

Development and Magnetic Analysis of Stirling Converter Assembly Linear Alternators

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Infinia Corporation is working with NASA Glenn Research Center to evolve the Infinia Technology Demonstration Converter into a lower mass, higher efficiency design. As part of the effort, the linear alternator has been re-designed and analyzed using a 3-D finite element analysis (FEA) software package. The linear alternator is the most massive component of the Stirling converter assembly and offers the highest potential for mass reduction and corresponding gains in power density. The 3-D MAXWELL software package was applied to determine the demagnetization margin for permanent magnets and to map the detailed magnetic field of the laminations to maximize the use of lamination iron, which is not provided by the empirical, in-house design code. Initial evaluation shows that substantial weight reduction can be achieved with a compact, moving-magnet linear alternator design. The improved linear alternators employ more compact copper coils and stator/mover iron and higher operation frequency to achieve significant overall weight reduction. This paper presents some of the analysis results and discusses areas for future improvement.

Nomenclature

<i>FPSE</i>	=	Free-Piston Stirling Engine
<i>CHP</i>	=	Combined Heat and Power
<i>GRC</i>	=	Glenn Research Center
<i>SCA</i>	=	Stirling Converter Assembly
<i>FEA</i>	=	Finite Element Analysis
<i>MTI</i>	=	Mechanical Technology Incorporated
<i>CTCP</i>	=	Component Test Power Converter
<i>SBIR</i>	=	Small Business Innovative Research

I. Introduction

Recently Infinia, supported through a NASA Glenn Research Center (GRC) task order contract, undertook a design study to reduce Stirling Converter Assembly (SCA) mass. Particular attention was paid to the converter assembly and the linear alternator, which constitutes 70% of the overall SCA mass. Several new, low-mass alternator configurations were designed and evaluated, from which a smaller, lighter, moving-magnet configuration was chosen as a promising upgrade over the Infinia legacy, moving-iron linear alternator. Other analyses of the general linear alternator design have identified significant potential mass savings through optimization of magnetic flux distribution, improved topologies, and coil/laminate usage. This paper provides some details regarding the new linear alternator designs, as well as results of analyses performed using 3-D MAXWELL.

II. Advanced Low-Mass Alternator

Moving-iron alternators, such as those used in legacy SCA systems, contribute significantly to overall mass. Reducing the overall stator diameter will be a key focus of the new design, considering that mass and volume both scale with the square of the diameter. Figure 1 provides an illustration of the current Infinia moving-iron linear

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RD Boyd

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Development And Magnetic Analysis Of Stirling Convertor:

A 3-D Magnetic Analysis of a Stirling Convertor Linear Alternator Under Load ,2001 Research & Technology 2002 ,
A 3-D Magnetic Analysis of a Linear Alternator For a Stirling Power System ,2000 **Magnetocaloric Energy Conversion** Andrej Kitanovski,Jaka Tušek,Urban Tomc,Uroš Plaznik,Marko Ožbolt,Alojz Poredoš,2014-12-03 This book provides the latest research on a new alternative form of technology the magnetocaloric energy conversion This area of research concerns magnetic refrigeration and cooling magnetic heat pumping and magnetic power generation The book s systematic approach offers the theoretical basis of magnetocaloric energy conversion and its various sub domains and this is supported with the practical examples Besides these fundamentals the book also introduces potential solutions to engineering problems in magnetocalorics and to alternative technologies of solid state energy conversion The aim of the book is therefore to provide engineers with the most up to date information and also to facilitate the understanding design and construction of future magnetocaloric energy conversion devices The magnetocaloric energy conversion represents an alternative to compressor based refrigerators and heat pumps It is a serious alternative to power generation with low enthalpy heat sources This green technology offers an opportunity to use environmentally friendly solid refrigerants and the potentially high energy efficiency follows the trends of future energy conversion devices This book is intended for postgraduate students and researchers of refrigeration heat pumping power generation alternatives heat regenerators and advanced heat transfer mechanisms **Aerospace America** ,2005 *A Collection of Technical Papers* Conference,Intersociety Energy Conversion Engineering,2000 **Space Technology and Applications International Forum 2007** Mohamed S. El-Genk,2007 The proceedings of STAIF 2007 feature a broad spectrum of topics on These topics span the range from basic research to the most recent technology advances and hardware development and testing The proceedings will be of particular interest to program managers practicing engineers academicians graduate students system designers and researchers interested in the fields of space technology and space science **NASA Technical Memorandum** ,1994 **Advancing Toward Technology Breakout in Energy Conversion** ,1986 Proceedings of the 27th Intersociety Energy Conversion Engineering Conference ,1992 Research and Technology 2002 ,2003 **Research & Technology 2003** , Energy ,1983 **Scientific and Technical Aerospace Reports** ,1994 *Proceedings of the 27th Intersociety Energy Conversion Engineering Conference: Policy impact* ,1992 *Energy Research Abstracts* ,1986
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Table of Contents Development And Magnetic Analysis Of Stirling Convertor

1. Understanding the eBook Development And Magnetic Analysis Of Stirling Convertor
 - The Rise of Digital Reading Development And Magnetic Analysis Of Stirling Convertor
 - Advantages of eBooks Over Traditional Books
2. Identifying Development And Magnetic Analysis Of Stirling Convertor
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in a Development And Magnetic Analysis Of Stirling Convertor
 - User-Friendly Interface
4. Exploring eBook Recommendations from Development And Magnetic Analysis Of Stirling Convertor
 - Personalized Recommendations
 - Development And Magnetic Analysis Of Stirling Convertor User Reviews and Ratings
 - Development And Magnetic Analysis Of Stirling Convertor and Bestseller Lists

5. Accessing Development And Magnetic Analysis Of Stirling Convertor Free and Paid eBooks
 - Development And Magnetic Analysis Of Stirling Convertor Public Domain eBooks
 - Development And Magnetic Analysis Of Stirling Convertor eBook Subscription Services
 - Development And Magnetic Analysis Of Stirling Convertor Budget-Friendly Options
6. Navigating Development And Magnetic Analysis Of Stirling Convertor eBook Formats
 - ePub, PDF, MOBI, and More
 - Development And Magnetic Analysis Of Stirling Convertor Compatibility with Devices
 - Development And Magnetic Analysis Of Stirling Convertor Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Development And Magnetic Analysis Of Stirling Convertor
 - Highlighting and Note-Taking Development And Magnetic Analysis Of Stirling Convertor
 - Interactive Elements Development And Magnetic Analysis Of Stirling Convertor
8. Staying Engaged with Development And Magnetic Analysis Of Stirling Convertor
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Development And Magnetic Analysis Of Stirling Convertor
9. Balancing eBooks and Physical Books Development And Magnetic Analysis Of Stirling Convertor
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Development And Magnetic Analysis Of Stirling Convertor
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Development And Magnetic Analysis Of Stirling Convertor
 - Setting Reading Goals Development And Magnetic Analysis Of Stirling Convertor
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Development And Magnetic Analysis Of Stirling Convertor
 - Fact-Checking eBook Content of Development And Magnetic Analysis Of Stirling Convertor
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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