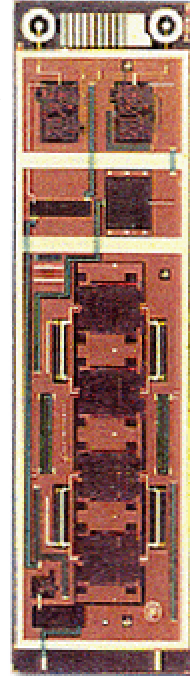
AMPS

Affordable Microwave Packaging System



Background

Lockheed Martin Naval Electronics and Surveillance Systems has been developing low-cost production processes and advanced materials for high volume production of transit/receive modules for future solid state Naval shipboard radar and communication systems. This is being accomplished under MANTECH funding for the Office of Naval Research, as directed by the American Competitiveness Institute (ACI), by leveraging commercial-off-the-shelf technology (COTS) and materials. Under the Affordable Microwave Packaging System (AMPS) program, a high-volume production process is being developed that makes use of high-density interconnect (HDI) technology in which kapton flex is encapsulated in plastic.

The plastic HDI process employs a chip first approach that uses a multi-up, pre-patterned kapton flex substrate. The flex is coated with adhesive and the Monolithic Microwave Integrated Circuit (MMIC) chips are installed face down onto the adhesive. The individual module outline is then defined by use of a dam-and-fill process which provides a foundation for additional laminations. Via holes are drilled using a laser process that etches through the flex and adhesive to contact the MMIC die pads. A vacuum-deposited plating and subsequent patterning process follows that provides the next metallization layer and interconnection to the vias. A series of laminations, laser drilled vias and patterned metallization complete the module stack-up.

Objective

The AMPS project objective is to reduce the risk (both technical and cost) for phased array radar transmit/receive (T/R) module production which employs high-density interconnect technology (HDI) developed by Lockheed Martin and the General Electric Corporate Research and Development Center. It is anticipated that the Lockheed Martin T/R modules will provide increased reliability and reduced size, as compared to modules that are made using conventional wirebond interconnect technology.

Benefits

- Reduction in the cost per T/R module from $4,000 currently, to approximately $2,500. Target cost savings per shipset is estimated at $7.5 million with combined cost reduction goals of both MANTECH and cost share efforts.
- Increase of up to 30% in the reliability of individual modules.

Applicable Weapons Systems

The primary initial target for HDI technology insertion is future AEGIS weapons systems platforms and Navy Theater Wide (NTW) applications. Additionally, other potential uses include satellite electronics, GPS, avionics (JSF), smart munitions, missiles (THAAD) and other commercial electronics packages where weight, size and reliability are important factors.

Technical Approach

The program is structured in three phases.

Phase I - Process optimization: The individual rate production process steps and advanced materials are developed.

Phase II - Prototype and pilot build demonstrations: A computer-integrated production and test environment is developed and demonstrated in small lot builds. Production processes developed in Phase I are integrated.

Phase III - Phase III includes a demonstration build of 5000 modules to qualify and characterize the integrated rate production capability and to support fabrication of a prototype array for qualification tesst.

The Phase III demonstration build portion of this program is currently unfunded and is contingent upon results of reliability tests and simulations as observed in Phase II.

Implementation Plan

The implementation strategy for the AMPS program is as follows:

1. Develop rate production processes and materials for plastic HDI that reduce risk and cost.
2. Integrate HDI production processes utilizing short duration prototype and pilot builds.
3. Develop and execute a certification plan to establish reliability that aligns with a planned insertion platform.
4. Provide basis for investment in line replaceable unit platform.