micross components

What make you think you’ve got fake components?

Firstly, what makes you suspect the component in the first instance. Was it too cheap, were you unsure about the purchasing chain or associated documentation. Does it look or feel different, have you read something somewhere, or do you just have an uncomfortable feeling about it. Analyse your fears first, as quite often there is the first clue to your suspicions.

At some stage, you should also question … does it matter. It certainly does if the component is destined for a pace-maker, or something else life-critical, but if it was to go in a musical birthday card, you might have a different viewpoint. Nonetheless, you would still have that feeling of being “ripped-off” by your supplier, because it’s not what you ordered and paid for.

So how do you go about ascertaining that your incoming component is exactly what you ordered, does what it says on the tin, and works as expected. That always assumes that you ordered the correct item!

1. The PAPERWORK tests …

Firstly, you don’t want to spend a fortune on checking up on your purchase, because you’ve already paid once, so you need to tackle the problem from a cost-sensitive viewpoint. Before even looking at the component in question, the first port of call should be on the paperwork, even though this is easily falsified. Does the documentation stack up with previous purchases? Whilst actually cheating on the paperwork is the simplest, cheapest method of counterfeiting, this is also an area where you get your first insight as to the likelihood of fakery. This is something every customer can do with minimal cost and without resorting to expensive test and analytical equipment.

Still don’t smell a rat? The next stage is to perform a visual inspection of the parts. Remember, from now on every stage or analysis starts costing time, effort and money, so regard these stages as successive insurance policies … only you know when you’ve spent enough money or collected enough evidence either way.

2. The VISUAL tests …

A visual inspection of the parts really should be performed alongside a good, known reference part, ideally from the same manufacturer. On IC’s, look for the obvious first … right number of leads, legs or pins? Right size package? Same moulding compound, same packaging finish, same printing style, font and colour. Check the date code, similar format to previous devices? Correct company logo? Is the component packing correct, same tubes or trays, same materials, similar type of labels/stickers? Correct spelling? Check the component package dimensions using shadow-graph equipment if necessary.

This list of questions is certainly non-exhaustive, but common sense dictates what to look for. If in doubt, visit the manufacturer’s website or contact the supplier / manufacturer and ask the questions directly. Do remember that many IC manufacturers regularly use subcontract assembly houses or have multiple plants whose output/finish many well be subtly different, so a degree of tolerance is needed … the tolerance is generally gained by experience.

So, in turn, lets ask some obvious (and not-so obvious) questions regarding the component concerned, and see if we can easily provide answers.

3. The ELECTRICAL tests …

Electrical tests can range from a simple pin-by-pin VI (curve trace) test all the way through to a complex dynamic functional and parametric test, coupled with an intensive environmental screen. It depends upon what question is really asked, as to what level of testing gives an adequate answer without going “overboard”.

Next follows some of the electrical tests … you may have to employ an external test house to perform the following tests.

Q. *Is there a chip inside this package ?*
A. An “opens & shorts” test will confirm that there is a chip inside, with the appropriate connections

Q. Is there a chip inside this package that looks like the last batch ?
A. Again, an “opens / shorts” test with curve tracing can confirm that the chip looks like the previous one, at least from the pin connection perspective.

Q. Is it an SRAM chip inside this package ?
A. A partial **FUNCTIONAL** electrical test can confirm that the chip inside the package is some sort of SRAM. This does not have to be exhaustive, but it still begs the question of being the correct SRAM.

Q. Is it a 1M by 8 SRAM chip inside this package ?
A. Only a full **FUNCTIONAL** electrical test can confirm that the chip inside the package is really a 1M by 8 SRAM

Q. Is it a 10nS 1M by 8 SRAM chip inside this package ?
A. Only a full-speed **DYNAMIC FUNCTIONAL** electrical test can confirm the 10nS

Q. Is it a 10nS 1M by 8 SRAM chip that meets this datasheet inside this package ?
A. Only a series of comprehensive **PARAMETRIC** and **DYNAMIC FUNCTIONAL** electrical tests can confirm all the parameters on the datasheet.

Q. Is it a 10nS 1M by 8 SRAM chip that meets this datasheet – to a MIL spec - inside this package ?
A. Again, only a series of comprehensive **PARAMETRIC** and **DYNAMIC FUNCTIONAL** electrical tests, to the MIL spec, can confirm all the parameters on the datasheet.

Q. How about reliability data?
A. Once again, only a comprehensive **PARAMETRIC** and **DYNAMIC FUNCTIONAL** test to the MIL spec, coupled to a **full reliability screen** and **burn-in**, can really give you these answers.

*Q. Is it a 10nS 1M by 8 SRAM chip, manufactured by **XXXXXX** - inside this package ?*
A. The only real way of ascertaining that it was made by manufacture **XXXXXX** is to de-lid and open up some samples on a batch-by-batch basis.

Q. *Is there a way of ensuring that my component is not counterfeit?*
A. Have you really read the above ?

4. The non-invasive/non-destructive INTERNAL tests

X-RAY fluorescence on the lead finish, which can determine similarity between the new "suspected" component and an original specimen. X-RAY fluorescence can also check for RoHS/WEEE and EOVL compliance, etc.

X-RAY radiography can generally address the obvious questions of die presence and die size. X-RAY radiography can also determine the bonding validity where Gold bond-wires have been used, but unfortunately, Copper and Aluminium bond-wires are not so visible under X-RAY.

SAM, Scanning Acoustic Microscopy. This is an analysis technique, using acoustic reflections, that can be used to detect :

- Plastic-to-Leadframe Delamination,
- Plastic-to-Die Delamination,
- Plastic-to-Die Attach Delamination,
- Die Attach Voids,
- Internal Cracks, etc.

Refinements to the SAM technique include CSAM (C-scan SAM), which builds up a 3D model of the components internals.

5. The invasive/destructive INTERNAL tests

We finally come to the destructive tests, which, of necessity, are only performed on a small sample. The tests can be quite time-consuming and hence, accordingly expensive, so should only be considered as a last resort. Even then, some of the tests don't answer the counterfeiting question, but rather address the "suitability" question … is this batch okay for me to use?

DeCAP, then inspection to check the die manufacturer, die type and mask revision. Bonding integrity (often difficult, dependant upon the DeCap technique). Cavity packages can, generally, be easily opened with the right technique. Plastic encapsulated devices generally need either chemical or plasma "attack", or both, and neither method is painless, and requires good DFA methodology, patience and knowledge from the operator.

PIND
Particle Impact Noise Detection isn't itself destructive, but any detected failure must be regarded as unusable. This technique "shakes, rattles and rolls" a cavity-packaged part, using a sensitive microphone to listen to any loose particles within the cavity. This method won't sort out counterfeit devices, but will indicate whether the manufacture of the part is "up to scratch", so to speak.

RGA
Residual Gas Analysis is totally destructive, only applicable to cavity-packaged parts, and like PIND will only indicate the competence of the manufacturing technology.

And now, we're heading for complete Defect Failure Analysis methodology, even though the parts aren't necessarily failing. Without listing a complete "to-do" list, the following techniques may be employed to further analyse the parts operation/function, material composition and assemble methods :-

- Optical and thermal detail Die Inspection, layout analysis.
- SEM including EDS (Energy Dispersive X-Ray Spectroscopy) (EELS & TEM)
- X-Ray and XRD (X-Ray diffractometry)
- Emission Microscopy and OBIC (Optical Beam Induced Current)
- Liquid Crystal thermal/potential analysis
- Micro-section and slice samples
- FIB (Focussed Ion Beam)

Back to reality.

Once again, we must ask ourselves, what makes us think that these devices are counterfeit, fakes or just plain unsuitable? Remember that to really find out the truth, detail investigation will cost.

Alun D Jones
Technical Director
Micross Components Ltd.,
Oriel Court, Omega Park
Alton, Hampshire, UK
GU34 2YT

Tel : +44 (0) 1420 594180
Email : alun.jones@micross.com
Web : www.micross.com