Glenbrook Technologies Inc.
X-RAY TECHNOLOGY LIKE NO OTHER

X-ray Inspection is Critical for Counterfeit Detection

By Joe Rance, Quality Assurance Manager, Abstract Electronics

As electronic components travel through the complex, worldwide supply chain from original manufacturers to distributors to product assemblers, every link in the chain owes it to the next link to ensure the authenticity of products as they are passed along. The fact that counterfeit products can be inserted into this chain imposes a responsibility on every business, at every step, to protect its customers from harm.

Unfortunately, there are bad actors out there. Fortunately, there are reliable tools that can help us perform due diligence to identify and remove them from the supply chain. Basic good business sense requires that we all do so. Utilizing x-ray inspection in your process is an important first-step in the detection of counterfeit product.

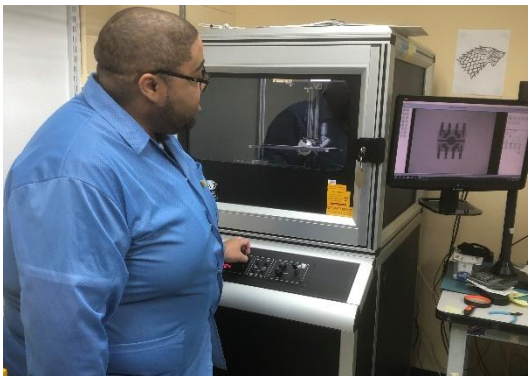

Figure 1. Glenbrook Technologies' JewelBox 70-T with GTI-5000 software, in use at Abstract Electronics.

Counterfeit semiconductors and integrated circuits come in two main categories, altered and unaltered product. The ability to detect anomalies in these categories form the foundation of an effective counterfeit detection process. Product which has been altered by someone other than the original manufacturer is the most common type of electronic counterfeit found in today's supply chain. In 2020, ERAI received 419 reports of suspect counterfeit parts and only two were in the unaltered category. Counterfeiters alter parts for the purpose of deception and misrepresentation.

Altered product includes parts that have been refurbished to appear as new, remarked to create a homogenous lot and date code.

Typically, this category is made up of used parts which may have an original manufactured date spanning decades. If the part is a speed and grade part, the remarking could be done to reflect a faster and higher temperature graded part. Remarking is also performed to convert a commercial grade part to a military grade part.

Unaltered product presents a more difficult challenge as there are no signs of alteration that could be detected using visual or microscope-aided inspections. The markings, leads, and case constructions are in factory-new condition because they are factory-new. Unaltered counterfeits can include factory rejects which somehow were diverted from the dumpster to the back of someone's car and then end up on your assembly line.

As the level of sophistication in the manufacturing of counterfeits increases, so must our ability to detect these products. The industry mantra of "buy only from authorized channels" is sound advice and eliminates the need to worry about preventing non-authentic product from entering your build. Unfortunately, this does not consider the fact that legacy builds require legacy products. Component manufacturers render products obsolete on a regular basis as demand falls below their acceptable levels. Often this obsolescence offers no direct crosses and forces a redesign that may not be feasible.

Additionally, shortages and long lead-times force users to consider the open market for availability when supply availability doesn't align with demand or delivery schedules. Product purchased from unauthorized channels will continue to be a reality as long as these market forces exist. Therefore, implementing an effective counterfeit detection and mitigation process is a necessity for all suppliers and users of electronic components. Anything less simply adds risk and liability.

Glenbrook Technologies, Inc.
11 Emery Ave., Randolph, NJ 07869, USA • Tel: 973-361-8866 • Fax: 973-361-9286
www.GlenbrookTech.com

Glenbrook Technologies Inc.

X-RAY TECHNOLOGY LIKE NO OTHER

As a distributor of both factory-authorized and non-authorized electronic components, the management team at Abstract Electronics understood the need to offer our customers a greater level of due diligence when it came to counterfeit detection. If we were to remain a valuable asset to our customers, we needed to do our part in protecting their assembly lines from suspect product. However, the costs and lead-times associated with out-sourcing enhanced inspections were more than many of our customers were willing to endure. We needed to have these abilities in-house and we needed to follow the industry guidelines of the AS6081 aerospace standard.

An effective counterfeit detection process begins with knowledgeable inspectors trained to detect signs of part alteration visually. However, not all counterfeits can be detected visually and a more in-depth and internal inspection is required. This is where x-ray becomes extremely useful as it reveals internal anomalies undetectable by visual inspection. X-ray inspection is highly effective in detecting the most common type of counterfeit, the altered part. However, when used properly, it can help in the detection of unaltered product as well. The x-ray machine offers value for dollars spent and does not require the user to be an engineer. Adding internal inspection to your existing external visual inspection adds another important layer in your inspection and increases the level of due diligence.

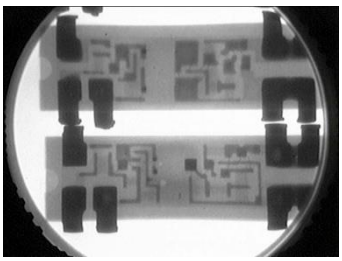

Figure 2. Inconsistent construction.

X-ray inspection reveals the different internal constructions and die sizes often found in altered counterfeits. A product with the same lot or date code should always have consistent internal construction. X-ray inspection provides the ability to detect inconsistencies quickly while verifying consistent construction, as shown in Figure 2.

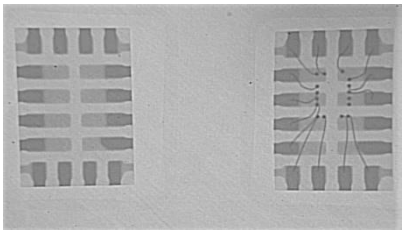

Figure 3. Missing die, missing bond wires.

When inspecting unaltered counterfeit product, the x-ray machine is an extremely valuable tool. For example, factory rejects, as shown in Figures 3 and 4, may include product without die, missing bond wires, or damaged bond wires. By measuring and recording die sizes of known good devices, historical data can be used to detect cloned devices using non-authentic die. Evaluating construction consistency and integrity is a key factor in the detection process.

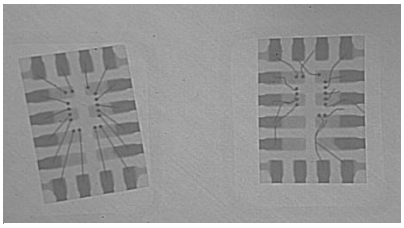

Figure 4. Missing and damaged bond wires.

As the number of your internal inspections increase, so do the number of images to manage. Having the ability to search histories for comparisons to your previous images creates a powerful reference tool. When selecting a picture management tool, the ability to add searchable keyword tags and labels is a key feature to consider. Abstract Electronics has more than 10 years' worth of images, resulting in more than 20 thousand images that can be searched by any combination of part number, manufacturer, vendor type, inspection number, PO number, date code, and known good status. Color coded labels tell us quickly the inspection result of the picture. A searchable image management tool designed to manage a volume of images, such as that shown in Figure 5, is an important part of any counterfeit detection program.

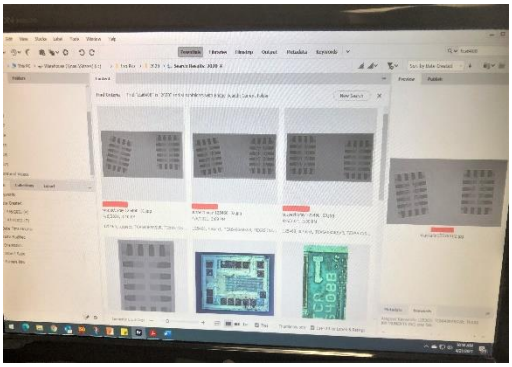

Figure 5. Image management software (Adobe Bridge).

A multitude of equipment and techniques are required to effectively detect the variety of anomalies present in counterfeit product. It is not difficult to spend north of $250,000 to assemble the necessary

inspection equipment. Often, companies find themselves asking “where do I begin, and which piece of equipment will provide the best cost/value result”? When we asked ourselves these questions, the answer was the x-ray machine.

To help us select the most appropriate x-ray system, we spoke with the knowledgeable and experienced people at Glenbrook Technologies and discussed our needs. We learned the importance of resolution and zoom in day-to-day inspections. After many informative conversations and a sampling of images using different machines with various specification levels, we selected Glenbrook’s JewelBox-70T with a 10-micron focal spot having both mechanical and optical zoom, with GTI-5000 software. The performance of this reasonably priced machine has met all our x-ray needs to date and has allowed us to detect anomalies and attributes which were previously undetectable. We found die identifiers, such as shown in Figure 6, embedded in layers that even decapsulation could not detect. This one piece of equipment made us a better and more capable company.

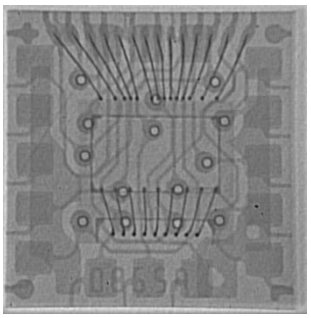

Figure 6. Embedded identifier.

As these examples make clear, x-ray inspection is a valuable tool that enables Abstract Electronics to detect and document hidden anomalies in semiconductors and integrated circuits. This due diligence is a critical step in detecting and removing counterfeit products from the supply chain. It helps protect our customers from unwittingly assembling products that may ultimately fail, creating extra rework, product returns, and costs. Utilizing x-ray inspection in your process just may be one of the most important and beneficial decisions you make, and a decision your customers will very much appreciate.

Contacts: Abstract Electronics, 11526 53rd Street North Clearwater, FL 33760; T: 866.306.9990; fax: F: 727.561.9716; www.AbstractElec.com.

Glenbrook Technologies, Inc., 11 Emery Avenue, Randolph, NJ 07869; T: 973-361-8866; fax: 973-361-9286; www.glenbrooktech.com.