

The Use of Designed Experiments in Process Development

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Abstract

Manufacturing semiconductor packaging requires a multitude of processes, many using high speed automatic equipment. Individual processes often have hundreds of programmable process parameters that can significantly affect yield, reliability and long-term quality. Wire bonding is one such process. Trillions of wires are bonded annually connecting semiconductor devices to the outside world. Wire bonding is a welding process. Currently as many as 25 wires/second can be bonded using state-of-the-art automatic machinery. The wires are bonded sequentially, each wire (2 welds and loop formation) is produced in 25mSec or less. Statistically designed experiments (DOEs, designed experiments) are the best method to understand, develop, and optimize the process. Designed experiments allow adjusting multiple variables simultaneously. During data analysis the effects of each variable are separated and tested to determine whether the differences between the levels of each variable have a statistically significant effect on the process response. In addition, many DOE designs are capable of measuring variable interactions. Often interaction effects can be very important in understanding process behavior. Statistical validity testing improves data based decisions, avoiding false conclusions on small amounts of data.

This short course will discuss the use of Taguchi, Factorial, Fractional Factorial designed experiments as a method for understanding complex manufacturing processes. Examples from wire bonding will be used as the core but any process can as easily be studied. It will include selection of variables, choosing ranges and determining sample size.