DC Charging compatibility

Grappling with challenges between 800V and 400V

VICOR

The technical challenges presented by 400/800V EV charging

800V vehicles require additional components or modifications to the existing subsystems

Any additional component or change must be designed to fulfill functional safety

Technical solution should be compatible with many different variants of existing DC charging stations (communication, safety, EMC)

DC Charging 400/800V compatibility

Vicor’s approach is to enable charging compatibility by:

- Simplifying design effort
- Maintaining the high performance of other components and subsystems in 800V architecture
- Occupying minimum weight and space
- Supplying a universal solution independent on charging station and battery configuration

Vicor solution

Highly integrated DC/DC converter (power modules) based on SAC (Sine Amplitude Converter)

- Virtualize 400V battery
- Minimizes BoM
- Simplifies assembly and packaging
- Minimizes filtering effort
- Scalable in power
- Doesn’t affect charging station control loop
- High power density with smallest packaging requirement
- Bi-directionality

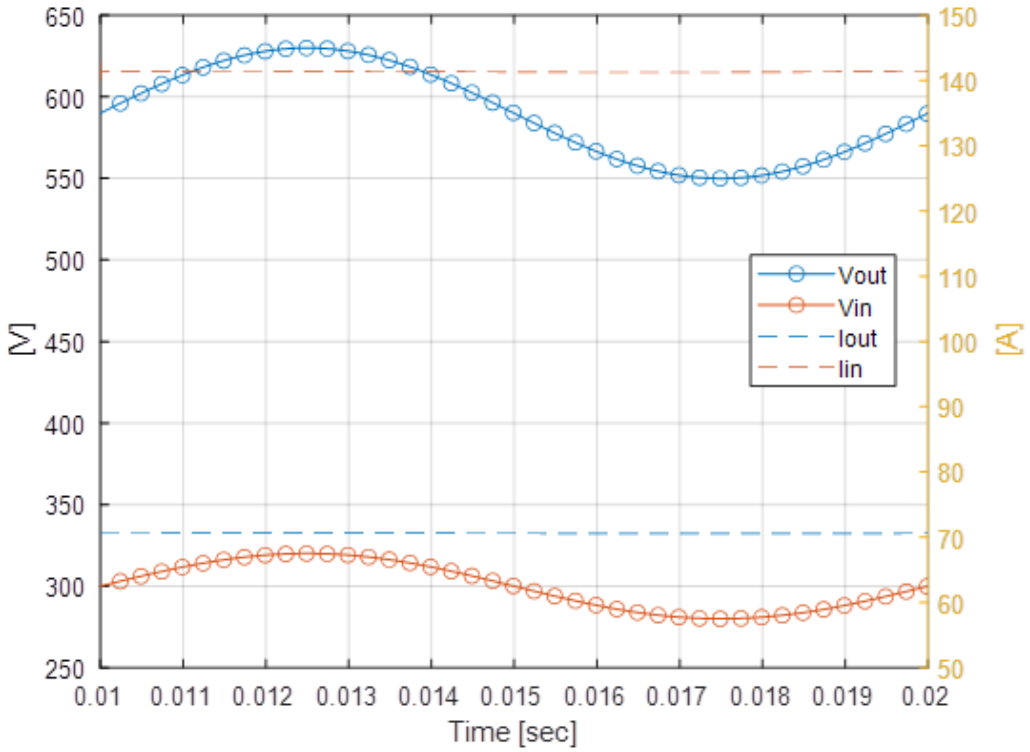
Battery virtualization

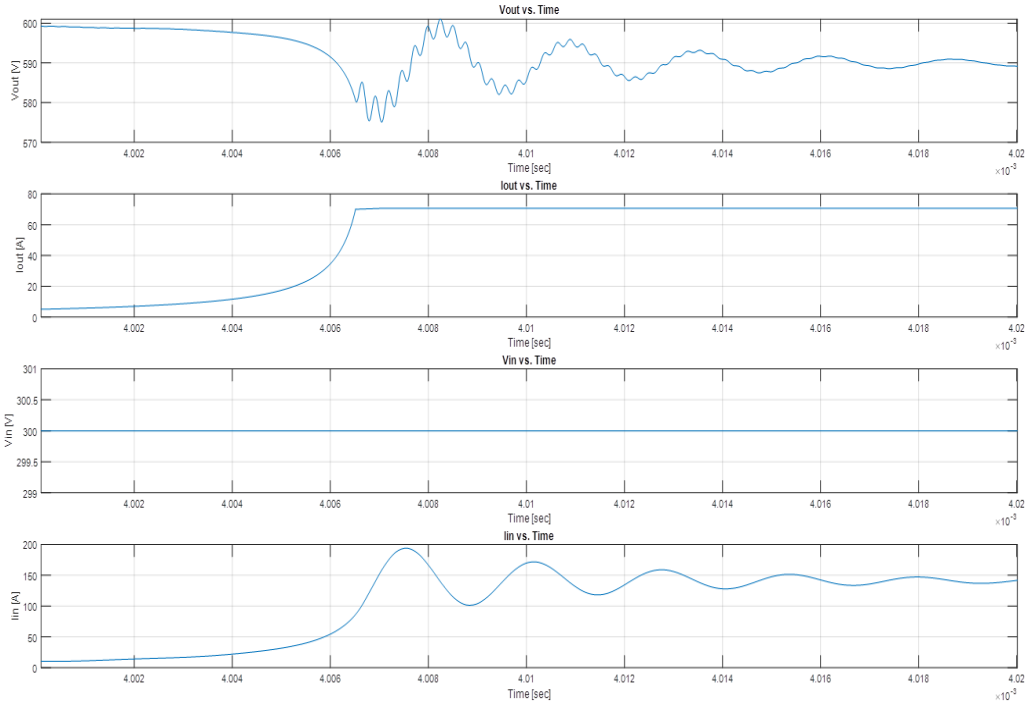
Concept based on SAC technology

- High bandwidth operation (no energy storage)
- Low impedance and low parasitic power train
- Soft switching
- Idealized voltage transformation

Connecting DC/DC power module to 800V battery, will virtualize 400V battery on other side.

Bandwidth and battery virtualization



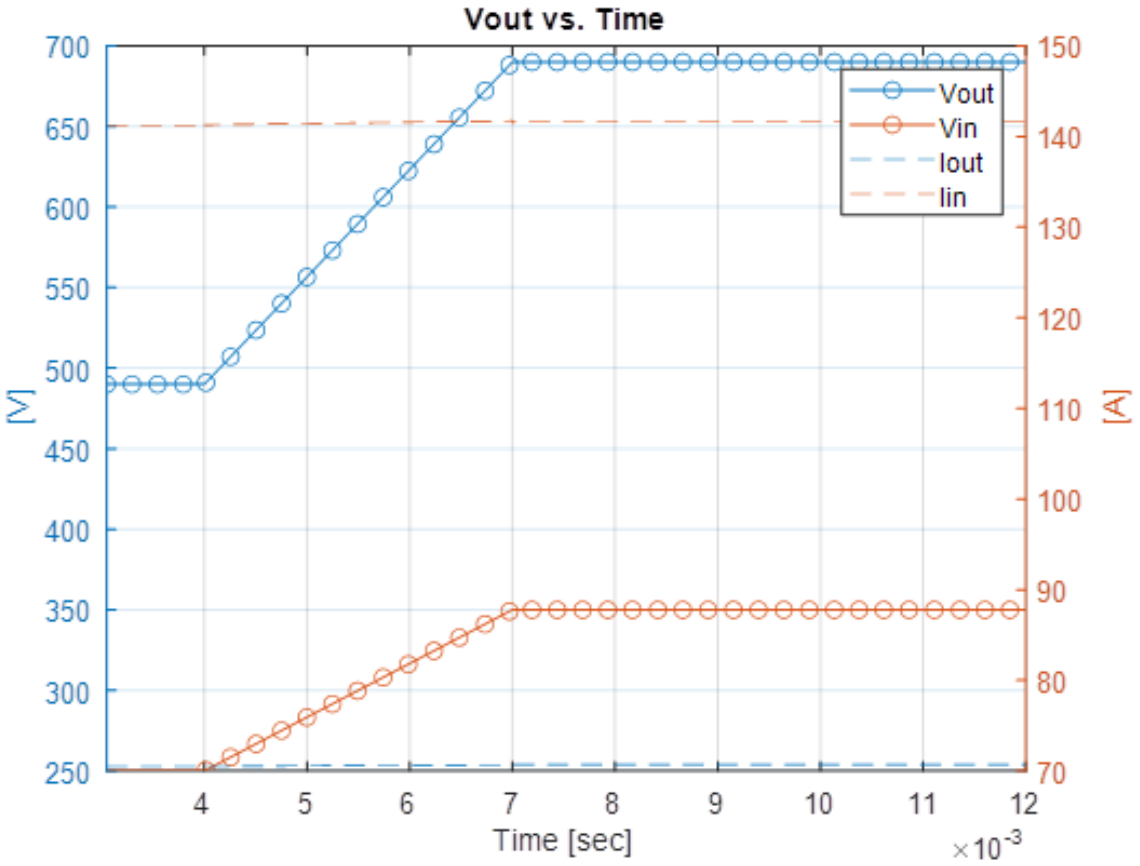


Voltage/current factorized conversion

DC/DC fixed ration converter acts as ideal voltage doubler without interference with charging station and current regulation

Current set point communicated between BMS from 800V will be translated to 400V charging station and Vicor DC/DC fixed ratio converter will act as translator, converting voltage and current based on following relations:

$$K_v = \frac{V_{out}}{V_{in}} = 2 \qquad K_i = \frac{I_{out}}{I_{in}} = \frac{1}{2}$$



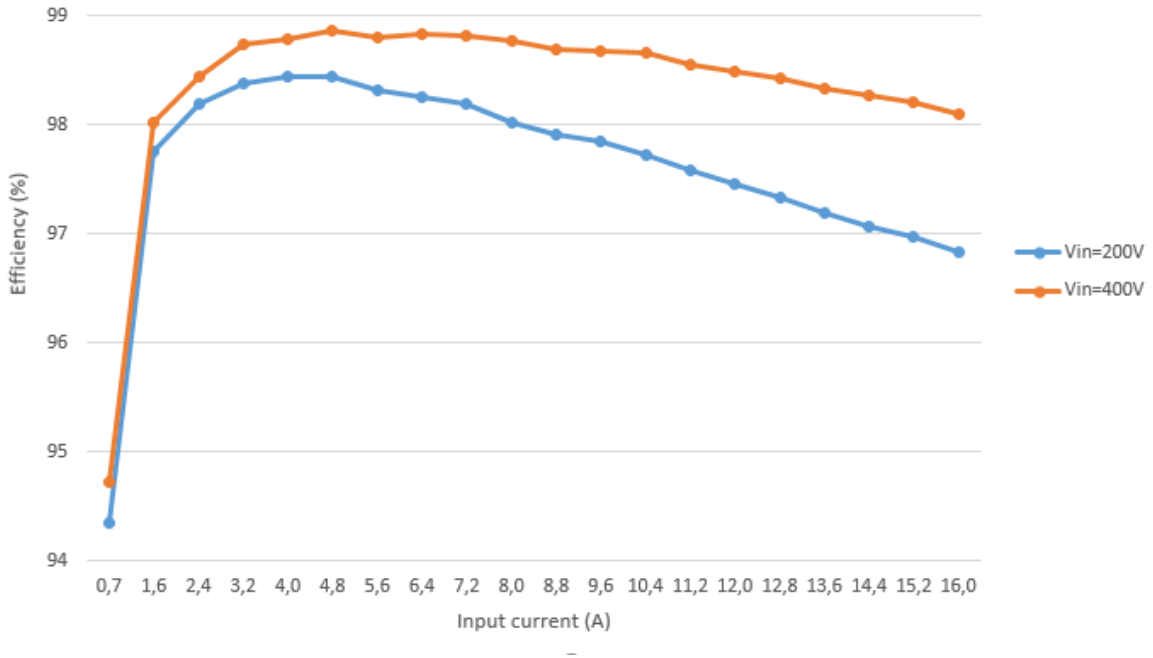
Highest power density

High efficiency enables highest integration rate and highest power density

It also simplifies cooling effort (thermal management)

This leads to minimum space consumption and weight added

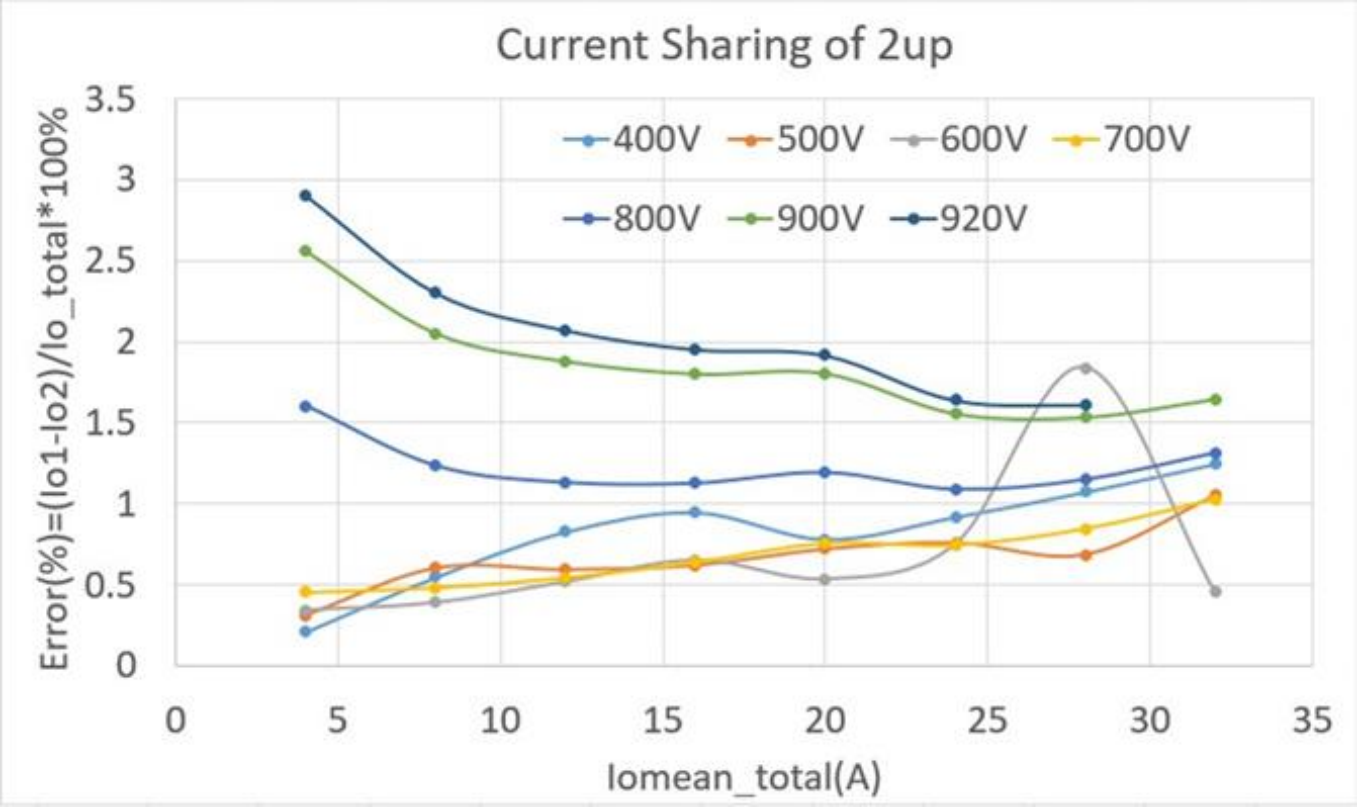
550kW/liter or 130kW/kg



Power scalability

Modular approach enables OEMs to scale the total power for DC fast charger for different platforms and different models

Gives OEMs opportunity to provide different options for charging power

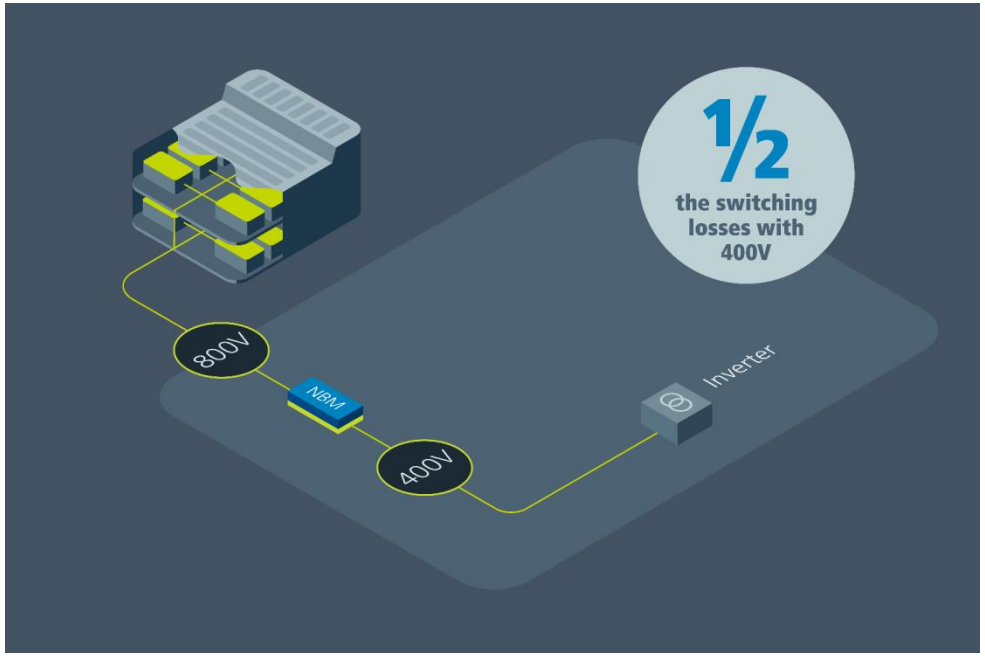


Vicor’s technology enables dual use

DC charging booster used for compatibility while vehicle is in charging mode

While vehicle is in motion, same converter can be used to supply traction inverter for low RPM operation and improve powertrain efficiency up to 5%

Or supply any other 400V loads



Comparison to competing solutions

Traction inverter	Battery reconfiguration	Vicor
- Utilizes existing equipment - Requires modification on the traction inverter - Charging power limited by single inverter and e-machine (for vehicles with multiple inverters and e-machines)	- No additional power electronics - New BMS and additional switches - Functional safety challenges - Limited by battery configuration	- Flexible and scalable to different platforms and models - Can be retrofitted to any existing platform - Takes minimum space and weight - Can be used as part of powertrain to improve efficiency or to supply 400V loads in vehicle while in motion - Possibility of isolation

Speaker information

Thank you

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