An investigation reveals how reducing the thickness of the gold layer in PCB's lowers production costs

The Merlin PCB Group has been working in partnership with Fischer Instrumentation (GB) Ltd to investigate the repeatability of measurements made on the gold layer of ENIG layers on printed circuit boards. Further measurements were made to determine the potential of using these data to allow closer control of the ENIG plating process.

Merlin PCB Group is an approved AS9100C, SC21 company who manufactures PCB's for the aerospace and defence sectors in addition to supplying industrial, medical and communications companies and organisations. Fischer Instrumentation supplied the XDAL® 237 SDD X Ray Analyser to provide the measurements.

Summary

This report contains preliminary experimental data from tests performed by Fischer Instrumentation. Results show that the standard deviation of measurements made on the gold layer can be as low as 1nm allowing close monitoring of the thickness of this layer. Measurements were made on boards from different production runs, these indicate that currently the gold is deposited thicker than is needed. Reduction of the thickness of this layer would lead to reduced costs in the production process.

Samples & Experimental Protocol

Nine boards were submitted for testing, every board had an IPC test coupon as shown in Figure 1 below. This was used as the test location on each board.

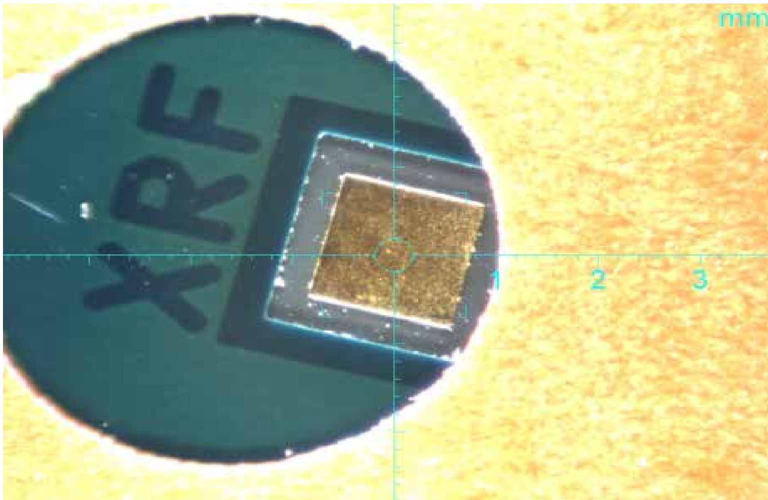

Figure 1: IPC test coupon

All 9 boards were coated with ENIG layers. The specification on the electroless nickel layer is that it should be 3-7 μm and the gold layer must be at least 40 nm.

Experiments were performed using a Fischer XDAL 237 SDD. One experiment was performed on each board using a test time of 30 seconds and a 0.3 mm collimator. Three of these boards were then selected, the thinnest and thickest gold layer were selected as well as one randomly selected additional board. 25 repeat measurements were made on each of these boards again using the 0.3mm collimator and a

30s test time. The larger 0.6mm collimator was then selected and the 25 tests repeated on each board. The actual measurements and results on all boards are in Appendix I.

Conclusions

Repeat measurements of the gold layer with the 0.3mm collimator give a standard deviation on all three boards of around 2nm. This equates to a coefficient of variation of around 2% for the thicker gold and 4% for the 48 nm layer. C.O.V for the nickel layer in all cases was less than 1%.

The minimum thickness for the gold is 0.04 µm, in order to reduce production costs he maximum gold plating thickness is required to be no more than 0.1 µm. These values were used to define process limits for a gauge capability study. Cg values using the 0.3 mm collimator are less than 1.33 indicating that longer measurement times would be required in order to allow the XDAL 237 SDD to monitor the process within the required tolerance.

The larger 0.6mm collimator gives more counts for analysis reducing the measurement uncertainty even further. Using the larger collimator significantly reduces the C.O.V to around 1% on all of the boards selected fo repeat testing. When these data are analysed to determine the Cg all are above 1.33 indicating that in this configuration (0.6 mm collimator and 30s measurement) the gauge is capable of monitoring the process within the required tolerance.

These results demonstrate the industry leading low gauge variation for measurements on thin gold layers. This means that results can be treated with confidence when economising the plating process.

Measurements on the nine boards indicate none are below the specified gold thickness and all fall within the tolerance band for the nickel layer. Using the same process limits as the gauge capability study these data were used to assess the process capability. This returns a Cp value of less tan 1.33 suggesting that modifications are required in order for the plating process to meet the required tolerance. The mean thickness of the gold layer is shifted toward the maximum thickness rather than being centered. This indicates that the process is typically putting down much more gold than is needed to satisfy the minimum layer thickness.