



## JonJu Tech Ltd.

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Without Prejudice



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### What it is all about

Clearly, when a company has a product manufactured by a supplier it wants to be sure that the quality of the resulting electronic product is assured. This can be vexing in the case of PCBAs because they are often such complex items, and it takes some of the most technically qualified in a company to discern and correct faults. For this reason, it is important to assure that the quality is assured at source, i.e., at the supplier. This White Paper is about how this is done.

### Quick Learn

- The best, but most costly, form of testing to have a supplier do is functional testing, i.e., the device has its in service function tested. This adds set up cost (jigs) and manufacturing test cost, but it finds problems most effectively and forces the supplier to reject (rather than ship) what is not functioning.
- Visit the manufacturer and confirm that AOI (ideally 3D), X-ray and visual inspection are covered. Flying probe testing should also be an option – although circumstances sometimes dictate it isn't the most efficient means of testing (high set up overhead)
- Don't be fooled by 100% inspection. Inspection is a law of diminishing returns and excessive inspection in a company usually masks fundamental process issues.
- Question to what degree support exists once failure has occurred. The quality of after sales service is often what differentiates the bad supplier from the good.
- Confirm re-work and modification is available (at a cost). Designs are very rarely right first time and a cut and strap (mods) may be required.

### Key Actions/Advice

As Quick Learn

### Rigour

For a complete picture of the means by which a PCBA is reified it is essential to consider the kinds of inspection and test that apply to the process.

### Flying Probe

A flying probe test machine is one that places/connects a pin to a reference node on a PCBA, e.g. 0V, and then has another pin connect to other nodes in the circuit: the impedance between the two points is then measured and compared to the value, with a tolerance, which is expected between those two particular nodes. Flying probe testing can be more extensive since it is possible to have advanced machines stimulate circuits with signals and set up proper ATE (automatic test equipment) using products like Labview, which means that it is possible to do extensive functional testing with flying probe testers.

### AOI

There are machines that use photographic images to monitor the quality of products. A high-quality image is made of a PCBA that is known to be correct (gold standard), and then the AOI machine takes images of each example of production and compares them to the gold standard. This method will find all sorts of faults:



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incorrectly orientated chips; diodes the wrong way round; lifted pins; and many other issues, but it will find many false faults, e.g. nominal change in the marking on the top of a chip. The problem is that there is a possibility of the machine 'crying wolf' and operators consequently ignoring important issues. The most modern AOIs are 3D and this brings in assessment of solder joins as well as components.

### KEY POINTS:

- ***Be clear whether your manufacturer has and uses AOIs. If carrying out an audit try to probe and find out how effectively the AOI facility is used.***
- ***Modern 3D AOIs collect statistics and lend themselves to advance quality assurance, e.g. six sigma. Assessing the existence of this is a good way measure the real quality of a supplier (one that does this is almost certainly from the top draw).***

### X-Ray

The problem with some modern electronics is that it is impossible to visually inspect, e.g. BGAs and fillet penetration in PTHs, and it is to assist with this that X-ray machines find a use. A BGA, which is a microchip with its pins underneath it in the form of small balls, gives no visual access to the points at which it is soldered. The X-ray machine permits the quality of these joins to be assessed.

### Visual Testing

All manufacturers have magnification equipment and people whose job it is to find issues with PCBAs. This is laborious work and it really is much better if such work is covered by AOI and flying probe machines. It, nevertheless, remains a main feature of test and inspection with most British manufacturers that extensive visual inspection is done.

### Functional Testing

The greatest confidence that a PCBA has been correctly manufactured is given by a functional test (power put on the PCBA and it is made to carry out the functions for which it was designed). Despite this ultimate confidence, the following are typical problems/advantages:

- It is expensive to design the necessary test jigs
- It is usually impractical to test every permutation and combination of function, and the test is consequently not entirely thorough.
- Flying probe testing can very thoroughly implement functional testing with no test jig overhead, or at most a very much reduced jig overhead.

### International Standards

The main standards that cover the aspects of making PCBAs are the IPC standards, most specifically IPC –A-610.



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### Further Investigation

None noted.

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### Definitions

BLE: Bluetooth Low Energy

Cut and strap: modification made to a PCBA by cutting tracks and/or soldering wires to change the circuit. Very common on early prototypes, but production released products should never have cut and straps on them.

EMC: Electromagnetic compatibility

ESD: electrostatic discharge

FMEA: failure mode and effect analysis

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PCB: printed circuit board without components assembled on it

PCBA: printed circuit board with components assembled on it

Production Release (PR): date at which production is launched without any involvement or supervision from a design authority.

SLEEP: a low current condition that a device can be put into to reduce its requirement for current, and hence longevity if powered by a battery.

WP: white paper