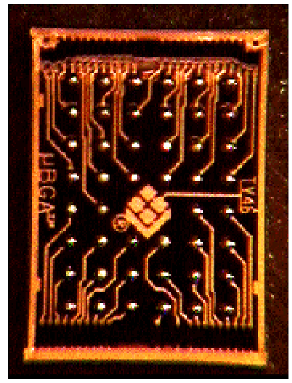
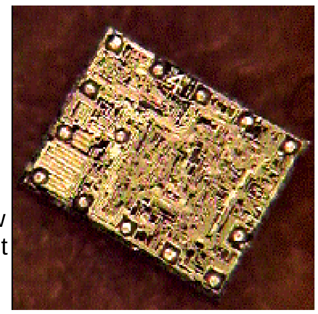
EMMA





Objective
The objective of this project was to determine, evaluate and mitigate the risks associated with integrating miniaturized commercial electronic packaging technologies into military guided missile systems.

Benefits
Legacy military weapon systems with electronic components universally face obsolescence issues in one form or another. The ability to go to the commercial marketplace with high-reliability electronic parts provides a solution to many of these obsolescence issues. The EMMA project has provided valuable data to decision-makers who must solve their weapon systems obsolescence problems.

Adding new or improved capability to existing weapon systems is another critical issue facing many programs. By inserting miniaturized commercial electronic packaging technologies to perform existing component functions, space is made available for additional hardware to add capability.

Total ownership cost (TOC) of a weapon system has become a primary focus area for all program managers. Introducing commercially available electronic packaging technologies has the dual cost advantage of reducing initial procurement costs and the higher reliability that typically accompanies the new technology. This translates into lower maintenance and repair costs throughout the life cycle of the weapon system.

Applicable Weapon Systems
The demonstration vehicle for this project is the Navy Standard Missile Autopilot Electronics Assembly, which currently uses 20 year old circuit card assembly technology. Overall cost savings to this program through reduced manufacturing costs are estimated to be in excess of $10M for the Standard Missile (over a six year period). Reliability is forecasted to increase by 50%, which will reduce TOC in the future. Cost savings from follow-on production contracts and other systems which leverage off this program will greatly increase these savings. Other weapon systems which will benefit from this program through the planned technology transfer program include the AIM-120, Javelin, Stinger, Patriot and Tomahawk.

Technical Approach
The EMPF is partnered with Raytheon and Rockwell Collins from industry; the Naval Surface Warfare Center-Crane and the Army Aviation and Missile Command from the government; and the University of Marquette and Georgia Tech Research Institute from academia on this 30 month project. The first major task was to survey the marketlace and determine what reliability data already existed so that a Design of Experiment (DOE) could be developed to address holes in the data. The state-of-the-market survey is complete, the DOE is developed, and parts are on order to build 440 test vehicle circuit cards with 20 different package types each.

The EMMA DOE test vehicles will contain a number of different factors as follows:

Board Type:
1. 0.062" Polyimide
2. High Tg FR4
3. Thermount

Surface Finish:
1. Organic solder preservative
2. Immersion gold

Conformal Coat:
1. Acrylic

2. none

Package Type:
1. Leaded (SOT, TQFP, TSSOP)
2. Ball grid array (input/output 64, 196, 256, 420, 560, 580 solder balls)
3. Chip scale package (input/output 46, 52, 64, 98, 128, 150, 240, 257 solder balls)
4. Flip chip (input/output 48 and 317 bumps)

Many previous DOEs with advanced package types have looked at temperature cycling only. Others have considered the effects of moisture, or perhaps vibration. The EMMA DOE is looking at five different environmental stress environments: thermal cycling, humidity, vibration, shock and salt fog. In addition several test vehicles will be reworked intentionally prior to each environment in order to identify the effect, if any, on reliability. Figure 1 shows the sort of solder ball interconnect failures that the experiment is designed to uncover.

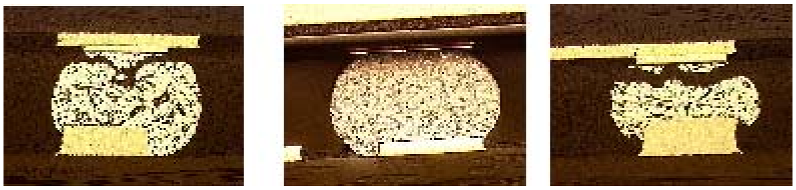


Figure 1

Results of the DOE, along with data gathered during the state-of-the-market survey, will be compiled into a Technology Application Guidelines (TAG) Handbook.