



Detecting Counterfeit Components

This article examines recommended techniques for identifying counterfeit components within the supply chain, and describes methodologies that minimize the risk of using these devices on production circuit boards within the assembly process.

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As electronic devices and components become more expensive, obsolete, or scarce and hard to find, it is an unfortunate reality that such a situation is ripe for exploitation by unscrupulous individuals who deal in counterfeit components. However carefully your supply chain is configured, the necessities of providing customers with their products in a timely fashion, combined with the ease of internet searches, often leads you or your suppliers onto the grey market. Issues with counterfeiting are not limited to expensive or exotic components, where the relative high unit cost would appear to be most attractive to the criminal element. Instead, counterfeiting often exists for long lead-time and/or obsolete devices with values below \$10 per unit. Such low value devices are arguably far more dangerous to the production quality of board level assemblers, with enormous risk and negative impact to their business reputation, in addition to the costs of identifying the problem and making the necessary rework and repair.

When are you most at risk?

As with any aspect of supply and demand, the opportunity for a counterfeiter increases as the need for the item increases. The drivers for counterfeiting in the printed circuit board assembly market include – limited availability of specialty devices, general market supply shortages for standard items, sourcing of obsolete components, single-sourced components which have a long lead time, non-availability of the necessary components to manufacture a new product introduction (NPI), pressure from customers requiring a faster time to market, and/or the necessity of purchasing components from the grey market to satisfy customer demands.

Although it should always be best practice to only obtain components from trusted and reputable sources of supply, the reality of the market pressures listed above means that your trusted suppliers cannot always provide what you need, when you need it. Therefore, you do the same as your attentive suppliers do or as well as everyone else wanting the same item, and turn to the web to source what you need. Sadly, this is what counterfeiters are waiting for.

Now that you have no choice but to look outside the known supply routes, suspicion must become the watchword. This is true even when receiving grey market items from your regular suppliers. Of course with expensive components of a few hundred dollars each, their high-value demands extra vigilance at all times. So it is quite natural to put in all the additional tests and quality assurance steps to guarantee the quality of these items before they are used. Unfortunately, much lower value devices are also being counterfeited that have values of \$10 or less.

Less Than \$10 Counterfeit Components

With such inexpensive devices being counterfeited, these are the most dangerous to your business and your reputation. This is because the wily counterfeiter can often supply a small quantity of real items for quality verification or sometimes include a small number of real components at the head of the reel. In addition, reel-based surface mount components are often not checked prior to placement, so a simple trick is for the counterfeiter to re-label the entire reel. Since many plastic components are moisture sensitive, if the items arrive in a specially-packaged, moisture-proof bag, most board level assemblers do not check inside the package for fear of exposing the components to moisture in the air. As a result, as long as the external label has the correct information then this is often sufficient to have the counterfeit components accepted.

Even if analytical checks on a few components off the end of the reel appear to be fine, it can generally not be afforded to check samples from every reel at incoming inspection especially when the cost is very low. Because of this reality, inexpensive counterfeit components can readily enter the production floor. The same is true for similar items purchased through the legitimate supply chain since your supplier

cannot always guarantee checking every low-value item they obtain on your behalf through the grey market without dramatically increasing costs. Again, as the component value is small, it does not raise suspicion.

In many cases the over-molding and exterior markings of good and counterfeit components look very similar. Often a detailed optical examination can reveal a difference in the cut termination of the counterfeit item. But again because it is only a less than \$10 component it often only merits a cursory inspection. However further x-ray inspection of these two items shows that in addition to the differences mentioned above, the aluminum wire count and bonding also varied (Figure 1).

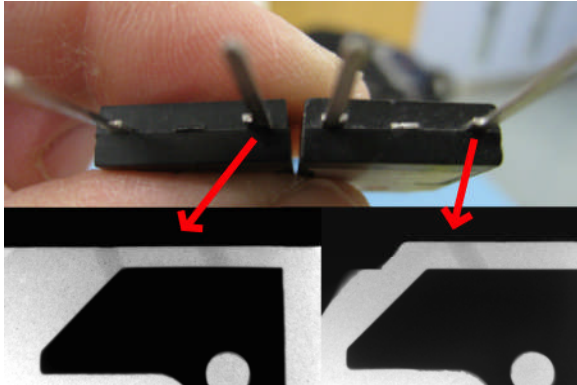


Figure 1. Optical image of the termination of good and counterfeit ultra-fast diodes, and x-ray images of aluminum wire connections at the leg of the good and counterfeit ultra-fast diodes

Because of the relatively low component cost and the high cost of verification, such low-value counterfeit components are the most insidious once they escape into production. This is because once they are assembled onto the board the presence of a low-value counterfeit is not the first or the easiest issue that will be considered as determining the root cause of bad product manufacture.

What can be done?

With a quick visual inspection often being the main acceptance test for low-value components, especially when undertaken without using a microscope, counterfeit components can easily pass since the serial number and other printed information appears to be correct. It should be noted that it is relatively easy for a counterfeiter to “black top,” or paint the device and reprint other details upon it.

The route from component manufacturer to end-user is often very long and can go through many hands legitimately so there are many opportunities for a counterfeiter to get their fakes into the system. Having a certificate of conformance is no guarantee because externally the counterfeits look like the real item and a swap could have easily been made at some point in the supply chain. Also, if the counterfeiter is capable of re-printing details on the devices themselves then forging a certificate of conformance to pass visual inspection is also relatively simple.

If everything appears to be correct on the outside, then the question remains what are the opportunities for inspecting the inside of the components. It is possible to remove the lid from some packages as well as dissolve away the plastic molding compound from others. However, such tests are, by their very nature, destructive and even if the tested components in a mixed batch are fine then they are now unable to be used for production. With a mixed batch of items it is, of course, impossible to test every item in such a way. Therefore, non-destructive tests are required, ideally that are quick and simple to perform.

X-ray Inspection

With the use of a good quality digital x-ray inspection system that provides high magnification at oblique views and a large greyscale sensitivity, it is possible to quickly and easily see inside the suspect packages non-destructively. By taking images of known good samples that clearly indicate the correct wiring and sub-assembly alignment within the packages then production operators and incoming inspectors can quickly compare these to suspect devices (Figure 2).

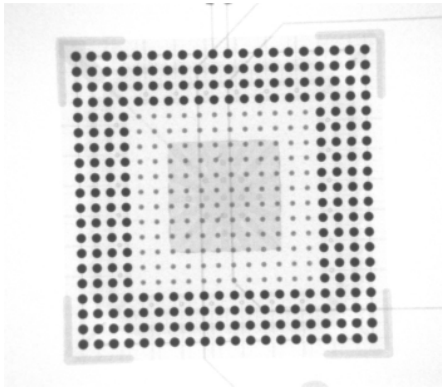


Figure 2. X-ray image of counterfeit device that has no die or wire bonding contained inside

If all is well, then these items can be passed directly for production use. However, if something is wrong then not only have these counterfeits been prevented from contaminating future production but these tests can be made when the components are still within their original packaging and without breaking any security seals. In this way, these suspect items can be rejected and compensation received from the supplier.

Other Inspection Techniques

X-ray fluorescence (XRF) allows components to be checked non-destructively for their chemical composition, in particular detecting the presence of lead in what may have been supplied as supposedly lead-free. Infrared microscopy allows selected surfaces of die and bond sites to be examined without removing the molding compound and exposing the top surface of the die (Figure 3). This leaves the bond sites intact for possible electrical test however, preparation of the component requires grinding so that access is available to the surface of the silicon.

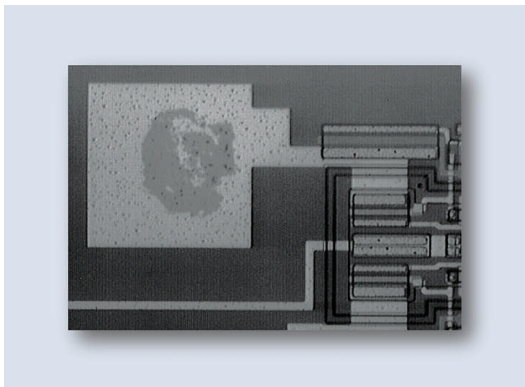


Figure 3. Infrared microscope image

Solvent body softening, component de-lidding and jet or plasma etching can also be used to carefully remove from the surface of the component so that further optical examination can be performed against a known good component. However, a quick check with x-ray inspection, even while the components were still on the reel, can have achieved the same results by exposing the insides of the good and counterfeit packages (Figure 4).

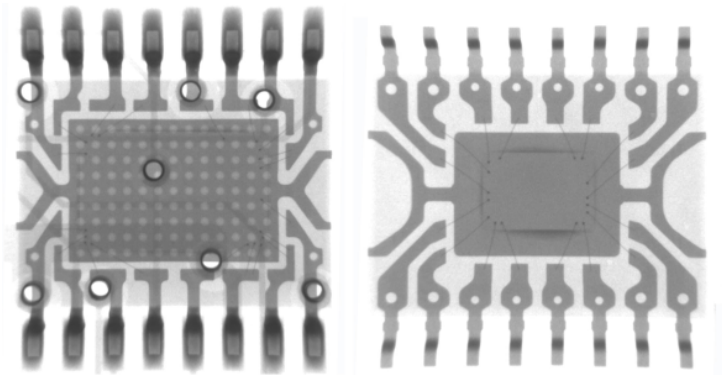


Figure 4. X-ray image of good and counterfeit DAC showing variation inside two identical packages

Therefore, x-ray inspection can non-destructively discriminate between good and bad components without laborious and time consuming testing.

Conclusion

Counterfeit components are a real issue. Unfortunately, they are not just being targeted at expensive devices but, more insidiously at very low-value items as well. It is difficult to quantify how big a problem counterfeiting is, but it has been suggested its impact could be as much as \$10 billion annually.

Adding x-ray inspection and other analytical techniques into acceptance procedures does add personnel, time and money to the bottom line. But if it is not done, it can result in counterfeit components being used on production boards where the real cost of fixing the problem in terms of repair, reputation and potential lost future business can be enormous.

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About Dage

With America's headquarters located in Fremont, California, Dage Precision Industries, Inc. is a unit of the Nordson Corporation and manufactures and supports a complete range of award winning digital X-ray inspection systems and bond test equipment for the printed circuit board assembly and semiconductor industries. For more information, visit www.dage-group.com.

About Nordson

Nordson Corporation is one of the world's leading producers of precision dispensing equipment that applies adhesives, sealants and coatings to a broad range of consumer and industrial products during manufacturing operations. The company also manufactures equipment used in the testing and inspection of electronic components as well as technology-based systems used for curing and surface treatment processes. Headquartered in Westlake, Ohio, Nordson Corporation has more than 4,100 employees worldwide, and direct operations and sales support offices in 34 countries.