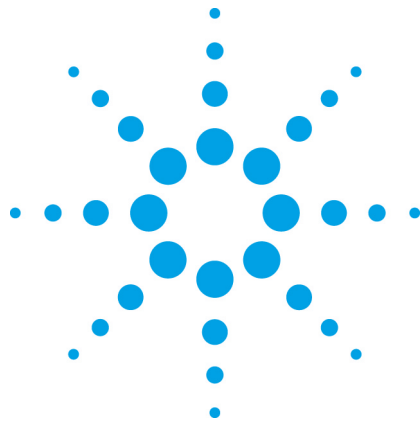**Agilent Medalist 5DX**
Automated X-ray Inspection System
DirectFET Device

Application Note

This application note applies to users on Agilent 5DX Software Version 8.4 or higher

Agilent Technologies

Table of Contents

1 Overview

DirectFET technology has been introduced in the recent past, and it has posed challenges to X-Ray structural testing. The leadless package design and the proportionally large land patterns allow for a very wide variety of joint formations. It was found that enhancements were needed to the original algorithm offerings in order to better capture potentially non-soldered or cold soldered joints. This required functionality was placed into the Paste algorithm and released in version 8.4 in December 2006. The functionality incorporates an edge slope technique and helps identifies whether the joint created a sharp edge or a shallow edge which is used to determine the quality of wetting.

This application note helps you in understand what a potential non-wetted DirectFET may look like with the 5DX along with how to utilize the 5DX Paste algorithm to catch this defect.
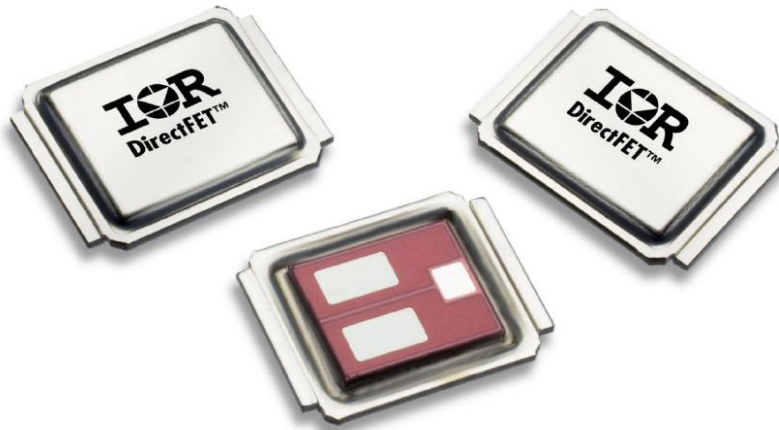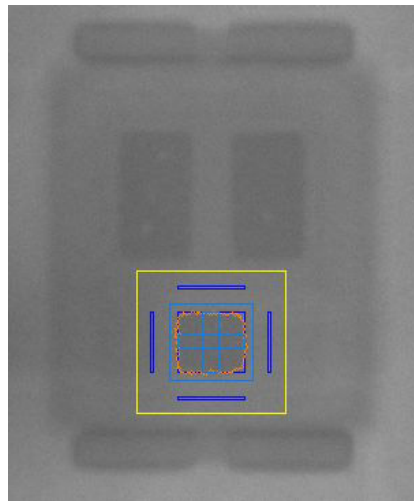

Figure 1: DirectFET's

Figure 2: 5DX X-ray image showing the new search regions included in Paste
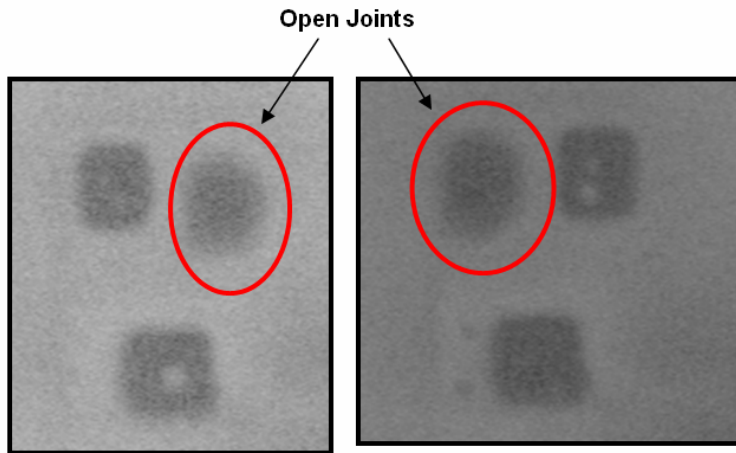
Figure 3: 5DX X-ray Images showing non-wetted solder joints.

2 Paste Locator Algorithm

The Paste algorithm was originally created to inspect solder paste before the component was placed. It was updated to test for voiding in large flat solder joints after reflow. In most cases, Voiding is the typical test and is utilized on larger flat pads. In some cases, such as FET type devices, an OPEN test is conducted as well to detect non-wetting on the larger pad, which has been found to be a crucial and common structural defect
To enable Paste Voiding testing, assign the Paste Algorithm to a package (or single pin) by using Test Link | Assign Packages and then ensure that Locator, SPC, and Voiding are the only algorithms enabled in Test Link | Panel Level Optional Processes | Algorithm Setup.

The Locator Algorithm works like any other algorithm family.
- Go to the CAD specified location.
- Move up and down - Move back and forth.
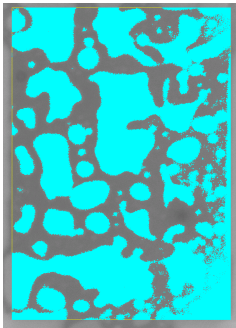- Return the location of the joint to the SPC Algorithm.

Tune Paste Locator

Figure 4: Screen capture of paste locator algorithm
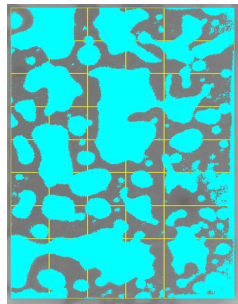
3 Paste Voiding Algorithm

Since the Statistical Process Control (SPC) algorithm does not pass any measurement data on to the Voiding Algorithm, all of the measurements and analysis is done within the Voiding Algorithm itself.

- Adjust the Sensitivity threshold:
  - Pixels identified as voids are marked in cyan (light blue). Adjust the Sensitivity threshold so that the marked pixels match the actual areas of voiding for most joints.
- Set the Region Width / Region Length thresholds:
  - These thresholds set the scaling as a percentage of the pad width and length for the inspection area/region. Define the region to be slightly small than the reflowed solder pad.
- Set the Maximum Void Percentage threshold:
  - Set to the maximum total amount of voiding for an acceptable joint.
- Determine void measurement accuracy:
  - Sometimes there may be changes in the underlying gray level of the pad and solder which prevent any Sensitivity setting from accurately measuring the voids. In this situation, it may be necessary to analyze different areas of the pad with different background values.
  - Set Use Subregions to ON to divide the inspection regions into smaller regions.
  - Set the Subregion Size threshold to adjust the size of the region in mils. Set to the diameter of the largest void and adjust if necessary. This threshold is only active if Use Subregions is set to ON.
  - If the area that is being inspected for voids has an irregular shape and is split into separate regions or the area will not fit into one view, you can adjust the Maximum Component Voiding threshold so that the entire area will be handled as one pad.
    - Adjust the Maximum Component Voiding threshold to a value of voiding that is acceptable for the pad. If the total measured voiding exceeds the threshold, then the component will fail.

Tune Paste
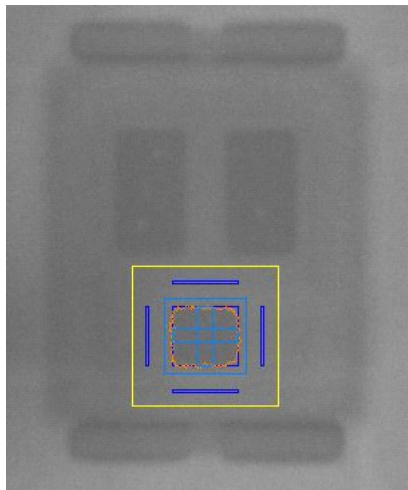**Voiding Algorithm**

Use Subregions
Turned ON

Figure 5: Screen capture of paste voiding algorithm

4 Paste SPC Algorithm – Non-Wetting (Open)

The Paste algorithm can also be utilized for the inspection of non-wetting of FET joints which reside entirely underneath the body of the component. The joint profile is typically very flat, so slope analysis along the edges is the primary indicator of open or non-wetted solder joints. The Locator Algorithm works like any other algorithm family.

- Go to the CAD specified location and analyze
- Return the location of the joint to the SPC Algorithm.
- The SPC Algorithm
  - Set Pad Profile Width – Default is 25% of joint size and applies to both "along" and "across". This can be increased to eliminate noise from along the edges, but it is recommended not to decrease by a large amount.
  - Background Profile Location – Confirm region is not on pad area.
  - Set Slope Search Region – Default is 10% and represents percentage of the pad profile utilized for the open algorithm slope calculations on the leading and trailing edges. Can range from 5% to 20%.

Tune Paste – Non-wetting (Open)
SPC Algorithm

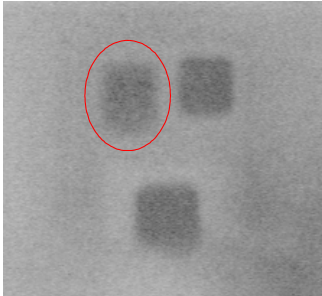Figure 6: Screen capture of SPC algorithm

5 Paste Open Algorithm – Non-Wetting (Open)

The SPC algorithm plays a major role in acquiring the information used in the open algorithm. Basically, the open algorithm examines the slope at different points along and across the surface of the joint. The slopes are calculated along the pad profile which is defined in the SPC and within the percentage based slope search region also defined. Utilize the review measurements tool along with a known good board and an "opens" board if it is available to assist with setting appropriate thresholds.

- Set the Min Leading Slope Along:
  - This slope value pertains to the measured maximum slope demonstrated on the leading edge of the "along" (vertical) portion of the joint. The threshold set is a minimum threshold for which this measured result should not be lower.
- Set the Min Trailing Slope Along:
  - This slope value pertains to the measured maximum slope demonstrated on the trailing edge of the "along" (vertical) portion of the joint.
- Set the Min Slope Sum Along:
  - This is simply the sum of the two values measured in the previous two measurements.
- Set the "Across" joint slope thresholds:
  - These are identical to the thresholds and measurements made in the previous 3 variables, but on the "across" (horizontal) joint profile.

Figure 7: Screen capture of Opens algorithm

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