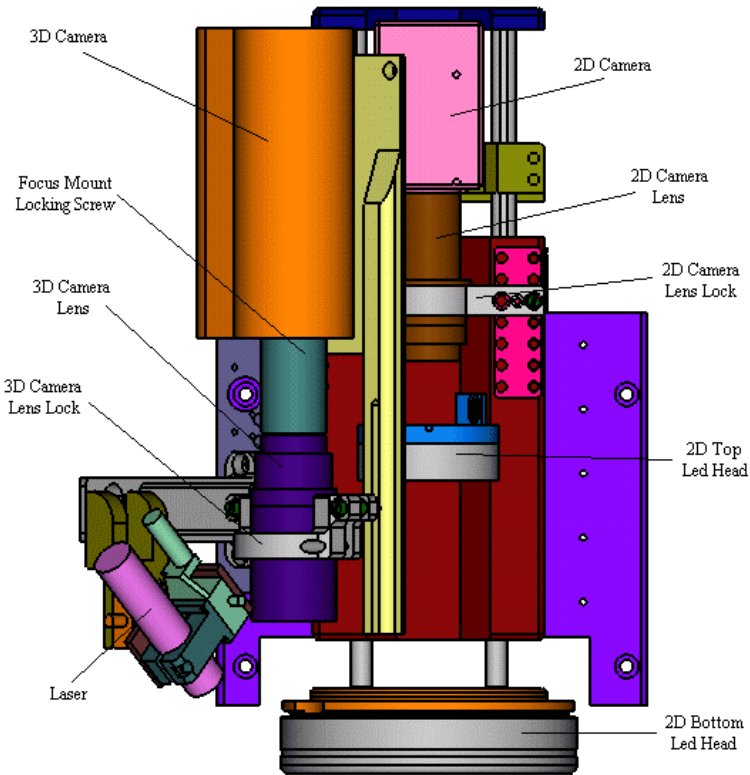5.   Set 3D lens aperture to max. open.
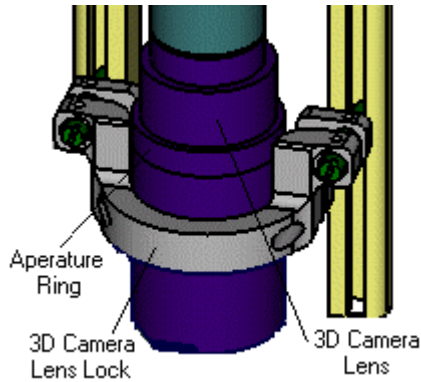

Figure 3.16 - SP-2 Camera Components

_____

_____

Figure 3.17 - 3D Camera Focusing System

Center the laser in the field of view

1. Load a board in the SP-2 at operational height. This may mean counteracting the E-stop by removing a side panel. Turn the XY table OFF if you do this.
2. Loosen the 'Rotational Locking Screws' of the laser mounting brackets (see below) with an allen wrench.
3. Rotate laser using 'Rotation Vernier' until it is centered in the camera's field of view.
4. Re-tighten the 'Rotation Locknut and Rotation Lock Screw' until the laser is firmly fixed.

_____

_____

Figure 3.18 - Laser Tilt Mechanism
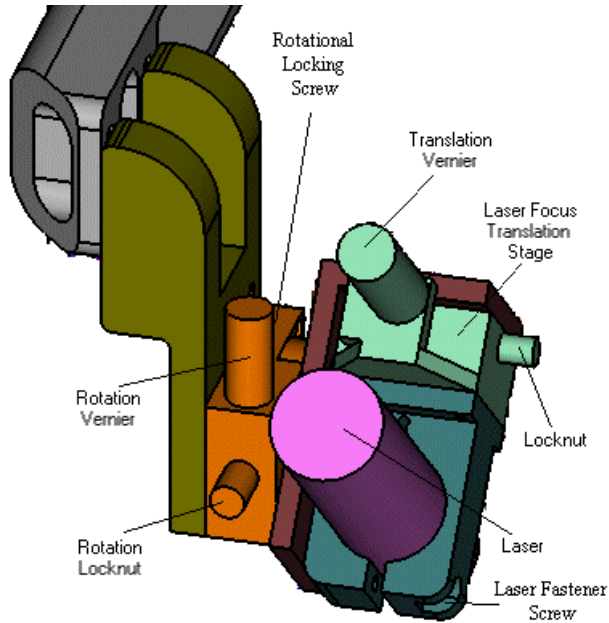
Focusing the Laser

1. Loosen the 'Laser Fastener Screw'.
2. Move the laser up and down in the 'Fastener' until the line is as thin as possible.
3. Fine tune Laser Focus with 'Line Translation Vernier Stage' (4mm - within ± 2mm).
4. Tighten the 'Laser Fastener Screw'.

Be careful not to touch the glass surfaces of the laser, as fingerprints will blur the final image.

_____

_____

Aligning the Camera Image

1. Access the 3D Camera Tools screen (Tools - Camera 3D Tools)
2. Click on "Align Laser" button. This will split the screen view of the laser line in the center.
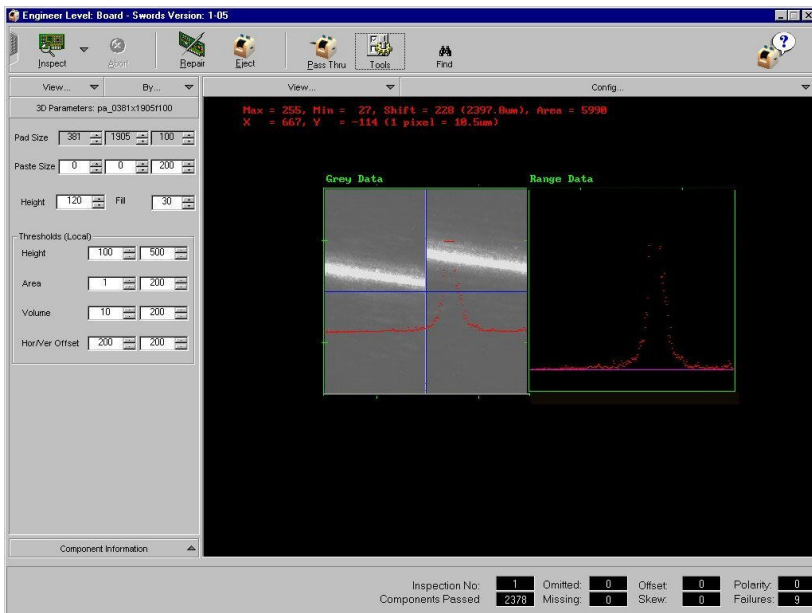

Figure 3.19 - The 'Align Laser' menu option

3. If the laser is not lined up, loosen the 'Laser Fastener Screw' with a 2.5-mm, allen wrench. Rotate the laser until the images align as (see the above diagrams). Then retighten the clamp.
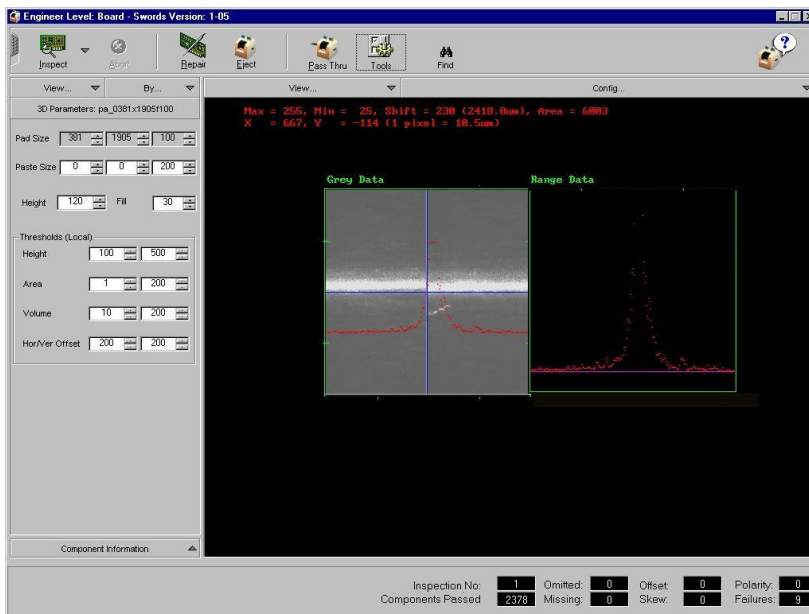
_____

Figure 3.20 - After rotating the laser in its holder

3D Camera Software Calibration

The 3D camera has to be calibrated for X/Y Offset, Pixel size and Paste Height. These require the use of a Calibration Plate (2001-0525). This is a plate with 6 inserts that simulate solder paste deposits of differing known heights (50-300µm)..
For best results, they should be done in the order listed here.

X/Y Offset Calibration

This calibration measures a 'deposit' on the Calibration Plate in 4 directions (+ X & Y and – X & Y). It compares these results and calculates the offset between the 2D and 3D cameras.
Steps:
1. Adjust the conveyor rails to accept the calibration plate.
2. Select X/Y Offset inspection template from the Boards List. The template is called **CalXY.**
3. Insert the calibration plate. Check that the correct template and deposits are selected, (Main Screen View Menu - Scan Selector).

_____

4.   Once the system has been clamped perform a 3D-Only Inspection. This will
     help to check that the correct template has been used and that the system
     works correctly. The target pin on the Calibration plate is the 3rd on the left.
     If the laser is running across a different pin then edit the manual X,Y offset
     fields in 'Tools' (3D Calibration) and reinspect the plate. Repeat procedure
     until the laser is running across the correct pin on the Calibration plate and
     the pin appears close to center in the graphics window.
5.   Once that has been established, click on Tools - 3D Calibration to go to the
     Calibration Menu.
6.   Click on "Camera Offsets". The camera will then perform the 4 scans and
     will display the 4 scanned images in the graphics screen.
7.   The deposit must be initially offset by no more than 1mm. It can be altered
     using the X and Y keys.
8.   At the end of the scans, the X and Y offset results for each scan will appear
     on the console window.
9.   Repeat steps 6-8 until the scan results are all less than 50µm.
10. When the desired offset is achieved recalibrate, the X/Y Offsets a couple of
     more times. The four offsets displayed should reduce to single or double
     figures.
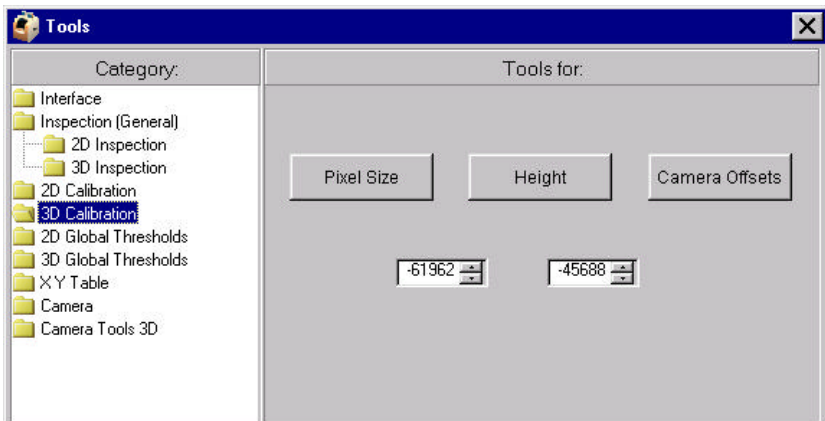

Figure 3.20 - 3D Calibration Tools

Pixel Size Calibration

The purpose of this calibration routine is to calculate the pixel size. It selects a
'deposit' on the calibration plate and scans it in 4 directions. As it travels a

_____

_____

defined distance and the deposit is of a defined size, it can easily calculate the amount traveled per pixel.

Steps:

1.   Adjust the conveyor rails to accept the calibration plate.
2.   Select Pixel Size inspection template from the Boards List. The template is called **CalXY.**
3.   Insert the calibration plate. Check that the correct template and the deposits are selected, (Main Screen View Menu - Scan Selector).
4.   Once the system has been clamped perform a 3D-Only Inspection. This will help to check that the correct template has been used and that the system works correctly. Calibrate the X,Y Offsets if necessary (see previous section).
5.   Once that has been established, click on Tools - 3D Calibration to go to the Calibration Menu.
6.   Click on "Pixel Size". The system will then go through its routine and recalibrate the pixel size. Check that the images of the 'deposits' appear in the center of the search box on the graphics screen. This should be automatic once the X/Y offsets are set. The Console Output displays the change in the pixel size. Repeat the calibration until the pixel size is changing by very small amounts.

Paste Height Calibration

This routine measures the height of the 'deposits' on the calibration plate and compares them to the results that system achieves in its current set-up. It will subsequently adjust its software so that the software measurements match the actual measurements.

1.   Adjust the conveyor rails to accept the calibration plate.
2.   Select the Paste Height Inspection template from the 'Set PCB Type' screen. The template is called **Cal3D.**
3.   Insert the calibration plate. Check that the correct template and the deposits are selected, (Main Screen View Menu - Scan Selector). Calibrate X,Y Offset and Pixel size if necessary.
4.   Once the system has been clamped perform a 3D-Only Inspection. This will help to check that the correct template has been used and that the system works correctly.
5.   Once that has been established, click on Tools - 3D Calibration to go to the Calibration Menu.

_____

_____

6.   Click on "Height''. The system will then go through its routine and
     recalibrate the paste height measurement.

Check the results

You can check the results by reading the file c:/cpi/data/spi.txt. This contains the
parameters that have been set in the previous calibration.
The ones to look out for are X, Y, P and H.
X & Y: these are 4 sets of values for the X/Y Offset.
X values should be between –60k and –65k.
Y values should be between –40k and –46k.
P: Pixel size. There are four values and they should be between 7.5 and
9.5 µm.
H: Paste height has two values. We are only interested in the first one.
           The first value should be between 0.05 and 0.65.

Loading New Software to 3D Imaging Head

MVT personnel load the 3D-calibration software onto the camera at their facility
before the system is shipped. However, in the unlikely event that this has to be
repeated.

Loading new software into the 3D-imaging head requires:

- A DB9 female to DB9 female cable with pins 2-3, 3-2, and 5-5
  connected.
- Hyper Terminal Software.
- Software for the 3D head - "Boot.hex".
- New Software for the 3D head - call it "SP-2-1-02a.hex.

The steps are:
1.   Exit the SP-2 software.
2.   Connect the 9 pin cable to the open Com port on the computer, and to the
     open connector on the 3D head.
3.   Launch Hyper Terminal -Settings: Com 1,115000 baud, 8 Data bits, no
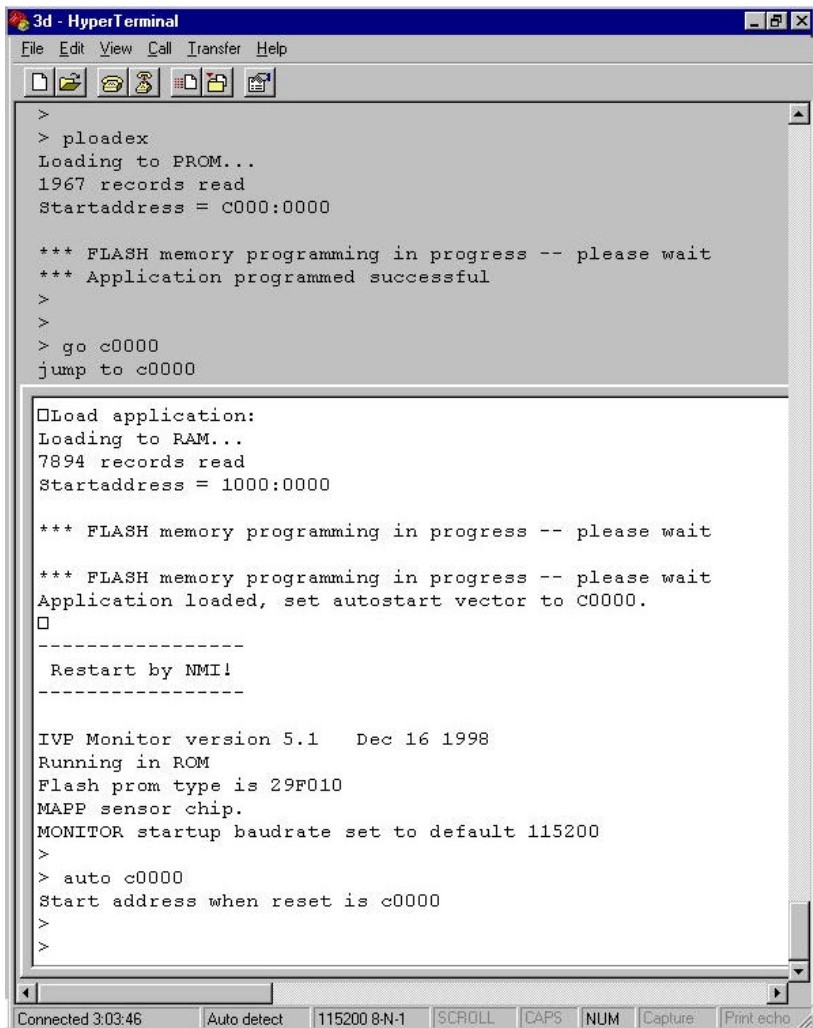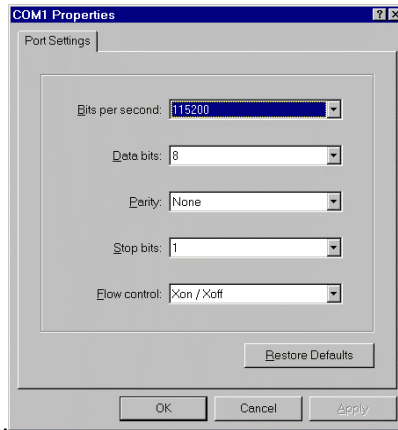   Parity, 1 Stop Bit, Xon/Xoff flow control.

_____

_____

Fig 3.13 – COM1 Properties

From Hyper Terminal:
4.   Press the "x" to stop the program.
5.   Enter "ploadex".
6.   From the pull down menu, select Transfer, Send Text File "Boot.hex" to the
     3D head.
7.   Enter "go c0000". This prepares the 3D head to receive new PROM
     software.
8.   From the pull down menu, select Transfer, Send Text File "SP-2-
     1.02a.hex".
9.   Enter "auto c0000", or whatever the new address is. This makes the new
     software restart every time the power is reset.

The cable may now be disconnected, and HyperTerminal can be stopped.
The power cable should also be termporarily disconnected from the 3D head to
restart the software.

_____

_____

```
3d - HyperTerminal                                                    _ B X
File  Edit  View  Call  Transfer  Help

   >
   > ploadex
   Loading to PROM...
   1967 records read
   Startaddress = C000:0000

   *** FLASH memory programming in progress -- please wait
   *** Application programmed successful
   >
   >
   > go c0000
   jump to c0000

   □Load application:
   Loading to RAM...
   7894 records read
   Startaddress = 1000:0000

   *** FLASH memory programming in progress -- please wait

   *** FLASH memory programming in progress -- please wait
   Application loaded, set autostart vector to C0000.
   □
   ------------------
    Restart by NMI!
   ------------------

   IVP Monitor version 5.1   Dec 16 1998
   Running in ROM
   Flash prom type is 29F010
   MAPP sensor chip.
   MONITOR startup baudrate set to default 115200
   >
   > auto c0000
   Start address when reset is c0000
   >
   >

Connected 3:03:46    | Auto detect | 115200 8-N-1 | SCROLL | CAPS | NUM | Capture | Print echo
```

Fig 3.14 – IVP HyperTerminal

_____