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Package Marking

Lasers and other options

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For many years, semiconductor package marking commanded little attention and continued with little change. However, the increasing demand for smaller components means that the available marking area also is smaller. So, while the complexity of electronic technologies increases, so do the demands on device identification technology.

Recently, the names of technology companies have become more complex with some names exceeding 20 characters in one line. Standards include two and three lines of identification codes to be marked, as well as a company logo (Figure 1). Marking codes require more details to be available to customers, ensuring that the correct product is purchased for their applications. The marks on the device package are the link to the component's complete identification and its process history.

Traceability

Traceability is valuable when defective components, parts, assemblies or products may be discovered during or after production or sale. Full traceability can allow accurate tracking and permit a partial rather than full recall to be carried out if necessary.

Traceability is defined as "the ability to trace the history, application or location of an entity by means of recorded identifications." Marking is only one of many steps. Data capture, management and analysis also are necessary to track manufactured products properly. Standardization must be implemented so different manufacturing elements result in a seamless flow of required information, and so that data and information can be exchanged between user and supplier. This improves overall semiconductor manufacturing capabilities.

Commercial marking specifications of semiconductor components are an outgrowth of military applications. These marking methods ensure correct component identification. Military requirements include package index identifier, chip identification code, drawing designator, part identification, country of origin, device type and class, case outline, manufacturer's designation, and many others (Figure 2). Today, component manufacturers' codes are based on some of these same requirements.

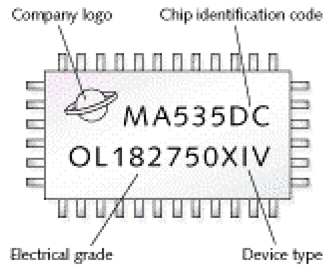

Figure 1. Basic package marking requirements.

Traditional Marking Processes
Generally, product and part identification quickly eliminate errors, valuable time and material waste expenditures, while helping to streamline production. Choosing the right marking system must be done carefully. The production application must be well defined as must the environment in which the system will be operating. Origin of manufacture, craftsmanship, service and support also should be considered because technical support may become an issue later.

Some current package marking methods are reviewed below:

Pad Printing. Basic steps in this process include the cliché step, in which the desired image to print is etched into a plate. This plate typically consists of hardened steel. Once placed on the printer, the cliché is inked by an open inkwell, a doktoring system (applying ink and scraping off the excess), or by an ink-cup sliding across the cliché. The second step is the transferring step where the pad picks up the inked image from the cliché and travels to the component to be marked. The pad then makes contact with the component using pressure to deliver the image.

Ink Marking. Inkjet printers use drop-on-demand technology. This means that the ink flow is turned on and off during the printing process to create patterns of ink droplets, resulting in an image. Thermal inkjet printing uses heat to vaporize ink expelled through the print nozzle as tiny droplets. The technology basis is to deflect and control a continuous inkjet droplet stream onto the printed media or into a gutter for recirculation by applying an electric field to previously charged inkjet droplets.

Electrolytic Marking. This procedure uses a unit to generate a low-voltage electric current (typically at 8 V) that is applied for a specific time onto the product through a stencil. An electrolyte chemical aids electricity flow applied to the marking head. The current etches away the top layer using conductive chemical solvents, leaving the stencil design permanently marked onto the product. The marking is completed in approximately two to three seconds.

Laser Marking
With the ability to provide legible characters smaller than any other available process, laser marking can provide capabilities that are not available with other processes. Laser marking also can present many different configurations, systems and methods. This technology will continue to grow, and it is important to select the proper laser wavelength for the application(s). The

variety of processing capabilities possible with laser marking can improve the overall cost-effectiveness of the marking system.

The production environment and type of machinery used to produce the product also must be considered. In most applications, it is ideal to mark the part prior to the packaging operation so that if any other process fails or is deemed to be a reject, the marking would not occur. This mark would verify that the component passed all assembly and testing operations, signaling a good product. Additionally, if the part required serialized numbers, this method would be the best choice to keep all the numbers in sequence.

Laser systems typically are used for well-defined, fast identification in which marking quality and space constraints matter. High-volume processing is ideal for this method as marking 200 to 300 characters per second can be achieved using a galvanometer configuration. This process has a wide range of applications, including industry standard 2-D, bar-code identification programs and complex graphics. Combined with vision systems, these machines can identify the placement of parts correctly prior to marking by any number of fiduciary marks, and then adjust the marking file accordingly to achieve optimum performance while substantially reducing material waste, time and personnel.

Figure 2. An example of the variety of information that can be marked on a semiconductor package.

Other Marking Variables

In today's high-volume manufacturing environment, it may be ideal to perform the marking operation on the fly, that is, while the product is moving or indexing on a conveyor or in-line type of system. This method lends itself to the laser marking concept for two major reasons. The first is the speed of typical laser marking systems. Second, most laser marking software has the capacity to modify one axis of marking in relation to the feed of the conveyor and moving part via an external quadrature encoder that is located on the conveyor mechanism. The laser manufacturer will be able to determine what the maximum marking "window" will be in relation to the size of the part surface to be marked and the speed of the conveying system.

Packages marked with a laser system have cradle-to-grave traceability, even in harsh environments. There are lasers that can process with some forgiveness in irregular surfaces, but this capability should be evaluated for any such application before committing to a particular process or piece of equipment. Other laser systems have limits on their material processing abilities and should be identified early in the research stage.

Laser marking systems have become a popular method of marking electronic components. From the operator and technician standpoint, the low-maintenance tool with no moving parts outside of the marking head adds to its appeal. Keeping the final output lens clean is the only maintenance required to the system.

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