

Integrated MEMS Packaging

PROBLEM/OBJECTIVE

Air Force, Army and Navy next-generation smart weapons have the need for a small, low-cost deeply integrated Inertial Navigation System/Global Positioning System (INS/GPS) that is also capable of being gun-hardened. There is also a need for improved accuracy, mission flexibility, survivability, and increased standoff range.

By improving manufacturing processes for the Micro Electro-Mechanical Systems (MEMS) gyro and accelerometer sensors, unaided and aided navigation accuracy can be improved. In addition to improved performance, the use of a highly integrated solution results in a smaller form factor for the INS/GPS anti-jam (AJ) system, which will require less power. This will open up trade space for target missiles or munitions. These improvements will also result in a lower product cost because fewer circuit card assemblies are needed and integration and test time is shortened.

ACCOMPLISHMENTS/PAYOFF

Process Improvement: The Integrated MEMS Packaging (IMP) program has shown that it has been possible to increase manufacturing throughput of both Integrated MEMS Accelerometer and Gyro packages. This was done while increasing system accuracy, increasing g-hardness, reducing susceptibility to external jamming and significantly reducing overall system cost.

The Air Force Manufacturing Technology Division awarded a Phase 0 contract to Honeywell Defense and Space Systems in June of 2005 to do a business case analysis to determine the feasibility of upgrading the manufacture of the tactical INS-GPS/AJ family of products being developed for the Air Force and other services. This was followed by Phase I and Phase II contracts which were successfully completed in March of 2011.

Implementation and Technology Transfer: To date, the program has matured the technology to a validated Manufacturing Readiness Level of 8 for the Integrated MEMS Accelerometer and 6 for the Gyro package. This would be higher except the Inertial Measurement Unit (IMU) using the new IMPs has not yet gone into full rate production.

Honeywell tactical MEMS IMUs are slated to be used in the manufacture of over 111,000 precision guided munitions between 2008 and 2012. The new Integrated MEMS package will be phased into a number of new Air Force, Army and Navy precision-guided munition systems as well as 15 systems being developed by allied countries.



Expected Benefits and Warfighter Impact:

- Lower price on the average of 59% by improved processes & yields. Reduces price of IMU from \$5K/unit to <\$3K/unit; ROI: 10:1
- Increase circular error probability (CEP) accuracy by developing ability to screen sensors at the chip level before assembly
 - Increase Aided CEP by factor of 2.2
 - Increase Unaided CEP by factor of 4.8
 - Increase Jam to Signal Ratio (dB) to 98
- MEMS size reduction highly critical to demonstrate g-hardening for tactical grade gyros
- Accelerates LRIP by 3 Years for Honeywell IMUs

TIMELINE/MILESTONE

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| Start Date | June 2005 |
| End Date | March 2011 |

FUNDING

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| ManTech | \$8,438K |
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PARTICIPANTS

AFRL ManTech, WPAFB OH
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