



iNEMI
International Electronics Manufacturing Initiative

**High-Voltage DC-DC
Power Module
Development
Public Review**

DC-DC Power Module Phase 1 (Spec Development) Project

Problem statement: A modular DC-DC power supply is needed to provide low cost, higher efficiency to the datacenter/rack system.

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Background or Context	Project Goals	Start:	7/2013	End:	10/2014
<ul style="list-style-type: none"> Because of Higher cost of AC UPS if used in modular form, lower efficiency and reliability issues with AC systems, DC distribution at 380V DC is being considered to power the Datacenters of the future. Although Telco already uses DC distribution, the 48V DC bus voltage is not sufficient to deliver sufficient power with the existing distribution cables for the future Telco systems. 	<ul style="list-style-type: none"> <u>Deliver a technical specification.</u> This will provide the participants with a specification that includes a complete assessment of the High Voltage DC – DC module with the UL and other safety certification requirements that can be used to build a prototype module 				
Key Learnings & Project Results	Next Steps & Timeline (if applicable)				
<ul style="list-style-type: none"> The specification is complete and approved by the team with input from multiple OEMs and their preferred power supply suppliers. 	<ul style="list-style-type: none"> Phase 2 involves building and testing the prototypes to meet the electrical and mechanical specification and based on measured results to decide on the final electrical specification regarding Efficiency and power delivery and mechanical specification regarding size of the module, input and output pin configuration This will be done by building the module and testing the modules to meet the electrical requirement. How/If to do this is under discussion. Main concern is cost and IP. 				



Project Summary

- **Problem**

- Lack of standardized high voltage DC-DC power module for cheaper, smaller and higher efficiency solution in the era of HVDC power system

- **Opportunity**

- High voltage DC-DC power module with low cost, small form factor and higher efficiency for HVDC power system

- **Goal**

- Phase 1: Technical specification of the high voltage DC-DC module
- Phase 2: Prototyping of the high voltage DC-DC module (TBD)

Background/Context

- **AC distribution power system for IT equipment**
 - Higher cost for AC UPS
 - Lower efficiency and reliability issue for multiple AC/DC conversion
- **48V DC distribution to Telco equipment**
 - Insufficient power delivery due to lower voltage for future Data Centers
- **380V DC distribution (HVDC) on the horizon**
 - Higher efficiency and reliability due to less conversion
 - Higher power distribution due to higher voltage
- **380VDC – 12V DC module in existing Data Center AC distribution**
 - Low cost Rack solution by AC – 380V Rectifier and 380VDC – 12V DC module
- **380VDC – 12V DC module in new Data Center DC distribution**
 - Low cost Data Center solution 380V Rectifier and 380VDC – 12V DC module

Scope of Work (Phase 1)

- **Documentation and evaluation on the feasibility of a High Voltage (380V) DC input to a 12V DC output module.**
 - **Feasibility review of size and power capability**
 - **Research on new devices/materials**
 - **Technical feasibility study and identification of dependencies for the specification**
 - **Assessment on time to market of the DC-DC module**
 - **Development of a technical specification for a 380V DC input to 12V DC output module.**

DC-DC Power Module Phase 1 (Per SOW 1/23/13)

This Project Is:	This Project IS NOT:
Phase 1 - Spec Development	
<p>Development of a technical specification for a DC-DC device within these tolerances:</p> <ul style="list-style-type: none"> •For use in 1 U height box (maximum) 1.75 inches so module is 1.4-1.5 inches height; Width and Length ---- TBD •500-750 W range Power Module •380 +/- 5% VDC Input and 12V DC Output. •Efficiency Target = 96 – 97% (Target equivalent to an AC 12V efficiency at a minimum) 	<p>Development of a standard</p>
<p>Ability to work in parallel (modular approach) – Minimum two suppliers</p>	<p>Repeat of prior or existing work</p>
<p>IT Hardware Optimized and Telecom Hardware Enabled</p>	<p>Biased towards specific suppliers, geographies, or market segments</p>
<p>Power Density: 200-250 watts per cubic inch</p>	<p>Defining/identifying suppliers</p>
<p>Leverage existing technology</p>	<p>Testing or prototyping</p>
<p>Output – Team only use for one year then reverts to iNEMI (Standard iNEMI agreement); membership report out is required (level of detail can be very high)</p>	<p>Sharing of intellectual property</p>

Purpose of Project

- **Address most, if not all, the electrical and mechanical specifications in this project for a DC-DC module.**
- **Provide the participants with a specification that includes a complete assessment of the High Voltage DC-DC module and safety certification requirements.**

Expected Benefits of Project

- **Cost benefit**
 - Industry standard product
 - Low cost power solution compared to the company proprietary expensive solutions
- **Improvements in time-to-market**
 - Specification and multiple sources for developing the product
- **Define Common Package for HV technology converter**
- **Size/Efficiency merits**
 - Narrow input voltage range for 380V DC proposed for higher efficiency
 - Lower DC distribution losses (I^2R) due to lower current
- **Meet the future power demand (5X more)**
 - 380V DC distribution over 48V DC distribution

Project Phase 1 Tasks

Task 1: Learning/Standards Review

Task 2: Team Discussion/ Specification Development

Task 3: Initial Draft of Specification

Task 4: OEM and Supplier Validation of Spec

Task 5: Specification Update based on Reviews

Overview of DC-DC Module Specification

Item	Minimum	Nominal	Maximum
Input Voltage	360 Vdc	380 Vdc	400 Vdc
Efficiency	92% @ 10% Load	96% @ full load	97% @ 50% load
DC Output Voltage	11.60 Vdc	12.00 Vdc	12.60 Vdc
DC Output Current	0 A		62.5 A
Current Sharing			Within 10% when operating \geq 20% load
Over Voltage Protection	13.46 Vdc		14.69 Vdc
Under Voltage Protection	9.79 Vdc		10.8 Vdc
Over Current Protection	105% of Max Load		120% of Max Load
Operating Temperature	- 5 C		60 C
Packaging		DOSA Quarter Brick Form Factor	
Reliability		1 Mhr MTBF Minimum	



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Phase 2 (Under Discussion)

Advancing manufacturing technology

Future Activities

Preparing for Phase 2 and beyond

- **Estimated Timeline: End 2014 to end of 2015**
- **Phase 2 SOW Development**
 - Open to all interested companies
- **Prototype building and testing to meet the specification**
 - Work with OEM's and suppliers to develop a module and perform verification testing
- **Improvement/enhancement of the prototype (Phase 2+)**
 - Efficiency, power density, packaging, PMBus control, etc.

Expected Benefits to Join Phase 2 DC-DC Project

- **For Suppliers**

- Access to the iNEMI HVDC specification developed in Phase 1
- Be aware of the efficiency, power density, reliability and temperature target requirements of HVDC modules for servers in Datacenters, Mobile Switching Centers and Central Offices
- A guaranteed way to obtain OEM feedback on your technical solution
- Potential to be first to market with a new HVDC building block
- Be a technology leader in HVDC
- Understand the implications of Silicon, GaN or SiC based devices as well as particular preferred topologies in order to fulfill the module target specifications

- **For OEMs**

- A way to influence the technical solutions from suppliers
- Awareness of the details of the HVDC building block
- Improved time to market of future products requiring the DC-DC building block
- Improved Total Cost of Ownership of HVDC Solution
- Improved Reliability and System Operating Life

