



SP-1 Operator Mode Manual

SP-1 SOLDER PASTE INSPECTION SYSTEM

SP-1 Operator Mode Manual

Revision 2.0

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Revision History

Rev.	Nature of Change	Author	Date
1.0	New Release	P. Browner	Sept '99
2.0	Changes made to Rev. 1.0. Note: Important change made to P13.	L.Stapleton	November '99

Chapter 1

Introduction

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Summary

This chapter gives a general introduction to the SP-1. It outlines what the system does; what it measures; its key characteristics; and its functional components.

SP-1 Overview

The SP-1 is an in-line solder paste inspection system designed to detect incorrectly placed solder paste on printed circuit boards (PCBs). The SP-1 can provide 100% 2D paste inspection and sampled 3D paste inspection.

The 100% 2D inspection detects stencil misalignment and area fill defects caused by random errors such as blocked apertures, low paste on the stencil, and dry paste.

The 3D-paste measurement identifies systematic errors leading to paste height/volume problems. This unique combination is sufficient to detect all paste-related problems.

Problem Type	Measurement Type
Open joints	Volume 3D
Paste profile	Height 3D
Missing/insufficient paste	Area 2D & 3D
Stencil misalignment	X/Y offset 2D
Smears	Area 2D
Bridging	2D

Table 1.1

In addition to carrying out an inspection the SP-1 2D/3D system also provides all the measurement data necessary for Statistical Process Control (SPC). The SP-1 utilises its powerful SPC software with these measurement results to allow process engineers to characterise and calibrate the solder paste printing process.

SP-1 Functional Components

Figure 1.1 displays the SP-1s main functional components. Figure 1.2 displays the location of the two main control panels.

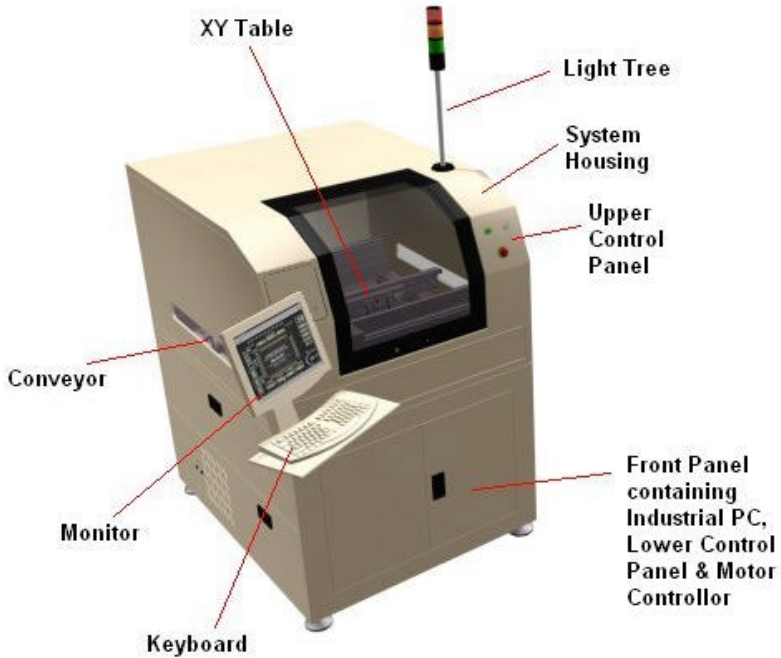


Figure 1.1 SP-1 main functional components

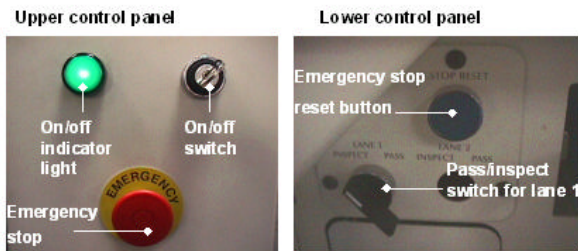


Figure 1.2 upper and lower control panel layout

Operator Tasks

An SP-1 operator has a number of important tasks to perform on the SP-1. Make sure that the machine is running correctly and that there are no software or hardware faults.

1. Load new PCB types and release boards from the machine to a downstream machine.

If operators want to inspect a new board type they must load the correct CAD. (file specifying the positions and size of the paste deposits) onto the SP-1. They can also release defective boards from the SP-1 and send them to a repair station.

2. Notify an Engineer if the SP-1 cannot inspect a board.

The SP-1 will not be able to inspect a board if it cannot find the fiducials (reference points) on a board.

3. Examine all solder paste defects to verify that they are genuine. Mark all non – genuine errors as **False Failures**.

If the SP-1 detects board errors then the operator must view each error in turn on the monitor to verify that these errors are genuine. If an error is not genuine then the operator must mark this as a **False Fail**.

Chapter 2

SP-1 Safety Features

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Summary

This chapter describes the various safety features that are incorporated into the machine to provide a safe environment for the operator.

The machine is designed so that during normal operation the user is never required to work in, or be exposed to hazardous situations where they could cause harm to themselves or others.

IMPORTANT

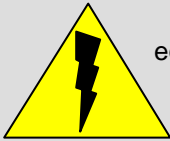
In the interests of safety, everyone should read this chapter before they operate or work on this system.

2.1 Electrical Safety



Warning: Lethal Voltage
 Dangerous voltages exist in this equipment. Ensure that all electrical enclosure covers are fitted and intact before operating the equipment.

Electrical Enclosure



WARNING: LETHAL VOLTAGE
 Dangerous voltages exist in this equipment. Ensure that all electrical enclosure covers are fitted and intact before operating the equipment.

All live power and control circuits are installed in an enclosure to reduce the risk of direct contact with live parts (as defined in 60204-1:1992, 6.2.1 a & b). It is positioned to the rear of the machine.

The main electrical enclosure provides further protection by interlocking the access door of the enclosure with the safety circuit. The enclosure door will not open until the user activates the interlocking device.

Activation of the lockable interlocking device removes power from all of the internal circuitry except the primary side of the mains contactor. This is clearly labeled and protected by a non-conducting cover.

The low voltage control gear in the pneumatics panel is also protected in a labeled enclosure behind 'Fixed Guard'. 'Fixed Guards' protect all other low voltage circuits.

The fixed guards should only be removed in an emergency or while performing installation, maintenance and calibration procedures outlined in the Hardware Manual (5000-0088).

Emergency Stop Loop

The Emergency Stop (or E-Stop) shuts down powered mechanisms that may cause harm to the user, during emergency situations. This machine has many modes of operation. The E-Stop can override each mode.

The E-Stop on this machine is clearly visible and identifiable. It is at the front right hand side of the machine. To activate the Emergency Stop- push down on it once (See Figure 1.2).

Raising the front hood door also activates the E-Stop. However it is recommended that the user should push down the E-Stop button before opening the hood door.

The user can only start or restart this machine with the proper controls. It is important to use the correct Power Up Sequence.

Note: The E-Stop on this machine is designed to meet the harmonised European standard for safety of machinery - electrical equipment EN 60204-1.

Power up Sequence to restore from 'E-Stop' Situation

- 1 Pull out the E-Stop button until it stays up.
- 2 Press the E-Stop reset switch as shown in Figure 1.2.

Note: An E-stop condition is automatically detected by the system and a message is displayed on-screen. Click on the OK button to clear the message.

No Uncontrolled motion on restart.

When power is removed from the system it defaults to its safe mode. On restoration of supply the safety relay will not re-close contacts until the power up sequence has been undertaken. This ensures that uncontrolled motion of X-Y table or conveyor is impossible without the operator resetting the power.

Earth Bonding

All external metal surfaces are mechanically and electrically bonded to the machine earth point. The bonding wire used is identified by its green and yellow insulation and is commonly used to earth bond throughout. Never remove or cut these wires and if you should find a cut or damaged connection, do not operate the machine and inform a technician immediately.

2.2 Laser Safety

The 3D ranging camera uses a class II semiconductor laser. Do not stare directly into the laser beam. Doing so could cause total or partial blindness.

The laser is wired into the E-Stop loop. Pressing the E-Stop button or raising the front hood door will automatically shut off power to the laser assembly and turn the beam off.



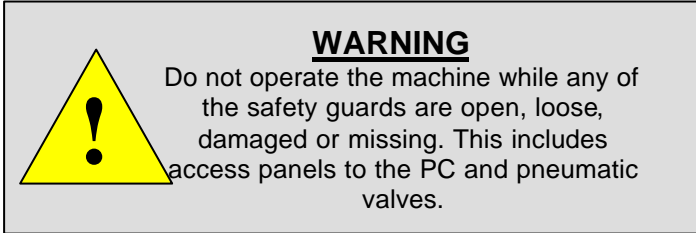
WARNING: LASER EQUIPMENT

This equipment contains class II laser equipment. Do not stare into the beam.

2.3 Protective Guards

MVT equipment is fitted with a set of protective guards that fully enclose any moving and electrical mechanisms that may harm the user and others during normal use.

On MVT equipment, fixed and moveable guards conform to the appropriate international safety standards.



2.4 Safety Warnings

Safety Devices

The safety features designed into this machine are designed to protect both operators and technicians.

MVT strongly recommend that Safety devices and interlocks are never overridden.

Conveyor safety

Do not touch the conveyor while it is running or if it is jammed while the machine is on. Touching the conveyor may cause friction burns or damage and or loss of limbs.

X-Y Gantry

The X-Y table is a solid metal assembly and can move at 1.5 m/s. It can cause severe impact or crush injury. Protective Guards are designed to prevent access to areas where this potential injury may occur.

Do not operate the machine while any of the safety guards are open, loose, damaged or missing.

Stability

This machine weighs approx. 1,500 kg, and has a low center of gravity.

**Do not attempt to lift or tip the machine at either end or side, as you will damage both the machine and your back.
Don't EVEN DO IT WITH THE HELP OF OTHERS!**

Lethal Voltages

Dangerous voltages exist in areas of this machine.

Ensure that all electrical enclosure covers are fitted and intact before operating the equipment.

Falling Objects

Ensure that the monitor(s) are secure on top of the hood so that there is no possibility of them falling during normal use of the machine. Do not store boards, equipment, stencils etc. on top of the machine.

Chapter 3

SP-1 Inspection Cycle

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Summary

This chapter describes the normal SP-1 inspection cycle. It outlines how to start the machine, chose the correct program, and what to do if a board passes or fails inspection.

General Inspection

There are three possible inspection modes for the SP-1: 2D inspection, 3D inspection, or a combination of both.

2D Inspection

You can set the system to conduct a 2D inspection only. In 2D mode the machine will inspect every board that passes through it. If the SP-1 does not find any board defects it will automatically release the board after the inspection.

If the machine detects 2D board defects during inspection then it will not release the board and the 2D Action on Failure screen will display. This screen provides the operator with various options such as reinspecting the errors to make sure they are genuine and saving images of failed components .

3D Inspection

You can set the system to conduct a 3D inspection only. This is considerably slower than a 2D Inspection so an engineer may specify that a sample of boards (e.g. every fourth or fifth) is inspected in 3D. If no board defects are detected during inspection then the machine will automatically release the board after inspection. However if the machine finds board defects then it will not release the board and the 3D Action on Failure menu will display on the screen. This menu has similar options to the 2D Action on Failure menu.

2D and 3D Inspection

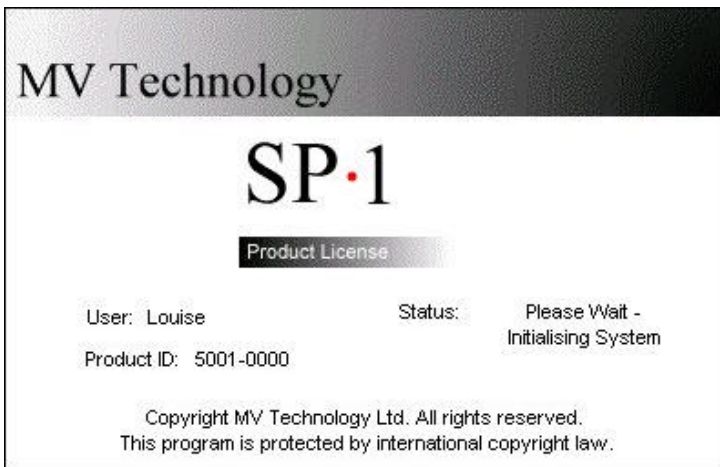
The system can be set up so that both 2D and 3D inspection are run on the same board. Every board entering the machine will be inspected in 2D. However, in 3D mode, an engineer will have programmed whether every board or a sample is to be inspected.

The 2D inspection of the board is always performed before the 3D inspection. Similarly if 2D and 3D board defects are detected then the 2D Action on Failure screen is displayed before the 3D Action on Failure Screen.

3.2 How to Startup / Login

Carry out the following procedure to startup the SP-1:

- 1 Ensure the front safety door is closed.
- 2 Ensure the Emergency Stop button is OFF.
- 3 Switch the rear system power switch to ON.
- 4 Switch the front system power key to ON. A green light will be lit.
- 5 Ensure the XY table power is on by checking that the LEDs (green lights) are lit on the Motor Controller Panel.
- 6 Switch the computer on. The system will take about 2 minutes to boot up.
- 7 Login to system:
 login name: **cpi**
 password: **cpi602**
 Login and Password are case (<Caps Lock>) sensitive.
- 8 Double-Click the SP-1 icon on the Desktop



- 9 System XY table will home on start-up.

Adjusting the conveyor rail width

An operator may have to adjust the conveyor rail width to accommodate a new board through the SP-1.

- 1 Press the E-Stop.
- 2 Open the front hood door.
- 3 Loosen the 2 thumbscrews fastening the conveyor rail in place.
- 4 Adjust the conveyor rail width until the board can travel along either end of the conveyor rail.
- 5 Tighten the thumbscrews to fasten conveyor rail in place.
- 6 Close the hood door and press the Emergency Stop Reset button (refer to fig.1.2).

3.3 Task Chooser

After login, the screen (shown below) will be displayed.

Note: This screen may be disabled in which case the "Choose File" screen will appear (see next section).

1. Click on the **Inspect Boards** icon. 

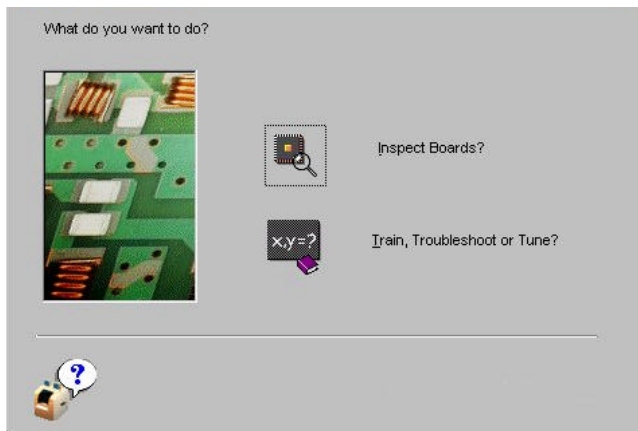




Figure 3.1 SP-1 Task Chooser

The  option is only available to Engineers and is password protected.


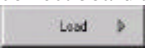
An operator can open a help file by using the mouse to click on the  button.

Choose File

The operator can select the board type to inspect from the "**Board Select**" menu (see Figure 3.2). The operator must click on the "*Board Select*" button from the upper toolbar to bring up this menu

If no board is selected from the list of boards displayed then the last board type inspected will be automatically loaded.

The operator should:

1. Click on the  button on the upper toolbar.
2. Click on the correct board type.
3. Click on the  button.

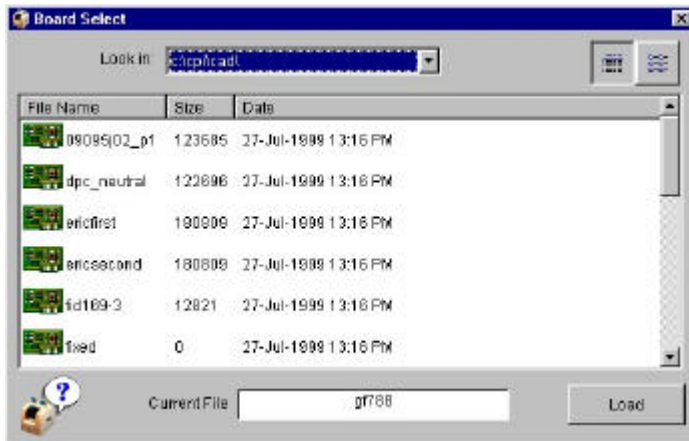


Figure 3.2 Board Select Menu

3.5 SP-1 Inspection

After you load the correct board CAD the SP-1 is ready to begin inspecting inspection and the screen will display a status message. When a board activates the entry sensor on the SP-1, the screen displays a message indicating that there is a board available for inspection.

The SP-1 will then look for the board fiducials, which are used by the SP-1 to align the XY coordinate system of the SP-1 to that used by the paste placement machine.

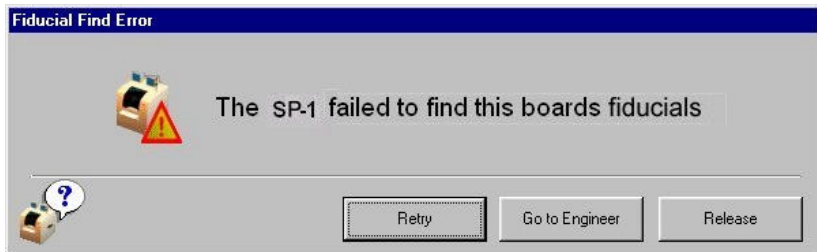
Two outcomes are possible:

SP-1 does not locate fiducials

SP-1 locates fiducials

SP-1 Does Not Locate Fiducials

In the unlikely event that the SP-1 does not find the fiducials, the system will display an error message. It gives the operator three options.



1. The operator should click on the retry button to retry finding the fiducials.
2. If this fails then the operator should report it to an engineer of technician.
3. If they are not available then the operator should select the release button to release the board from the system.

Note: The "Go to Engineer" option is password protected and is only available to engineers.

SP-1 Locates Fiducials







When the machine locates the fiducials it will automatically start inspecting the board. The screen will show the board images as they are inspected.

SP-1 detects PCB errors

If the SP-1 detected errors on the board during inspection then the board will not be released from the system. Instead the board is clamped until the operator views each error in turn to verify that these errors are genuine. The operator must then release the board to a downstream machine such as a Repair Station.

Note: Reinspect all board defects from the Action on Failure Menu to verify that they are genuine.

The procedures for carrying out the action on failure options and tasks are documented in the following Chapters

-   2D Action on Failure options – Ch. 4
-   3D Action on Failure options – Ch. 5
-   2D & 3D Action on Failure options – Ch. 6

Graphical Display

After a board is released from the SP-1, either automatically by the SP-1 (when no board errors are detected) or manually by an operator (board defects are detected), the screen displays a graphical analysis of the board until the inspection is complete and the next board enters the machine.





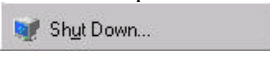
Note: Wait until another board enters and the SP-1 starts inspecting.



Figure 3.3 Graphical display after board is released from system

3.8 How to Shutdown

Carry out the following procedure to shutdown the SP-1:

- 1 Click on the  button on the top right hand corner of the screen
- 2 Click on the "Yes" button on the dialogue box that appears.
- 3 Shut down the computer.
 -  Move the mouse pointer over the  Button on the main Windows toolbar and click the left mouse button to reveal the Start menu options.
 -  Select the  option to shut down the PC.
- 4 Switch off the PC.
- 5 Turn the main system power key to "Off".

Chapter 4

2D Action on Failure Cycle

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Summary

This chapter outlines all the 2D AOF options and operator tasks.

- 1 Section 4.1** describes the various AOF options and graphical displays.
- 2 Section 4.2** describes genuine 2D board defects and shows the operator how to spot defects that are not genuine-"false fails".
- 3 Section 4.3** details the 2D AOF procedure that an operator should carry out once the 2D AOF menu is displayed.

Note: Read Sections 4.1 and 4.2 carefully so that you will be able to carry out the procedure described in 4.3.

4.1 2D Action on Failure Options

If board errors were detected by the SP-1 then the following statistics and options are initially displayed on screen

1. **Initial error images display**
2. **Main AOF screen**
3. **Component Information screen.**

Initial error image display

After a 2D inspection the screen displays images of the failed deposits (see below).

By default the maximum number of images that can be saved on screen is 12.

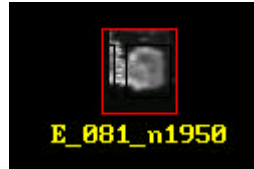
However, there may be more defects present on the board then there are initially displayed on screen.



Figure 4.1 2D AOF Display

Images are saved under the following format:

E_Rep File Number_Deposit
reference designator
e.g., E_081_n1950 as shown.



Main AOF screen

Select "**Next Error**" on the upper toolbar to bring up the 2D AOF Screen.

The Main AOF screen comprises 3 parts:

- 1 The main **Graphics Screen** showing the camera view of the paste deposits on the board.
- 2 The **Upper Toolbar** containing various functional buttons.
- 3 The **Statistics Bar** displaying various inspection statistics.

Graphics Screen

This displays the camera view of defective paste deposits.

Once the "*Reinspect*" button is selected the following information is also displayed:

Various colored boxes are displayed over the defective image.

Another image of the deposit is displayed to the right of the main image.

An error message is displayed detailing the reason for the deposit failure.

Upper toolbar



- Next Error:** Brings the user to the next failed deposit detected during inspection.
- Previous Error:** Returns the user to the previously inspected paste deposit that you viewed.
- Repair Board:** Sends the board to a repair station where the board defects can be re-examined and repaired.
- Release Board:** Releases the board from the SP-1.
Note: If there is a repair station located after the SP-1 and you select the "*Release Board*" option then the board will not stop for repair in the repair station.



Brings up the context sensitive Help file. This will be available in future SP-1 releases.

Lower status toolbar

This displays various inspection-related statistics.

Inspection No:	1	Omitted:	0	Offset:	0	Polarity:	0
Components Passed:	3845	Missing:	0	Skew:	0	Failures:	687

- Inspection No:** The number of inspections that have been run on the machine since you started using the software.
- Components Passed:** The total number of paste deposits that have successfully passed inspection.
- Omitted:** The number of paste deposits that an engineer has decided are to be skipped from inspection
- Missing:** The total number of missing (LoPaste) paste deposits.
- Offset:** The number of deposits that are positioned offset from their desired position.
- Failures:** The total number of failures on the Board.

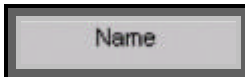
Note: The "Polarity" and "Skew" fields are not relevant.

2D Deposit Information tab



The Deposit Information Tab provides the operator with various inspection-related statistics and options. In particular, it enables operators to reinspect a paste deposit and mark it as a false fail if it is not a genuine error.

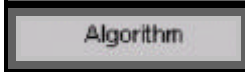
Figure 4.2 Component Information tab



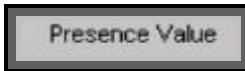
The deposit Reference Designator, which specifies the unique location of the deposit on the board.



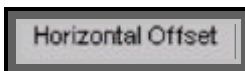
This is a group of components with different names but with the same physical properties.



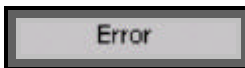
The name of the 2D algorithm that the system uses to locate solder paste. This algorithm always has the same format
 $pa_number1 * number\ 2\ fnumber\ 3$
 e.g. $pa_0610xf079$



This value shows how much of a deposit is present. A value of 1000 means that 100% of the paste deposit is present (divide by 10). Values of 900 and 1100 means that 90 percent and 110% percent of the deposit is present.



This value (in microns - 1 millionth of a meter) shows the distance from the actual center of the paste deposit to its CAD position.



This displays the current error type.



This command allows the user to reinspect the current failed deposit. The component information tab will be automatically updated once this is selected. In addition coloured boxes will be displayed over the defective deposit, and a second camera image of the deposit will display immediately to the right of the main image (see section 4.2)



This allows the user to mark a false fail if the SP-1 incorrectly marks a deposit as being defective when in fact the deposit is good. This may occur if the 2D parameters or thresholds have been incorrectly set. When this option is selected the user is required to type in a reason for the false failure. See Section 4.2.

2D Algorithm

The 2D system basically works as follows:

The screen print stencil has the correct location and size of the paste deposits on the board.

The SP-1, using camera images and vision algorithms, determines the actual location and size of the deposits.

By comparing the supposed size and location of the deposits with the actual size and location it can determine if a deposit passes or fails inspection.

The 2D system uses a camera to take 2 images of paste deposits on the board.

The system uses the difference in brightness between the paste and pad (on which the paste is deposited) to determine which is paste and which is pad. Once a deposit is reinspected using the "Reinspect" button the 2 camera images are displayed on screen side-by-side (see below).

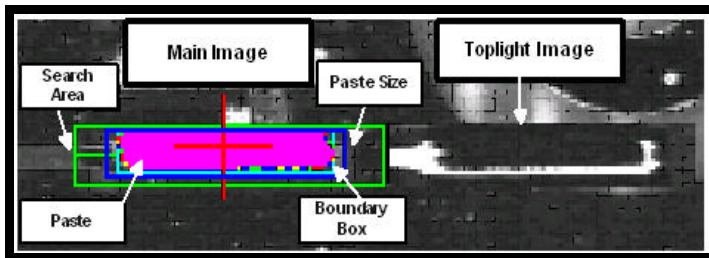


Figure 4.3 2D AOF error image display

Main Image

In the main camera image. The pink area represents the amount of paste calculated by the algorithm. Bright yellow, green, red, and blue dots (pixels) represent areas on the deposit that are just below the paste threshold.

Paste Size X and Y - this dark blue box represents the actual size that the paste deposit is supposed to be.

Bounding Box-this light blue box the smallest box that can be drawn around the paste.

Search Area (Green box) - this box represents the area where the algorithms will look for the paste deposits. The paste deposit should be in the centre of this box.

Bridging box - this yellow box is used for bridging. If enabled -Bridging is a fault where a continuous line of paste joins two adjacent paste deposits.

Toplight Image Display

The toplight camera image always displays immediately to the right of the main image.

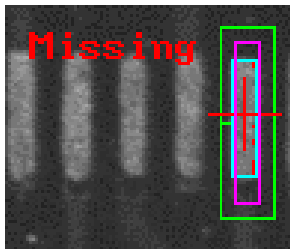
☞☞ Pads appear as white areas in the toplight image.

☞☞ Paste deposits appear as dark areas on the toplight image.

The toplight image is very useful in determining if the correct 2D thresholds are being used.

2D board defects

The following errors are genuine errors that the SP-1 can detect on the board.



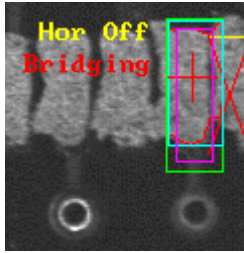
Missing paste

The white paste area is significantly smaller than the blue box (supposed area of paste). In this case a "Missing" error is flagged by the system.



Horizontal or vertical offset

The paste is present but not centered in the middle of the green Search box. It has been placed horizontally and/or vertically offset from the required position.



Bridging

There is a continuous line of white paste that joins 2 adjacent paste deposits.



Too much paste

The white paste area is significantly larger than the blue box. As a result a "Too Much Paste" error is flagged.

2D False Errors

Unless you program the 2D setup correctly (includes Algorithms, thresholds and optics) the SP-1 will register false 2D board errors. False errors can result from:

- ✘ Incorrectly set thresholds.
- ✘ Incorrect CAD.
- ✘ Search Area too small for bridging.
- ✘ Incorrect optical setup.

Incorrect thresholds

Verifying that the paste or pad thresholds are set correctly involves comparing the main deposit image with the toplight deposit image. The areas designated as paste, (pink areas) in the main image should match up with the dark areas in the toplight image. This occurs in Figure 4.4.

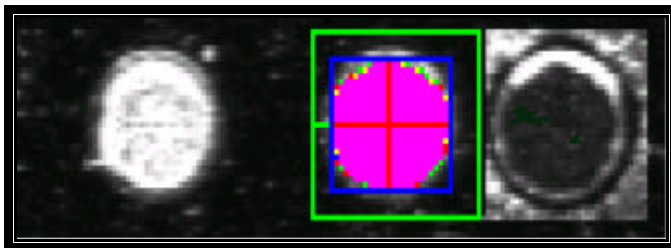


Figure 4.4 Blob Thresholds set correctly

However, Figure 4.5 shows an incorrectly flagged "Missing" error. It is obvious from the toplight image that there is no paste missing. The user would expect all

areas in main image to be pink but they are not because an engineer has set an incorrect threshold. In this case the user would mark an "Incorrect Thresholds" false failure.

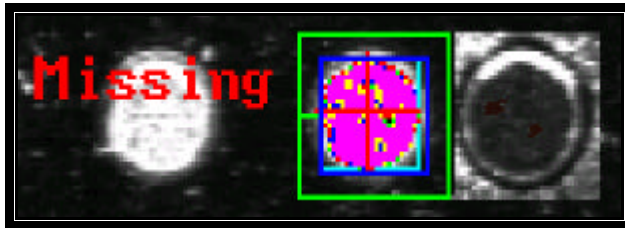


Figure 4.5 False failure due to incorrectly set thresholds

Incorrect CAD

The Algorithm expects to find the paste deposit contained in an area Paste X and Paste Y (dark blue box). This Paste Size information is directly taken from the size of the stencils used to deposit the paste. This information is contained in the SP-1 CAD file and automatically used by the SP-1 for the Paste Size X and Y. However if some of the CAD is wrong then possible false errors will be detected on the Board.

Figure 4.6 shows a "Too much Paste" error. It is obvious that the Paste Size bounding box (dark blue box) is significantly smaller than the deposit and corresponding deposits of the same type. Enlarge this box to its correct size to clear the error.



Figure 4.6 Blue Paste box too small

Figure 4.7 shows a "Missing" error. However it is obvious that the Paste Size bounding box (dark blue box) is significantly larger than the deposit and corresponding deposits of the same type. Figure 4.8 below shows how the blue paste size box should appear.

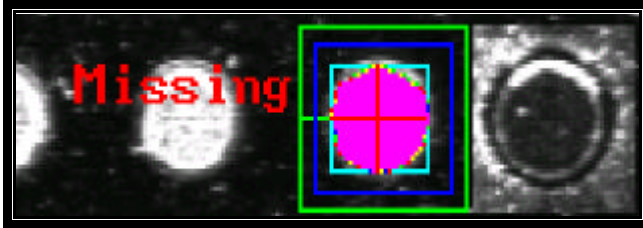


Figure 4.7 False failure because blue paste box too large

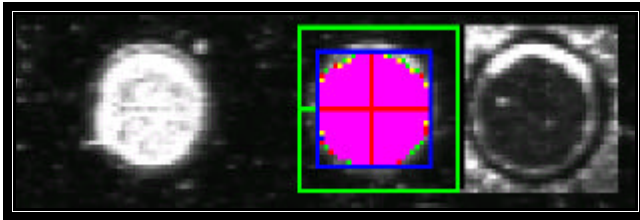


Figure 4.8 Blue paste box correct.

False bridging error

A genuine bridging error occurs when a continuous line of paste travels from one paste deposit to one next to it. This does not occur in Figure 4.9 and yet a bridging error has been flagged. The paste (white line) almost travels all the way to the next paste deposit but does not actually make contact with the deposit. In this case the user should flag a "False Bridging Error".

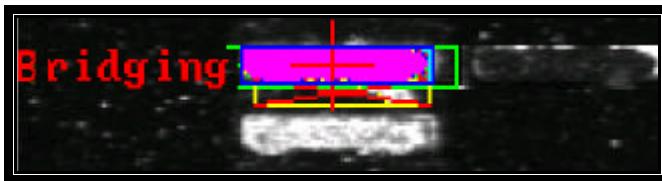



Figure 4.9 False bridging error


4.3 Operator tasks in 2D AOF

The operator should carry out the following procedure once 2D errors have been detected by the SP-1 and the 2D Action on Failure screen is displayed.

1. Examine the errors to confirm that they are genuine.
 - ?? Go through each error to be inspected using the "Next" button
 - ?? Reinspect each board defect using the "Reinspect" button.
2. If you encounter a false fail
 - ?? Report the false fail to an engineer and/or
 - ?? Mark error as false fail if this option is enabled.
 - ?? The choice should be dictated by company policy.
3. Mark any false failures on the board by clicking on the "False Fails" button. When the false failure dialog box appears, type in a reason and then click on the "Okay" button.
3. After sorting through the errors on the PCB the operator can click the appropriate icon to either:
 - 
 - 4. Send the board to a repair station

or

b) Release the board from the SP-1



Repeat steps 1 to 4 when the machine inspects the next board.

Chapter 5

3D Action on Failure Cycle

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Summary

Read sections 5.1 and 5.2 carefully so that you will be able to carry out the procedure described in Section 5.3.

This chapter has 3 sections that document all the 3D AOF options and operator tasks.

- 1 Section 5.1** describes the various AOF options and graphical displays.
- 2 Section 5.2** describes genuine 3D board defects and shows the operator how to spot defects that are not genuine, i.e., "false fails".
- 3 Section 5.3** details the 3D AOF procedure that an operator should carry out once the 2D AOF menu is displayed.

3D action on Failure Options

If the SP-1 detects 3D errors then it displays the following statistics and options on the screen.

- 1 3D AOF screen
- 2 3D AOF Deposit Information tab

Note: If the system finds 2D and 3D defects the 2D AOF screen will display before the 3D AOF screen.

3D AOF screen

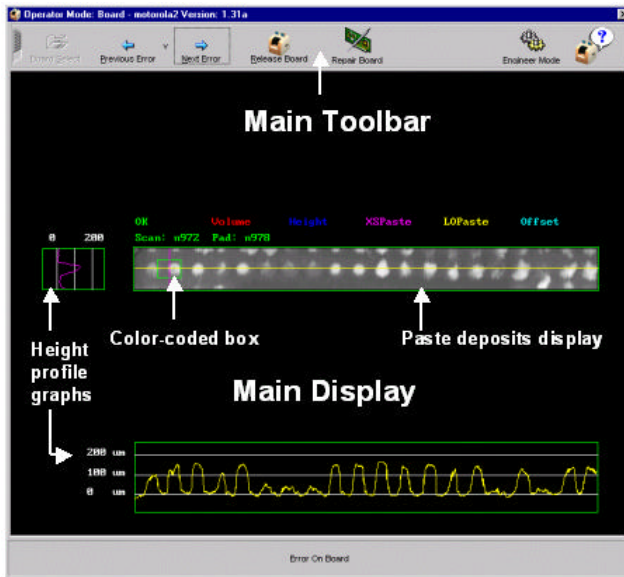


Figure 5.1 3D AOF screen

The Main AOF 3D screen appears automatically after an inspection that detected 3D board defects. The Main AOF screen comprises 2 parts: the *Upper toolbar* and *main graphical display*

Upper AOF Toolbar

The toolbar options in the 3D screen are the same as those in the 2D AOF menu.



- Next Error:** Brings the user to the next failed deposit detected during inspection.
- Previous Error:** Returns the user to the previously inspected paste deposit viewed using the "Next" button.
- Help:** Brings up the context sensitive Help file.
- Repair Board:** Sends the board to a repair station where the board defects can be re-examined and repaired.
- Release Board:** Releases the board from the system.
- Engineer Mode:** Allows the user to go from the 2D operator AOF menu to the 2D engineer AOF menu. This option is password protected and only for Engineers.

Main Display

The main display comprises the *Paste deposit display* and the *Height profile graphs*

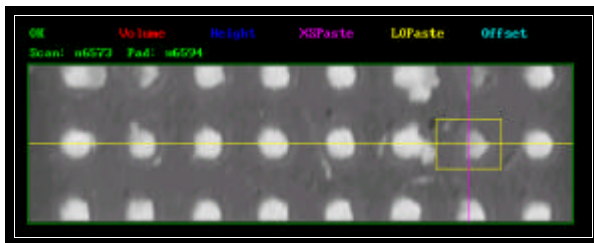


Figure 5.2 Paste deposit display

The screen displays a height profile of the board that includes a colored search box centered on a paste deposit. The colour of the Search Boxes lined over the paste deposits reveals the status of the paste deposits. Directly above the camera view of the board is a guide that reveals the association between color and error type (see below).



Also displayed above the camera view of the board is the Scan number and the

Pad number - **Scan: n6573 Pad: n6594**


Height Profile Graphs

The graph directly to the left of the camera view display shows the variation in height (in microns) along the major axis (the pink-colored line) of the solder paste deposit currently under inspection.


The graph directly beneath the camera view display shows the height variation along each paste deposit's minor axis (the yellow line). See Figure 5.1.

3D Deposit Information tab

Scan:	
Pad	n1186-1
Nominal Height	182250
Nominal Area	18037800
Nominal Volume	145
Measured Height	61717
Measured Area	8044502
Measured Volume	-17
Error	Missing



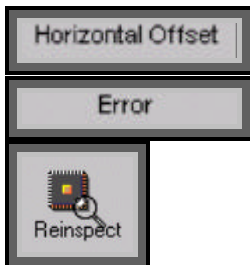
Reinspect



False Fail

The Component Information Tab provides the operator with various inspection-related statistics and options. In particular, it enables operators to reinspect a paste deposit and mark it as a false fails if it is not a genuine error.

Pad
Nominal Height
Nominal Area



Measured Height.

Measured Area.

Measured Volume.



Error.

5.2 3D Algorithm

The 3D system uses a laser to determine the heights of the paste deposits and a camera to measure the area of each deposit. By comparing the expected size, location, and height and volume of the deposits with the measured size, location, height, and volume we can determine if a deposit passes or fails inspection. In the 3D AOF menu paste is displayed in white as shown below.

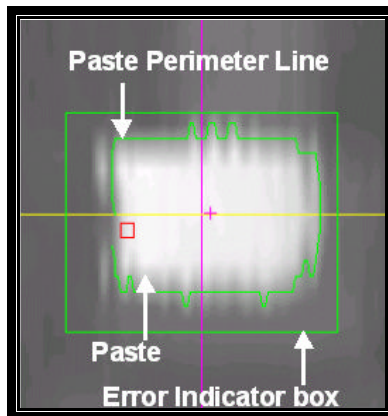







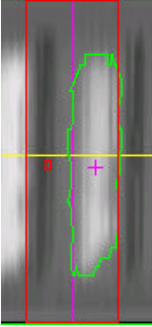
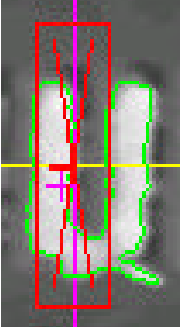
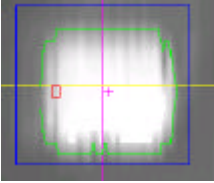


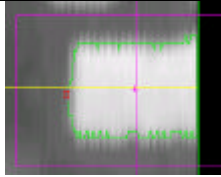
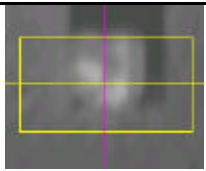
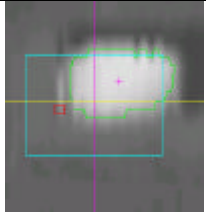
Figure 5.3 3D AOF image display

5.3 Paste Defects

Different errors have different levels of importance that reflect the severity of the error. A volume error is the most serious error so that receives the highest level of Importance. Therefore if paste deposit has a bridging error and a volume error then only the volume error will be reported because it is more serious error with a higher level of importance.

						
Red X	GREEN	RED	BLUE	MAGENTA	GREEN	CYAN
Bridging error	Paste deposit is O.K	Volume error	Height error	Too much paste	Not enough paste	Paste Deposit is offset

	<p>A Volume Error</p> <p>Occurs when the measured volume is lower than the lower threshold (normally 70%) of the required volume or greater than the upper threshold (normally 130%) of the required volume.</p> <p>Importance: 6</p>
	<p>A Bridging error</p> <p>Occurs when a continuous line of paste joins two separate paste deposits. The systems marks a bridging error when a line a paste twice the length or width of the bridging box (Red box) is detected by the system.</p> <p>Importance: 5</p>
	<p>Height Error</p> <p>Occurs when the measured height is lower than the lower threshold (typically 70% of the nominal height) or greater than the upper threshold (typically 130).</p> <p>Importance: 4</p>

	<p>Excess Paste Error Occurs when the measured area of paste is greater than a threshold (typically 130) of the required area. Importance: 3</p>
	<p>A low paste error Occurs when the measured area of paste is less than a threshold (typically 70) of the required area. Importance: 2</p>
	<p>Offset error Occurs when the paste deposit is placed offset by more than a pre-specified distance in microns. Importance: 1</p>

False Errors

False 3D board errors can be registered by the SP-1 if the 3D setup is incorrect. False Errors can occur for many reasons including: incorrectly set Blob Tracker threshold, incorrectly set Top threshold, wrong CAD, bridging, incorrect optical setup.

Incorrect Blob Tracker threshold

The Blob Tracker threshold is set **correctly** when the green Paste Perimeter line is only drawn around the blob perimeter.

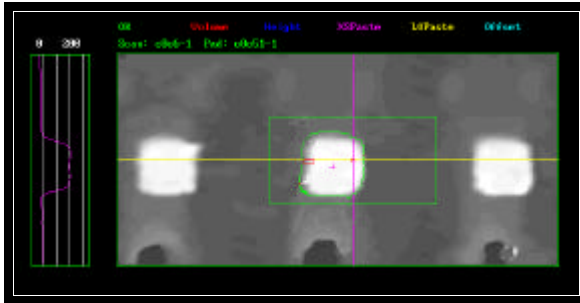


Figure 5.4 Blob Tracker threshold set correctly

If the Blob Tracker threshold is set **too low** then the green Paste Perimeter line could be drawn around other features on the board that are not paste.

In Figure 5.5 the threshold has been set too low and the system has assumed that the copper track adjoined to the paste deposit is paste. The height of the copper track is greater than the Blob Tracker threshold. The system has incorrectly given a bridging error because the length of the measured paste is twice the area of the Red Bounding box.

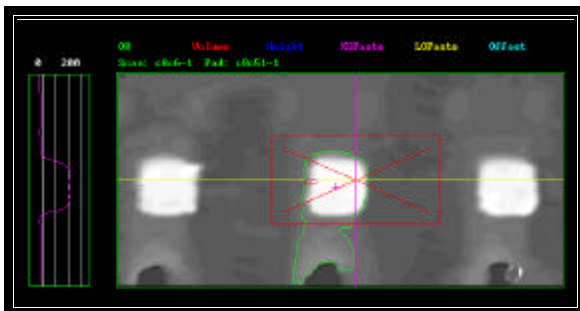


Figure 5.5. False fail because Blob Tracker threshold set too low

If the Blob Tracker threshold is set **too high** then the paste area measured by the SP-1 will be too low and a LoPaste error or an Offset error may be returned (see below).

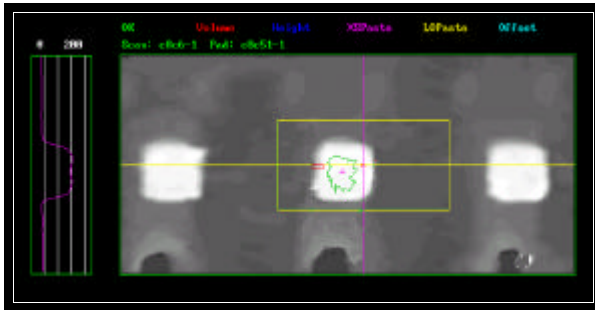


Figure 5.6 False fails Blob Tracker threshold set correctly

Camera offset error

If there is an incorrect XY camera offset the SP-1 may detect a false error. When the XY camera is properly calibrated the yellow and pink lines and search box are along the center axes of the deposits. This is clearly not the case in Figure 5.7 where neither line is located along the center axes of the paste deposits. The system has incorrectly marked a height error when in fact the system is not properly calibrated.

If the XY camera offsets are calibrated correctly (as in Figure 5.8) this paste deposit will pass inspection. It is important to check neighboring deposits to verify that this is a Camera offset problem and not due to the paste deposit being offset or due to a CAD error.

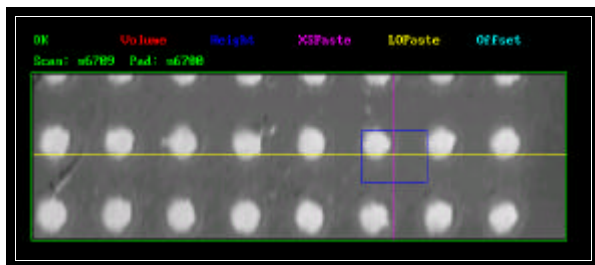


Figure 5.7 False error due to camera offset

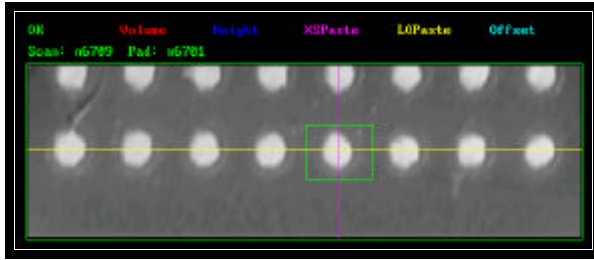


Figure 5.8 No false fail because camera properly calibrated

CAD Errors

Figure 5.9 shows how gradually the CAD has become offset over a large QFP- this can be seen by the pink cross hairs that mark the nominal location of the deposit.

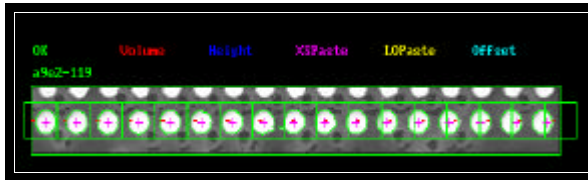


Figure 5.9 CAD offset

Top threshold wrong

The top threshold tells the SP-1 to ignore anything above this height (e.g. components).

If you leave this at the default setting, a false fail should never occur. If you change this threshold the following image may appear on screen. The dark gray patches, appearing in the image of the paste deposits may indicate an incorrect setting on this threshold.

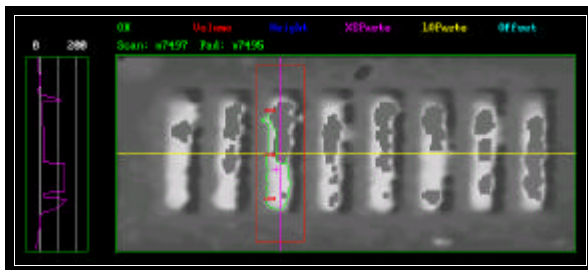


Figure 5.10 Top threshold set too low causing a false fail.

5.4 Operator tasks in 3D AOF

The operator tasks in 3D are identical to those in 2D.

The operator should carry out the following procedure once 3D errors have been detected by the SP-1 and the 3D action on Failure screen is displayed.

- 1 The operator should examine the errors to confirm that they are genuine.
 - ?? Use the Next button and examine each error.
 - ?? Reinspect each board defect using the "*Reinspect*" button.
- 2 If you encounter a false fail
 - a) Report the false fail to an engineer and/or
 - b) Mark the error as a false fail using the false fails button (if the option is enabled) –the screen will prompt the user to insert a comment.

The choice should be dictated by company policy.

3. After sorting through the errors on the PCB the operator can:

?? Send a board to the repair station



?? **Or**

?? Release the board from the SP-1



4. Repeat steps 1 to 3 when the machine inspects the next board

Chapter 6

2D & 3D AOF

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Summary

This chapter describes how to carry out a 2D & 3D inspection.

2D & 3D Inspection

When running 2D & 3D inspection three outcomes are possible.

1 Only 2D errors are found on the board

?? The 2D AOF screen will be displayed.

?? Carry out the 2D AOF options described in Chapter 4.

2 Only 3D errors are found on the board

?? The 3D AOF screen will be displayed.

?? Carry out the 3D AOF options described in Chapter 5.

3 Both 2D and 3D errors are found on the board.

?? The 2D AOF screen will initially be displayed.

?? Once the operator has scrolled through all the 2D errors using the "Next" button the 3D AOF screen will automatically be displayed. The user should then scroll through and re-examine all the 3D errors.

Scroll through and re-examine all 2D errors as described in Chapter 4.

Scroll through and re-examine all 3D errors as described in Chapter 5.

Note: An operator cannot return to the 2D AOF menu from the 3D AOF Menu.