2012 DOE Vehicle Technologies Program Review

Next Generation Inverter

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Project ID # **APE040**

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Overview

Timeline

- Start - October 2011
- Finish – January 2016
- 2.0% Complete

Barriers

- Cost
- Efficiency
- Performance and Lifetime
- Mass and Volume

Budget

- Total project funding
  - DOE - $6.0M
  - GM - $10.6M
- Funding received in FY12
  - GM - $0.1M
  - National Labs - $0.0M

Partners

- Lead – General Motors
- Tier 1, 2, & 3 Suppliers - Hitachi, Delphi, Infineon, HRL, Panasonic, AVX, Kemet, and VePoint
- Collaborations - National Renewable Energy Laboratory, and Oak Ridge National Laboratory

Relevance

Research Focus Area: Inverter

➔Modularity/Scalability

➔Components – power module, gate drive, capacitor, current sensor and control card

➔Supplier development

Objective

- Program, develop the technologies and the engineering product design for a low cost highly efficient next generation power inverter capable of 55kW peak/30kW continuous power.
- Current (10/11 through 1/13), investigate, experiment, and evaluate potential technology for automotive application

Addresses Targets

- The Inverter is to improve the cost of the power electronics to $3.30/kW produced in quantities of 100,000 units, and the power density to 13.4kW/l, and a specific power of 14.1kW/kg, with an efficiency >94% (10%-100% speed at 20% rated torque) to meet the DOE 2020 goals

Uniqueness and Impacts

- Technology Co-development with the Tier 1, 2, and 3 suppliers
- Detailed knowledge of vehicle application and ability to understand and assess vehicle impacts to make necessary materials and technology trades.

Milestone

Month /Year	Milestone or Go/No-Go Decision
June 2012	Power Inverters Based on Conventional, Transfer Molded, and Encapsulated Power Module Technology Delivered for Evaluation
Jan 2013	Initial Technology and Production Cost Assessment Complete with Report
Jan 2014	Concept Design Review – DOE “Go/No-Go” Decision

Approach

- Engage with Tier 1, 2, and 3 suppliers along with National Labs to co-develop technology that reduces cost and increase efficiency, without increasing volume or mass
- Ensure modularity and scalability of inverter to meet all vehicle applications
  - Packaging
  - Consistent electrical characteristics and mechanical
  - Has to provide adequate cooling for the capacitor
  - Has to have low inductance
  - Has to adhere to global manufacturing processes

Strategy

- Inverter requirements need to be refined to better describe real vehicle use
  - Inputs necessary for actuate results are as follows: vehicle, powertrain, and electric traction system
- Select technologies that are aligned with vehicle application to make common inverters
  - Power module, gate drive, capacitor, and control card
- Cost reduction versus performance trade-offs
- Ensure compatibility with future switches

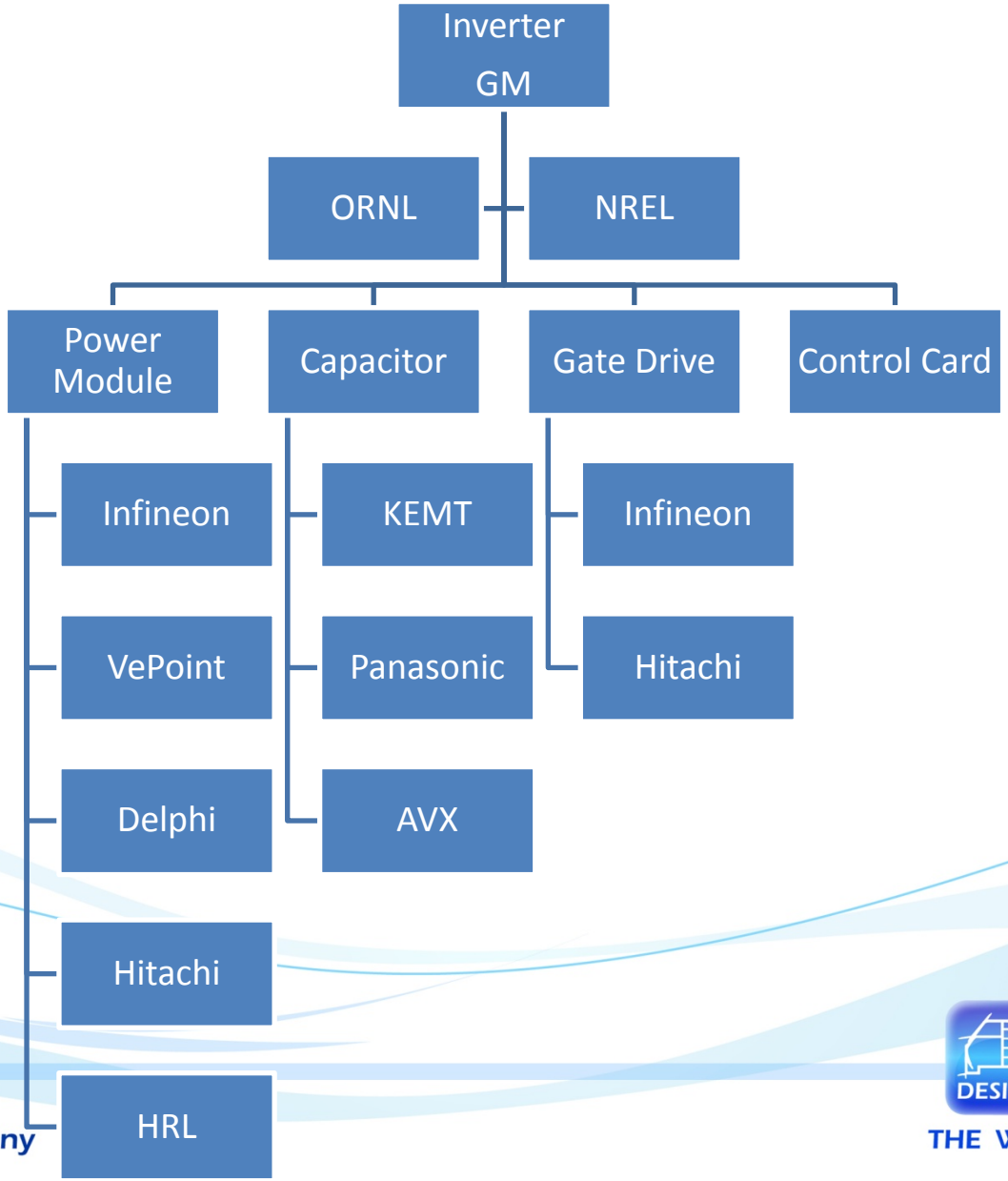
Accomplishments

- Specifications have been developed for the key vehicle applications
  - Integrated and remote mounted applications
  - Identified specifications needing refinement
- Inverter/Power module evaluation (Conventional, Transfer Molded, and Encapsulated)
  - Test Plan has been developed and testing started

Accomplishments (con't)

- Silicon Carbide study completed
- Capacitor statement of work has been completed and sent out to tier 2 suppliers
- Gate drive, have met with tier 1 and 2 suppliers
- Processor study comparing various solutions from tier 2 suppliers has been completed

Collaborations and Coordination



Future Work

FY12

- Well defined requirements
- Experimentation and evaluation power modules, capacitors, gate drive, and processor

FY13

- Initial Technology Assessment and Production Cost Assessment
- Start Design Concept

Summary

- Preliminary CTS (Component Technical Specification) completed after reviewing appropriate VTS and SSTS
- Starting power module testing of conventional and transfer molded
- Working with tier 1 and 2 suppliers
  - Capacitor
  - Gate Drive
- Evaluating processor choices