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The New Generation Infinia Free-Piston Stirling Engine for Micro-CHP and Remote Power Applications

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The advancement of free-piston Stirling engines in the last decade has made them attractive for use in the micro-CHP (combined heat and power) and remote power markets. Infinia Corporation, the leader in free-piston Stirling engine technology development, is the primary provider of high-efficiency, long-life Stirling engines and cryocoolers to U.S. government and commercial companies. This paper reviews Infinia's free-piston Stirling technology development and latest technology advancements as they relate to the next generation Infinia 3.1-kW free-piston engine for micro-CHP and remote power applications. This new generation 3.1-kW Stirling engine inherits the key features of all Infinia free-piston engines – prodigious durability, low noise, and multi-fuels compatibility – while substantially reducing costs and increasing specific power. Many new technologies and features have been implemented to further improve the reliability and some design issues have been addressed to simplify system integration.

Nomenclature

SCA = Stirling Convertor Assembly
CHP = combined heat and power
FPSE = free-piston Stirling engine
SBIR = Small Business Innovation Research

I. Introduction

INFINIA Corporation developed and prototyped the 1-kW Stirling Convertor Assembly (SCA) for use in the European residential combined heat and power (CHP) market under sponsorship of the Dutch consortium, ENATEC. As with all Infinia free-piston Stirling engines (FPSE), the 1-kW design embodied the hallmark features of prodigious durability, low noise, and multi-fuel compatibility. ENATEC is conducting successful home trials of systems based on this design, with some now exceeding 2 years of operation.

As part of manufacturing cost reduction assessments conducted internally at Infinia, and in collaboration with Infinia licensees, several approaches have been identified to reduce the production costs of the 1-kW FPSE technology to levels that support cost-beneficial consumer purchases. Cost reduction approaches include assembly improvements and part redesigns for the 1-kW SCA. This includes design changes to accommodate new manufacturing methods, such as stamping and casting metal parts, as well as extensive modeling of new, high-volume friendly configurations and low-cost materials. The results of these efforts will directly benefit Infinia's future ability to provide consumers with reliable, low-cost systems.

Additionally, efforts funded under a Phase I Small Business Innovation Research (SBIR) grant with the U.S. Army have been focused on reducing the SCA mass and volume of the 1-kW SCA. The resulting technology developments described in this paper include:

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