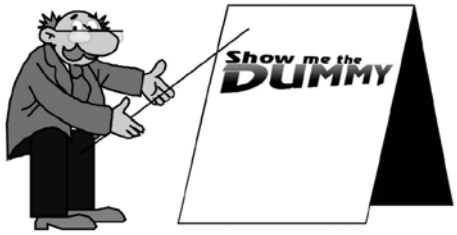
Dummies Provide SMT Process Improvements

Since the early 1980s, researchers have used dummies in the quest to improve SMT assembly processes. Dummies (also known as mechanical packages, test die or test vehicles) cost less than using electrically functional devices for a wide variety of process related applications. However, not all dummies perform equally. One size does not fit all applications. Skill and understanding is required when selecting the correct dummy for the job.

How to Select the Correct Dummy



Device		Typical Application					
Daisy Chain	Silicon Die	Parts Placement	Rework Practice	Underfil	Continuity Checking	S.I.R. Testing	Temperature Cycling
With	With	✓	✓	✓	✓	-	✓
	Without	✓	✓	✓	✓	-	-
Without	With	✓	✓	-	-	✓	-
	Without	✓	✓	-	-	✓	-

Dummies are used in a wide variety of process related applications within the electronics industry, especially involving SMT (Surface Mount Technology).

Dummies are often used for demonstrating SMT mounting machines (a.k.a. pick and place machines). Rudimentary applications such as machine evaluation, maintenance, calibration and acceptance testing require simple dummy packages, without the need for daisy chain or silicon die. Dummy packages such as QFP, TQFP, QFN, SOP, PLCC and area array packages such as BGA and CSP are lifted by vacuum nozzles from trays, reels or tubes and placed onto a platen, often just a double sided printed circuit board. The next time you visit a major trade show such as IPC Apex or Semicon, take a close look, and you will probably see placement machines demonstrating mounting dummy components onto printed circuit boards coated with double-sided adhesive tape, without using solder paste.

Particular applications involving life cycle testing require dummies with daisy chain and dummy silicon die. Such dummies are sometimes called test die, test vehicles or test components. The daisy chain permits electrical continuity testing. The dummy silicon die simulates the thermal mass of a "live" device during reflow soldering. The daisy chain is made by bonding gold wire between pairs of bonding pads on the lead frame. BGA and CSP daisy chain is usually made with copper traces between pairs of ball pads on the substrate, though wire bonding within the die cavity may also be used to form the daisy chain. Daisy chain means that pin 1 is connected to pin 2

within the device. Pin 3 is connected to pin 4. Pin 5 is connected to pin 6, and so forth until the last pin "N". On the PCB board, copper traces connect the landing pads of pin 2 to pin 3, pin 4 to pin 5, and pin 6 until the last pad. Electrical continuity is formed between the PC board and the device after soldering. After assembly, a short circuit is measured by probing an ohmmeter from the board's test point-pin 1 through test point pin "N". Solder joint reliability is verified by vibrating, dropping testing and temperature cycling the assembly using JEDEC, IPC and Mil specifications (eg: -55°C to +125°C in a humidity chamber) until a failure occurs. A "failure" means the daisy chain circuit goes from a "short" (near zero ohm) to an "open" circuit. The assembly and solder joint is forensically analyzed to determine the caused the failure. Dummies devices with daisy chain and silicon die are the most economical way to study why failures occur and how to improve the assembly process.

Dummy packages are also used in conducting PC board cleaning and cleanliness evaluations. A megohm meter plots the surface insulation resistance (S.I.R.) of the PC board before and after assembly and cleaning. In most S.I.R. applications, dummies must be completely isolated (open circuit) to avoid shorting out the S.I.R coupon, located under the component. However, certain S.I.R. testing requires daisy chain BGA/CSP devices.

BGA, CSP and flip chip test die with daisy chain are used in underfil experiments. Dummies are mounted on a test board, underfilled and then temperature cycled to a point of failure, and the results are observed. Dispensing and encapsulation evaluations also use dummy components. Still other applications involve certification of operators while using dummy components to rework and solder. While a case can be made to avoid the expense of using dummy components by simply using scrap components and defective boards, it should be understood that scrap parts do not have daisy chain, and in the case where thousands of components are required, there may not be sufficient number of scrap boards available.

Dummy components have become an accepted practice and low cost way for making improvements in SMT assembly processes. Major companies such as Intel, IBM, Motorola, Hewlett Packard, Cisco, Flextronics, Celestica, Sanmina-SCI, Jabil, NASA, Northrop Grumman, Lockheed, Boeing and numerous others understand the benefits of using dummy components for defining and refining SMT processes. While the annual consumption of dummy devices remains modest, dummies offer highly leveraged benefits for applications involving experimentation, demonstration, evaluation and learning. It is comforting to know that dummies have contributed to the knowledge base of some of the world's greatest inventions.

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