### Increased Reliability and Quality with the Assistance by IPC Standards

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#### ABSTRACT

The use of electronics in modern societies has from the beginning of 1950<sup>th</sup> increased dramatically. The number of PCBA (Printed Circuit Boards Assembled) used/consumed in the whole world reach several billion per year. At the same time the complexity of components and bare boards been goon from simple circuits to a sophisticated electronic product, which needs to play together with the components, design, and choice of base material, PCB (Printed Circuit Board "bare board", assembling, soldering, touch up, cleaning, conformal coating and test. To be able to do that it is a need of international accepted standards to avoid problems in the reliability and quality of the electronic products we all need today.

#### **HISTORICAL BACKGRAOUND**

How many remember today that 1958 the state of the art regarding components was a radio tube, see Figure 1.



Figure 1. Radio Tube 1958

Just 4 years later1962 the electronic industry was producing the following type of PCBA, see Figure 2.





Ten years later in the middle of 1970<sup>th</sup> the market saw the first microprocessor and in the end of the same decade Motorola launched the MC68000. A PCBA could look like Figure 3.



Figure 3. PCBA 1981

During the last 10 years the component development have passed at least two revolutions, see figure 4.



Figure 4. The Japan Jisso Technology revolution towards the 21st Century.

Parallel with the components development the PCB had also gone from single sided boards without any PTH (Plated Through Holes) to PCBs with MV (Micro Vias) and embedded components, see figure 5.



Figure 5. PCB with MV and embedded components.

The coming years both the development of the components and the PCBs will continue and POP (Package On Package) will be more common, see Figure 6.



Figure 6. POP

#### new demands and challanges

Not only have the technical improvements been given the electronic industry some challenges over the last 60-70 years. Also environmental legislations like RoHS 1 and 2 plus REACH, EUP and conflict materials have been factors which have made the production of electronic hardware more difficult. See Figure 7.







#### NOW CAN IPC STANDARDS ASSIST?

In many areas in the electronic industry the OEM (Original Equipment Manufacturer) are demanding that the EMS (Electronic Manufacturing Service) shall deliver IPC Class 3 according to IPC-610E. What a majority of the OEMs forget that it will be very difficult for the EMS companies to reach IPC Class 3 if not the design have the same IPC class. To be able to do that many IPC standards have to be followed, see Figure 8.



Figure 8. IPC Standards in the design area

In addition it means that if the end demand on the solder joint is IPC Class 3 the PCB and design can't have a lower IPC Class. The chain to be able to reach an end result on a PCBA of IPC Class 3 is the following:

A. Advanced functions mean Advanced Components.

B. Advanced Components means Advanced CAD.

C. Advanced CAD means many layer and several via hole types (PTH, Micro, Blind and Buried Vias).

D. Advanced PCB needs Robust Design acc to IPC-2221B and IPC-2222A according to IPC Class 3.

E. Advanced PCB needs Footprints acc to IPC-7351B Level A.

F. High reliability and Quality needs Base Material acc to IPC-4101C/xxx.

G. High reliability and Quality needs PCB production acc to IPC-6012C Class 3.

H. High reliability and Quality demands for the PCB must be according to IPC-600H Class 3.

I. High reliability and Quality demands for the PCBA must be according to J-STD-001E Class 3.

J. If voids in BGA (Ball Grid Array) or CSP (Chip Scale Packages is a concern the IPC-7095C Class 3 have to be followed both in the design and in the in the x-ray inspection.

K. If voids in BTC (Bottom Terminated Components) is a concern the IPC-7093 Class 3 have to be followed both in the design and in the in the x-ray inspection.

L. If cleaning of the PCBA is needed design, cleaning process and measuring should be considered according to IPC-CH-65B.

M. If conformal coating of the PCBA is needed design, cleaning process and measuring should be considered according to IPC-CC-830.

N. When all in items A-M are followed the PCBA shall be inspected according to IPC-610E Class 3.

The entire chain can be illustrated with the following, see figures 9, 10 and 11.











Figure 11. Cleaning and Conformal Coating factory.

#### need of an IPC checklist

This chain of hardware production include around 30 parameters, where every parameter have a number of different variables. If every variable have an influence on all other variables the theoretical number of combinations will be, see figure 12.

## Number of Combinations

## 4200 000 000 000 000 000 0

# 4,2 E19!!

Figure 12. Number of combinations

To be able to have some control of all this combinations you need an IPC Checklist, see figure 13.





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Figure 13. IPC Checklist.

#### conclusion

Without a systematical use of IPC standards throughout the entire production chain of electronic hardware it will be hard to obtain a good yield for PCBAs and put them on the market as legal.