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Newsletter

Editorial

Volker Pape

Dr. Martin Heuser

Dear Readers,

3D, Industry 4.0, networking – these buzzwords are everywhere these days. They are important subjects, but they need to be used correctly and sensibly. We don't want to use marketing to win over our customers – we'd much rather focus on practice-oriented implementation. And in this matter, both our new ideas and our many years of experience are sure to score highly. For example, have you ever attempted a global library concept with your inspection system? At Viscom, it is an inherent part of our systems; with some other suppliers, it's just the luck of the draw. There are lots of examples that we take for granted, so we don't always push them to the fore. Ask us anything – we're waiting to win you over!

Best regards,

Volker Pape
Executive Board
Viscom AG

Dr. Martin Heuser
Executive Board
Viscom AG

3D Inspection Concepts for MXI and AXI

The Right X-Ray

Not all soldered connections on electronic assemblies are optically visible: On components such as the Ball Grid Array (BGA), the soldered connections are located beneath the component and so evade a normal optical inspection. For these reasons, X-ray inspection with MXI or AOI is increasingly used after soldering, so these „invisible" soldered connections also undergo quality control. This gives rise to the question of which inspection should be employed: 2D, „2.5D", or 3D technology? In-line or offline? Random sample or 100 %? In any case, it is helpful to be clear about what inspection coverage is needed, to then develop an appropriate overall concept with the available technologies.

Typical Defects in Hidden Soldered Connections

The X-ray inspection is frequently used to check hidden soldered connections. Such components include:

- BGA
- QFN (Quad Flat No-lead package)
- Power components
- DFN (Discrete Flat No-lead package)

Within the context of miniaturization, for quite some time BGAs and QFNs have been indispensable in modern, high-demand electronic assemblies. DFN components as well are employed

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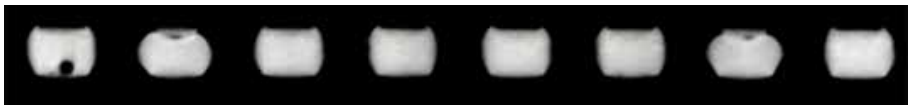
in SMD production more and more often and in more diverse ways in the area of transistor and diode components. Their advantages include reduced space requirements, increased electrical performance, low component height and improved heat conductivity.

Especially for QFN and DFN components, frequently attempts are made to find the solder defects with an optical inspection. Yet this only succeeds when the component has a special pad edge that is visible and wettable from an external view, and the AOI provides angled view cameras. X-ray inspection represents a universal, reliable solution.

On the BGA, for example, the following defect types can be differentiated:

- Head in pillow (HIP)
- Voids (inclusions)
- Bridges
- No wetting

With an HIP, the BGA ball and the paste deposit on the pad before soldering are, in principle, perfectly fine. However, during soldering the ball and paste do not combine; instead, at the end the ball rests in the pad like a head in a pillow (Head in Pillow). The HIP represents a very special and demanding inspection task for the X-ray inspection. For one, its causes are not yet fully known; for another, the visual characteristics are very similar under vertical and angled penetration, and also in a slice image of a correct soldered connection. The following image shows two HIPs (each the second soldered connection from the left and right) on an actual production board in a vertical slice. The left ball exhibits a void.



HIP on BGA, vertical section

Overall, the actual defect spectrum in the specific production has an impact on the selection of the inspection technology and concept.

2D, 2.5D and 3D X-Ray Technology

In the area of X-ray inspection systems, a general distinction is made between the following approaches:

- 2D: Vertical penetration
- „2.5D“: Angled penetration, possibly from several directions
- 3D: Angled penetration from several directions with 3D back calculation / slice image calculation

Use of the 2D approach presumes that the soldered connection under consideration is not shadowed, e.g., by components placed on the other side of the electronic assembly. In addition, the relevant defect types must be recognizable in the 2D penetration image. The advantages are a relatively high speed (each scene requires just one image) and less technical effort. However, versatility and inspection depth are correspondingly limited.

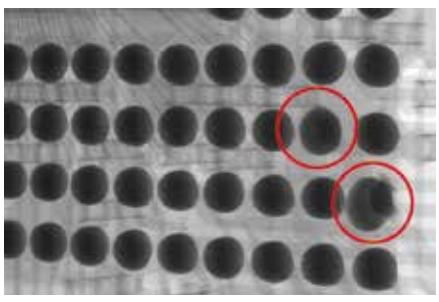
With the 2.5D approach, shadowing can be better handled or remediated because defects are better recognized through an angled penetration. Technical effort is increased because generation of the angled views requires either more image converters or a movable converter.

The 3D view permits optimum handling or remediation of shadowing as long as enough different and sufficiently angled views are incorporated into the 3D back calculation. Certain defects are only recognized in the first place, e.g., on double-sided densely populated electronic assemblies, whereas under certain circumstances 2D fails completely and 2.5D, at very least, means an enormous setup and programming effort. An increased technical effort is associated with the 3D approach, as described below.

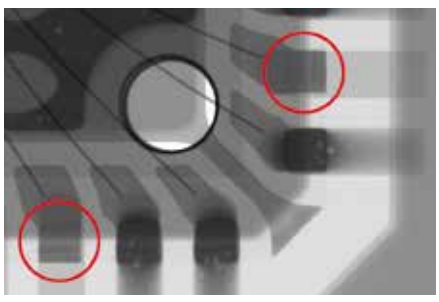
3D X-Ray Technology

On X-ray inspection systems, „3D“ refers to the possibility to generate slice or layer pictures. For printed circuit boards populated on both sides or for package-on-package (PoP), this makes it possible to extract a specific „level“ and eliminate other distracting levels. The advantages are:

- Establishing inspectability
- Reduced programming effort through fewer manual adaptations
- Less human error due to more information for the operator at the verification station.



HIP on BGA



Missing solder on QFN, partial view

Usually the components are located between the X-ray tube and the image converter. Depending on the three-dimensional arrangement of these three elements, the result is an angled penetration with a specific angle and specific magnification or resolution. The quality of the 3D back calculation is determined by the following influencing factors:

- Number of different angled penetrations (the more the better)
- Angle deviations from vertical (the greater the angle the better, up to a limit angle)
- Selected magnification or effective pixel resolution on the image converter (the higher the better)
- Type, number and size of the image converter(s)
- Type of back calculation process

This listing makes clear, that higher quality with many views and a high resolution is always associated with a reduction in inspection speed. If necessary, this reduction can be met by an increased technical effort (e.g., image converter with larger surface).

Framework Conditions

Some external factors can have a significant influence on the X-ray inspection concept:

- Customer requirements for the inspection
- Application area of the electronic assemblies
- Structure of the production line

If there are no special requirements, a random X-ray inspection with a 3D MXI is often sufficient, especially when 3D SPI and a corresponding quality in placement have experientially established that the BGA soldering does not pose any problems.

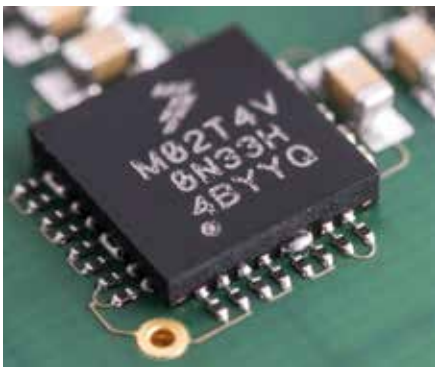
However, if the electronic assemblies are deployed in safety-relevant areas – e.g., automotive, aviation, etc. – a customer requirement for 100 % quality control exists. For hidden soldered connections, this means an X-ray inspection, usually in-line, meaning MXI is eliminated from consideration here.

In other areas, such as Consumer, Computer und Communication, quite often components are very densely populated and the inspection should take place at the end of the production line with the boards populated on both sides. In this case, often coverings are also already mounted, so SMDs with soldered connections that are actually visible can no longer be optically inspected. Here, the entire electronic assembly should be inspected with 3D X-ray technology wherever possible.

Optimum X-Ray System Portfolio

To be able to offer an appropriate solution for the X-ray inspection under the circumstances stated for each application case, the following portfolio appears optimum:

- MXI: Versatile off-line system for inspection of random samples and small to medium batch sizes with 3D functionality, e.g., with the Viscom X8011 PCB
- 3D AOI/AXI combination system: In-line system for combined, balanced AOI and versatile 3D AXI inspection, e.g., with the Viscom X7056
- 3D AXI: Full-surface 3D inspection of electronic assemblies populated on both sides, e.g., with the Viscom X7058



Section of a typical component with hidden soldered connections

For the above reasons, Viscom has extended its X-ray system portfolio and conducted model updates on its existing systems.

Summary

The explanations underscore the fact: THE solution for an X-ray inspection does not exist. The requirements and framework conditions for each production spectrum are extremely diverse, so adapted inspection concepts are sought.

Insofar as a 100 % X-ray inspection is not required, an MXI with full 3D functionality is sufficient.

If an AOI inspection with visible soldered connections is accepted and established, an X-ray inspection focused on the hidden soldered connections can be used. A 3D function is important here, so electronic assemblies populated on both sides can also be reliably inspected.

For highly integrated electronic assemblies with covers, an X-ray inspection of all components represents the best solution. Here, an AXI can record and inspect the entire electronic assembly in 3D without laborious setup work. ■

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The text is truncated. Here you will find an detailed article about the subject:
www.technical-articles.viscom.com

3D X-ray Inspection with Flat Panel Detector

3D square: Powerful 3D X-ray Inspection and 3D AOI with the Viscom X7056 FPD

Currently, Viscom is equipping its successful X7056 system for automatic 3D in-line X-ray inspection with flat panel detectors. For combined AXI/AOI inspection, the system can also be assembled with an AOI unit and the high-performance module XM 3D. With these features, Viscom offers a one-of-a-kind inspection concept and the optimum X-ray inspection for high-end applications: 3D square.

For many years, Viscom has been known as the leading manufacturer of AOI systems for assembly inspection. Since the mid-90s, the company has also offered first-class systems for X-ray inspection – and was the first supplier in the world to offer a combined AOI/AXI inspection. Over the past several decades, the X-ray portfolio has continued to grow and by now is in every way the equal of the AOI range. The product palette extends from the automatic 3D in-line X-ray inspection through AXI/AOI combination systems and both manual and automatic off-line solutions, right up to proprietary computed tomography for 3D visualization. All in all, the entire bandwidth of inspection demands for electronics manufacturing could not be better covered.

The inspection system X7056 was developed for powerful and versatile 3D X-ray analysis, where the highest precision and inspection depth is at a premium. This innovative inspection concept enables any view of the inspection object to be realized and so guarantees versatile adaptation of the 3D image quality to the widest range of inspection requirements.

The high-quality flat panel detector ensures first-class image quality with remarkable depth of information and high contrast. Together with the powerful sealed microfocus X-ray tubes, a very good first pass yield is achieved.

Even the inspection of electronic assemblies populated on both sides is accomplished without a hitch. By separating the two sides of the assembly in the 3D reconstruction, reliable inspection of all production defects is guaranteed.

The system can also be equipped with an optional AOI unit. Here, the Viscom 8M, XM or XM 3D camera modules can be employed. The advantage of which is two inspection technologies which supplement each other perfectly are covered by just one system. ■

Reliable Inspection with S3088 CCI

Conformal Coating Inspection S3088 CCI – now with High Precision Plasma Coating Inspection

Viscom is pleased to announce that the new S3088 system for Conformal Coating Inspection (CCI) inspects coatings quickly and reliably for typical defects such as cracks, defective areas, layers that are too thin or too thick, smearing, impurities or splashes. Transparent protective conformal coatings protect electronics assemblies against damage from moisture and wetness. With the S3088, electronic assemblies are inspected from an orthogonal view as well as from an angled view. In addition to an optional wet inspection for defective areas before the coating has cured, the system now features high-precision plasma coating inspection.

The new inspection system for conformal coatings has been an integral part of the Viscom product family since 2013. It works with UV LEDs, which strongly contrast the UV-reactive conformal coating against the background material, clearly detecting the contours of the lacquer. With a resolution of 11.7 or 23.5 µm/pixel, even the smallest defective areas, impurities or splashes are clearly visible. These are then either classified as defects, or used as valuable indicators to further optimize the coating process.

Viscom's angled view enables the S3088 CCI to reliably inspect the spaces between the components for defects, in addition to offering orthogonal inspection. Furthermore, a wet inspection facilitates optical inspection before the conformal coating has cured. This way, defects can be recognized during an early production stage.

The S3088 CCI also is available with a new high-precision plasma inspection feature. For plasma coatings, polymers in the nanometer range are vapor-deposited in sheer layers within a vacuum chamber with under pressure. With the help of a new, high-performance illumination, Viscom can now inspect these weakly fluorescing plasma coatings with full reliability.

With its versatile algorithms, the system can be quickly adapted to different conformal coatings. Simple inspection programs can be created in only a few minutes. The Viscom S3088 CCI ensures that electronics manufacturers fully comply with the IPC-CC-830 directive for qualification and performance of electrical insulating compounds for printed circuit boards.

This system works with the Viscom SI inspection software and offers the same user and programming interface as other inspection systems from the Viscom portfolio. Thus, traceability concepts and special inspections such as reading labels with a data matrix code (DMC), for example, can be realized. The S3088 CCI also can be easily integrated into Manufacturing Execution Systems (MES). ■

Lower Saxony Technology Center

Viscom Campaigns for Young Female Professionals

The Lower Saxony Technology Center is an effective, sustainable concept for quickly gaining talented young female MINT professionals. MINT stands for Mathematics, Information Technology, the Natural Sciences, and Technology. Young women who have received their Baccalaureate or Advanced Technical College certificate but are still undecided as to whether the career of an engineer or a scientist is right for them can come to the Center for six months to see if MINT actually corresponds to their capabilities and preferences. During this time, a well-balanced combination of practical training and „taster courses" conveys solid experience in theory and practice to the participants and gives companies a chance to become thoroughly acquainted with a potential female employee over these six months.

As a modern company, Viscom AG has a strong interest in standing aside the Lower Saxony Technology Center as a partner and especially to engage itself in promoting young female professionals. In 2014, two young women decided to complete their technical education at Viscom – in cooperation with the Machine Engineering faculty at the University of Applied Sciences Hanover and with the University of Erlangen. Johanna Reus and Lea Marie Jürke used this opportunity to experience a half year within the operating processes

The final presentation

at Viscom. They attended trainings, got to know the work on the different systems and with different software, solved exercises and accompanied colleagues on business trips, to meetings, or to the cafeteria. After several trainings the participants were well-equipped to work on their own project with the support of the Institute for production Automation and Production Systems (FAPS), which was concluded with a presentation. ■

Viscom supports young patients

Donation at Year's End for MHH Children's Clinic

In December 2014, there was reason for celebration at the Children's Clinic of the Medical University of Hanover (MHH). Volker Pape, Viscom AG Executive Board, came for a visit – and he did not come empty-handed. To support the engaged work of the Children's Clinic, he presented Prof. Dr. med. Gesine Hansen, Medical Director of the Center for Pediatrics and Adolescent Medicine, a symbolic check for over 5000 Euros.

Prof. Dr. med. Gesine Hansen was very pleased

Often, many children and adolescents must stay in the clinic over weeks and months; during this time, the clinic becomes a second home. In addition to their health restrictions, the young patients also have to struggle with the boredom of day-to-day clinic life their illness imposes on them. To make this experience more entertaining for the patients and to facilitate contact with the world outside, the rooms are to be equipped with additional media. A good laptop with Internet access, a television and other aids to lighten the lives of the children should be provided thereby. This is how the donation of the Viscom AG can help make a stay in the clinic be as comfortable as possible for the children and their parents. ■

Fit for inspection and process control

Viscom Technology Forum and User Meeting 2015

The Viscom Technology Forum and User Meeting once again had lots to offer this year: user reports on experiences of the inspection systems in practice, interesting specialist presentations, free workshops, and live demonstrations.

"Great things often start off as dreams. The power of these dreams is what helps you to overcome the challenges," said Jutta Kleinschmidt. And as her exciting report made all too clear, challenges were not in short supply. The rally driver and physics graduate is one of the world's most successful women in racing. She is not only the first – and so far only – woman to win the toughest rally in the world, the Dakar Rally, in the overall ranking: she was also the first German to appear on the winners' podium.

In her presentation, she took the audience with her on a fascinating journey through rally driving – from her first motorcycle tours and following the Paris-Dakar Rally through to having her own works team. The message of her keynote speech was that if you trust yourself and your team, you can take risks in order to achieve success.

Next specialist presentations and application studies related to SMT production were offered to the audience. As always, the Viscom User Meeting took place in parallel to the presentations in the Forum. Once again this year, the participants had the opportunity to find out about the inspection systems in numerous free workshops. There were also plenty of chances to exchange ideas and information: participants were able to share experiences among themselves and with Viscom employees, and take away valuable suggestions and tips from the experts.

To kick off the traditional evening get-together, Peter Krippner (Senior Vice President at Viscom), Dirk Nülle (Head of SP Product Development), and Rolf Demitz (Vice President for the New Products Business Unit) presented the applications and advantages of X-ray inspection in a live demonstration with the X7056 (AXI) and X8068 (MXI) systems. They used live applications to show the key advantages and uses of both systems.

Following the presentation, there was time for a bit of relaxing. With live music from the jazz/pop band "The Ellingtons", cold drinks, and delicious food from the buffet, there was ample opportunity to continue discussions from earlier or just to chat for a while. Later on, there was more entertainment in the shape of the two "Musichanics" from Auto-di-Takt – with a mind-boggling array of automobile instruments of their own devising, they treated the audience to a first-class musical pit stop. Whether it is an exhaust pipe didgeridoo, hubcap drum, or clarituba, the two musicians seem to be able to make an instrument out of even the most unassuming car part, and the performance went down a storm. ■

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