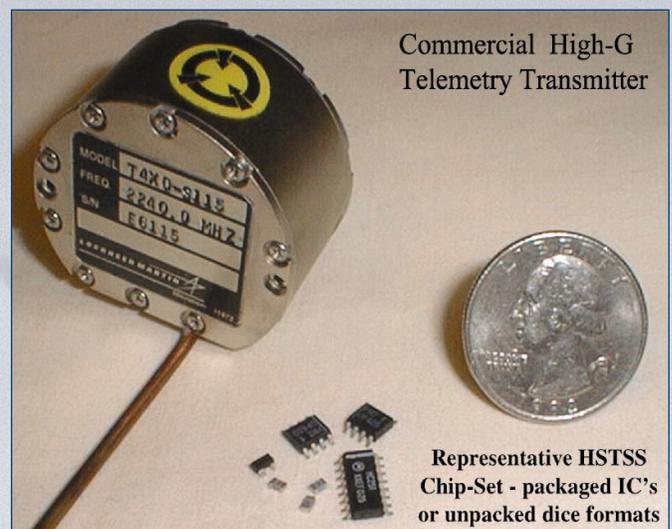




MINIATURE TELEMETRY FOR PROJECTILES, ROCKETS, AND MISSILES

The Project Manager for Instrumentation, Targets, and Threat Simulators (PM-ITTS) leads the DoD/Army HSTSS Program, with technology development and flight demonstrations provided by U.S. Army Research Laboratory (ARL), the U.S. Army Test and Evaluation Command, and industry.

PM-ITTS of the Simulation, Training and Instrumentation Command (STRICOM) has teamed with the Weapons and Materials Research Directorate of ARL for the conduct of the Hardened Subminiature Telemetry and Sensor System (HSTSS) program. The intent of the HSTSS program is to provide the test community with a new generation of high-g telemetry technologies to support gun-launched munitions. The HSTSS program is jointly funded by the DoD Central Test and Evaluation Investment Program (CTEIP) and PM-ITTS. Utilization of commercial-off-the-shelf (COTS) technologies microelectromechanical systems (MEMS) developed under the support of the Defense Advanced Research Projects Agency (DARPA) has been blended with high-g telemetry experience of ARL. Major contracts have been executed with the commercial sector.



HSTSS Transmitter Chip-Set from M/A-COM

SENSORS

The HSTSS program has been instrumental in demonstrating that MEMS-based devices (accelerometers, angular rate sensors, etc.) can be successfully used in gun-launched munitions. These devices will be available as packaged integrated circuits or known good die for assembly using multi-chip module technologies that have

• M898 In-Flight Vibration Survey

• MEMS Accelerometer has Survived 15,000 g and 250 Hz Spin to Measure Radial Accelerations and Find Projectile Dynamic Axes

• Yawsonde Measures Pitch/Yaw/Roll History and with Radar Yields Real Aerodynamics

M898 Projectile with 2 SADARM Submunitions

Built-In-Test Telemetry (BITT)

ADXT181 ($\pm 500\text{ g}$ @ 17 KHz)

YAWSONDE SENSOR

NATO-Compatible Fuze Package

DARPA MEMS Technology with ARL Yawsonde

MEMS Resonating Bar Magnetometer
Joint effort with Julius Hopkins University Applied Physics Lab and ARL

MEMS Angular-Rate Sensor Progress

DARPA MEMS Sensors

DATA ACQUISITION CHIP-SETS (DAC)

A contract with M/A-COM utilizes cellular technologies for a series of high-g qualified telemetry chip sets (transmitter and separate power amplifiers). Another effort with SPEC will provide programmable data acquisition chips (using standard pulse code modulation formats) that are "stackable" to provide a broad spectrum of solutions for

The Challenge: Develop a chip-set architecture that is programmable and expandable for use in a configurable instrumentation system to monitor sensors during flight testing of gun-launched munitions and missiles.

DAC Architecture based on Application-Specific Integrated Circuits (ASICs)

- 4-Channel Pulse Code Modulation (4-Ch PCM)
- "Stackable" 4-Channel Unit (up to 64-Ch PCM)
- Input Signal Conditioner (ISC)
- Delay/Repeater
- 6-Channel Frequency Division Multiplexer (FDM)

64-Channel chip-on-board configuration

4-Channel PCM single chip configuration

19-Channel PCM in MCM Package

19-Channel PCM for 2.75" Missile Application

SPEC 4-CH PCM in TPQFP-50

SPEC ISC in TPQFP-100

Three (3) Expansion ISCs on reverse for up to 64 Channel

19-Channel PCM with Growth to 64 Channels

System and Process Engineering Corp. (SPEC) DAC Contract

PACKAGING AND FLIGHT TESTING

An initial goal for the HSTSS program was to demonstrate the feasibility of locating a complete telemetry well of a kinetic energy (KE) projectile. That goal was recently realized with the successful demonstration of an S-band system. A new transmitter, battery, antenna, and mechanical package were fitted into a 105mm M735 KE training projectile. Launch accelerations of 65,000 g's were experienced with a successful measurement of free-flight spin. This flight test proves that the most extreme in-bore environments can be accommodated. This demonstration was made without the benefit of the M/A-COM and SPEC products. When these products are available, in-bore and free-flight measurements will be readily accomplished for a variety of medium and large-caliber munitions.

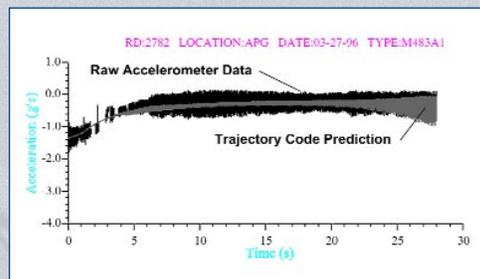
"Soda-Can" Warhead Replacement Kit with Inertial Mass Remount Unit (IMU)

HTSS-based MEMS IMU and Ultralife Battery

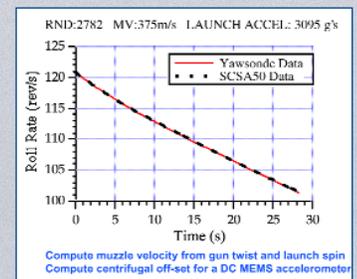
NAWC-China Lake, RTTC, ARL Team

Army REP for ATRCM community - Advanced Missile Instrumentation Package

Flight Systems that must be Built for the Test Community



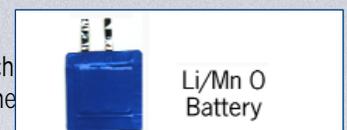
MEMS Accelerometer Flight Test (Spin Compensation using GMR Test data)



HSTSS GMR Spin Measurements (M483A1 Projectile)

BATTERIES

Other contracts are focused on qualify lithium primary and secondary batteries for high-g and spin launch and flight environments. The voltage levels of the transmitter and data acquisition chips are linked to the native voltage of these lithium power sources, 3-4 volts.



FOR FURTHER INFORMATION, CONTACT:

U.S. Army Research Laboratory
Weapons and Materials Research Directorate
Attn: AMSRL-WM
Aberdeen Proving Ground, Maryland 21005
amsrl-wm@arl.mil

Dr. William D'Amico
Chief, Advanced Munitions Concepts Branch
(410) 306-0980 or DSN 458-0980
damico@arl.mil

