Circuit Technology

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Changing PWB Technology

The printed wiring board (PWB) industry emerged in the 1950s as a print and etch technology that would enable the interconnection of electronic components. The original process has had difficulty in erasing that earlier crude image. In the 1960s, plated through-hole and multilayer technology was introduced, which created competition with the more sophisticated ceramic hybrid circuits industry in some high-tech applications.

At that time, military electronics was the driving force of the PWB industry. Reliability, rather than cost, was the determining factor in selection of interconnect systems. Hybrid circuits emerged as the innovative technology to be financed by military contracts, thereby superimposing dependability over cost factors.

With high-tech commercial electronics now expanding into the consumer market, the need for reliability at a reasonable cost has never been greater. Reduced defense spending—resulting from the conclusion of the cold war—has also fostered inflated emphasis on cost control in military electronics, providing the PWB industry with an opportunity to compete in areas previously reserved for hybrids.

The PWB Advantage

The main advantage of PWBs over ceramic hybrid circuits lies in material cost/size. The brittleness of ceramics creates handling problems on substrates with dimensions >15 cm (6 in.), while PWBs >122 cm (48 in.) are routinely processed. Hybrid ceramic circuits are normally manufactured individually, whereas multiple PWBs can be fabricated on large panels and later separated into individual wiring boards. This advantage saves in processing operations.

MCM-L, PBGA, TAB, and COB technologies have also enabled PWBs to compete with the more sophisticated hybrid circuits in high-tech applications requiring high-density packaging.

Selling price is often a decisive factor in determining size of the market for a product. The market for new products (FAX machines, cellular phones, laptop/handheld/desktop computers, laser printers) has expanded beyond initial predictions with costs decreasing to affordability for the average consumer.

PWB Fabrication Changes

To continue to share in this rapidly advancing high-tech market, the PWB industry must explore new manufacturing methods and improve present processes. High-density packaging requires fine lines/spaces, narrow vias, accurate dimensions, ultrathin MLBs and, often times, high-performance laminate material incrementing the cost of PWBs and necessitating high first-pass yields.

Areas of exploration to improve efficiency and streamline the manufacturing process include:

- Through-hole direct metallization
  - Carbon/conductive polymer/precious metal colloid technologies
- Ultrathin MLBs
  - Optimization of handling and lamination procedures
- Multiple surface finishes
  - Selective stripping/plating/hot coating
- Fine line imaging
  - ED resists/permanent inner layer resists
- Narrow vias
  - Laser drilling/buried vias

Advantages include:

- Direct metallization streamlines PWB processing and minimizes waste treatment.
- Ultrathin MLBs reduce weight and size of electronic devices.
- Multiple surface finishes permit components to be attached by different bonding methods.
- Fine lines/spaces/pads/vias conserve real estate, which is crucial for increasing packaging density.

Recent Success

During the last three years, some fabricators have been successful in implementing direct metallization and ultrathin MLBs. A difficult learning curve was required to master the techniques, install the equipment and effect the process changes required for direct metallization, and to efficiently manufacture ultrathin MLBs to PCMCIA standards.

Further implementation will be needed for selective finishes, fine lines/spaces <0.127 mm (<0.005 in.) and narrow vias <0.305 mm (<0.012 in.), in order to remain competitive with hybrid circuits in high-tech applications.

Although only a limited amount of production currently utilizes direct metallization, and only the more advanced PWB manufacturers have been successful with ultrathin multilayers, there has been enough success to prove both processes viable. Mastery of both is the key ingredient in the high-tech PWB market. ❑

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