Imbedded Component/Die Technology (IC/DT®)

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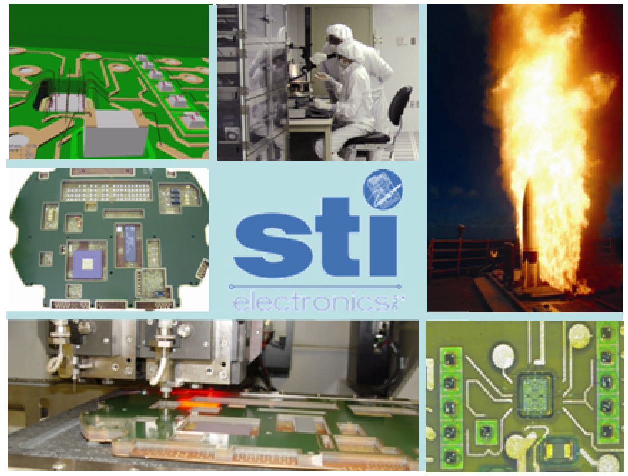

TECHNOLOGY DESCRIPTION

STI has developed a patented[1] packaging technology coined Imbedded Component/Die Technology (IC/DT®) to integrate multiple subsystems within an electronics assembly into a single, advanced, high-density assembly. Imbedded Component/Die Technology (IC/DT®) enables the manufacturing and assembly of smaller, lighter, and more technologically advanced high density CCAs through imbedding unpackaged components in a 3-D laminate substrate with integrated thermal management (see Figure 1). STI's IC/DT® packaging approach addresses miniaturization, thermal management, performance, reliability, and system capability requirements through innovative design guidelines and materials selection in order to meet form, fit, and function requirements.

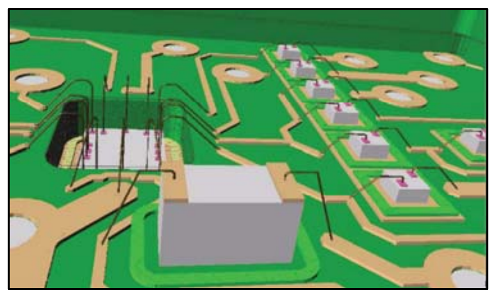

Figure 1. Unpackaged die imbedded in a laminate substrate.

Miniaturization and weight reduction required for electronics systems is achieved as IC/DT® utilizes unpackaged components for design with the smallest form and fit factor available. Component geometries can be reduced up to 85% through the removal of external lead frames, package substrates, and overmold encapsulants. Imbedded device types include bare die (face-up), bumped die or flip chip (face-down), thin film passives, and thick film passives. Multiple device types can be imbedded within the same cavity to integrate complex circuits with high performance requirements (see Figure 2). This advanced capability enables the integration of multiple subsystems, such as integrating daughter cards into a motherboard CCA within the current CCA form factor, and leads to reductions in pitch between CCAs in the chassis.

[1] Raby, J. et al. "Imbedded Component Integrated Circuit Assembly and Method of Making Same" United States Patent No. 7,116,557, October 3, 2006.

Very flexible light-weight interconnects, wire bonds, are utilized during operation in demanding thermal and mechanical environments such as high temperature, vibration, and/or mechanical shock. A mass savings is achieved by using wire bonds rather than solder because of the decreased volume of material per connection, as well as the lower density of standard wire bond materials compared to eutectic (Sn63/Pb37) solder. In addition to a mass savings, the IC/DT® concept distributes the applied stress in contrast to a soldered connection, which localizes the applied stress, producing a more robust and rugged electronics assembly for reliable use in harsh environments.

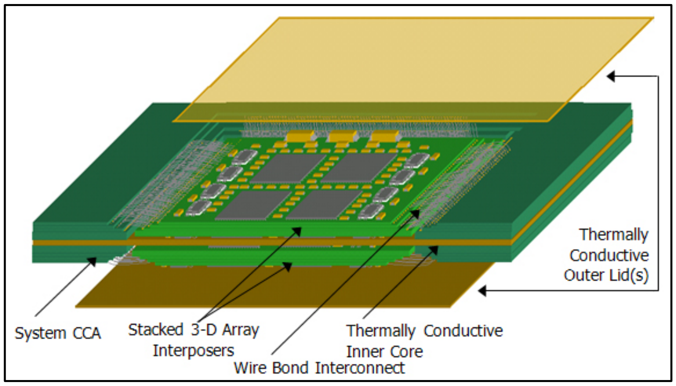

Figure 2. Imbedded processor arrays in a high-density circuit card assembly.

Conventionally, a high power CCA would dissipate heat through convection or radiation from the component and substrate surfaces, often including package-level heat sinks or cooling fans. However, advanced handheld applications inhibit the use of active cooling devices such as large, finned heat sinks and fans. Therefore, IC/DT® provides a solution through relying on passive cooling via conduction from the backside of the bare die to a single, central cooling core to remove heat from high power devices and to evenly distribute the thermal energy along the interface. Through creative thermal management, die junction temperatures (T_J) are reduced which increases the performance and longevity of the electronic components and further increases system-level reliability.

IC/DT® improves long-term signal reliability by eliminating unnecessary failure opportunities and utilizing reliable electrical interconnects. All first level component packaging is eliminated thus reducing two to four possible modes of electrical failures associated with component-level packaging. Through multiple subsystem integration, failure-prone connectors and wiring assemblies are eliminated which lead to an increase in long-term reliability of the electronics system.

Table 1: Features, Advantages, and Benefits

Features	Advantages	Benefits
Bare die, flip chip, and thick-film components	Enables mass reduction, Reduces component height and CCA pitch	Meets miniaturization requirements
Imbedded cavities and components	Controlled environment with coatings and encapsulants	Increases robustness of CCA in harsh environments
Multiple circuit card assembly integration	Reduction in interconnects (failure opportunities)	Improves reliability
Imbed die to an integrated substrate thermal core	Improves thermal characteristics of assembly	Lowers device junction temperatures

REFERENCES

STI is currently engaged in two SBIR Phase-II efforts to demonstrate the scalability of Lockheed Martin's SPAR-X image processor design using IC/DT® technology in order to achieve a 400% increase in processing capability within the existing form factor. The technical point of contact (TPOC) from Lockheed Martin, Jon Shatz, may be contacted for more information regarding integration of their design using STI's technology.

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STI is also involved in a collaborative SBIR Phase-II effort with three other small businesses, supported by Lockheed Martin's MKV and MKV Kill Vehicle Programs, to integrate multiple subsystems into a single miniaturized avionics module. The technical monitor (TM) for the collaborative effort, Charles Pagel, may be contacted for more information regarding integration of the multiple subsystems using STI's technology.

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ABOUT THE COMPANY

STI Electronics, Inc.'s Engineering Services division is a multifaceted technical organization whose common goal is to provide engineering support in the field of electronics manufacturing. STI is distinctive from other manufacturing and research and development (R&D) facilities in that it is a full service resource for advanced systems development, prototyping, manufacturing and assembly, and laboratory analysis. Utilizing some of the most advanced equipment for R&D, prototyping, and analysis enables engineers and analysts at STI the versatility to provide the highest quality services for a wide range of products in order to address the challenges and issues facing today's electronic manufacturers. Through product design and manufacturability analysis, to pre-production prototype and development (Engineering Services division is ISO 9001:2000 certified), STI's Prototype and Development Lab is a full service design review and pre-production facility. As problems arise in the manufacturing process, the Analytical Lab provides a wide range of services designed to characterize materials, detect failure modes, and perform exploratory analysis of products or processes.

Furthermore, the Microelectronics Lab was established to meet the rising need for advanced systems development and assembly including current technologies such as COB and Multichip Module (MCM). Over the past few years, the Microelectronics Lab has developed a unique packaging technology coined Imbedded Component/Die Technology for CCA design and assembly to solve a number of issues and problems facing conventional surface mount technology for military and aerospace applications such as the Standard-Missile 2, THAAD, and MKV. Imbedded Component/Die Technology's (IC/DT®) success lies in its ability to address systems and electronics hardware design that currently cannot be built small enough or dense enough with conventional surface mount technology.

An Imbedded Component/Die Technology prototype was integrated into a Standard Missile-2 flight test that was successfully conducted at Point Mugu, California on October 10, 2007. The San Diego based Aegis Destroyer, USS Kidd, using a Standard Missile–2 (SM-2) Block IIIA missile, successfully intercepted a target during its midcourse phase of flight. The Navy's Standard Missile Program Office used the flight test to support a technology demonstration of STI's Imbedded Component/Die Technology prototype, validating the electrical and mechanical performance of this new and innovative electronics-packaging concept. The Navy's Program Executive Office for Integrated Warfare Systems and STANDARD Missile Program Office (PEO IWS 3A) identified the need for more robust circuit cards for critical missile applications.[2]

[2] http://www.solderingtech.com/news/SM2.pdf