

Full Circle Commercialization of a Dual-Use Micromachined Quartz Rate Sensor Technology

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Abstract

In early 1990s, BEI Systron Donner introduced a new MEMS tuning fork Quartz Rate Sensor (QRS) gyroscope technology (based on the Coriolis effect) that had been successfully utilized in several Aerospace and Defense (A&D) applications, including the guidance of the Maverick Missile. The technology had not captured significant market share beyond A&D and as the defense market contracted at the end of the Cold War, it caused a significant revenue reduction forcing the company to look at other markets.

An emerging application for low-cost rate sensors in automotive stability control brake systems was identified. The QRS exceeded automotive performance specifications and demonstrated potential for high volume, automated manufacturing techniques for lowering costs.

A massive culture and infrastructure change was implemented over the next 5 years to penetrate this market. Multi-discipline teams re-engineered every department to conform to automotive quality and ERP systems, statistical process controls, factory automation, engineering design/validation and technology road-mapping techniques for lowest unit cost and continuous cost reduction, exhaustive failure mode analysis and development of a global supplier and customer base.

Engineering re-designed production in three key areas: (1) quartz tuning fork fabrication, (2) fork balancing and hermetic packaging and (3) final assembly, calibration and test. Labor-intensive processes were eliminated by automation and proofed against human error. R&D Engineering achieved continuous cost reduction with 5 year technology roadmap plans including a unique design resulting in significant sensor size reduction while increasing performance, an outcome traditionally unexpected with size reduction in such mass based sensors. Primary customer needs of tight performance specifications and continuous fault detection for safety-critical applications were met, resulting in enthusiastic acceptance by the automotive industry with over 10 million sensors shipped to date.

With renewed Government emphasis on A&D budgets, this low-cost, high performance technology is being leveraged back into A&D applications (UAV's, low-cost missiles, smart munitions, guided bombs, avionics, etc) while simultaneously penetrating advanced automotive applications.

This full circle commercialization has produced unprecedented profitable growth for the company including revenue growth exceeding a factor of 6 since 1995.

Short Bio

Dr. Asad M. Madni is President and Chief Operating Officer of BEI Technologies, Inc., located in Sylmar, California. Prior to joining BEI in 1992 he was with Systron Donner Corporation (A Thorn/EMI Company) for 18 years where he served in various senior level technical and executive positions, eventually as Chairman, President and CEO. He received the A.A.S. degree from RCA Institutes, Inc., B.S. and M.S. degrees from University of California, Los Angeles and the Ph.D. degree from California Coast University, all in electrical engineering. He is also a graduate of the Certificate Program in Engineering Management at the California Institute of Technology, the Executive Institute at Stanford University and the Program for Senior Executives at MIT Sloan School of Management. Dr. Madni is an internationally recognized authority with over 30 years of experience in “intelligent” system design and signal processing. He is credited with over 90 refereed publications, 24 issued patents and 16 patents pending resulting in numerous “industry firsts.” He serves as a director on the board of four technology companies and on the advisory boards of several professional and academic organizations including California State University Northridge, College of Extended Learning, UCLA Electrical, Mechanical and Aerospace Engineering Departments, UCLA Wireless Internet for Mobile Enterprise Consortium (WINMEC), UCLA WINMEC Radio Frequency Identification (RFID) Group, USC Electrical Engineering Advisory Board and the Journal SENSORS. Dr. Madni is also the recipient of numerous awards and honors including, the 2004 Distinguished Engineering Achievement Award from the San Fernando Valley Engineers’ Council, the 2003 George Washington Engineer of the Year Award from the Los Angeles Council of Engineers and Scientists (LACES), the 2002 UCLA Professional Achievement Award Medal, IEEE Third Millennium Medal, Joseph F. Engelberger best paper award at the 2000 World Automation Congress, California Coast University Distinguished Alumni Award, and is listed in all the major Who’s Who publications including Who’s Who in America. He is a Chartered Engineer, Fellow of the Institute of Electrical and Electronics Engineers, Fellow of the Institution of Electrical Engineers (UK), Fellow of the Institute for the Advancement of Engineering, Fellow of the New York Academy of Sciences, Fellow of the American Association for the Advancement of Science, and Fellow of the International Biographical Association. He is also a Lifetime Senior Member of the American Institute of Aeronautics and Astronautics, Life Member of the Association of Old Crows, and Member of the Society of Automotive Engineers.