High Power Density Power Module Applications in eVTOL

Vicor

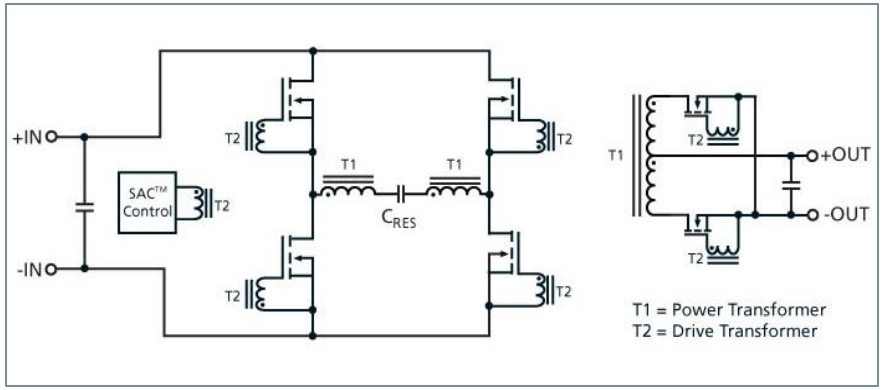
May 2025

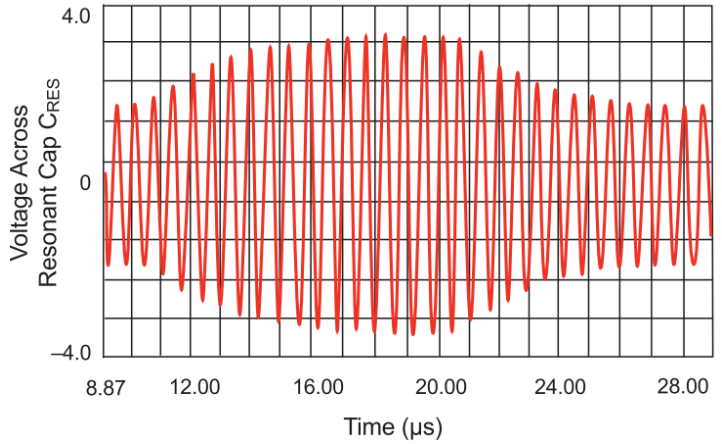
Vicor Applications

- Vicor Advantages
  - SAC Advantages
  - Light weight and high efficiency
- The eVTOL forms that Vicor products fit
  - Tiltrotor motor
  - Compound wing
- The application and characteristics of Vicor products in eVTOL
  - Application Circuit Block Diagram for 800V to 48V Step-Down Conversion
  - Features：Bidirectional Operation, Rapid Response, High Peak Power Capability

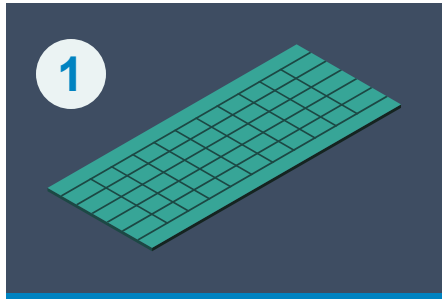
Vicor Advantages： SAC Topologies

- Low switching losses : efficiency up to 99%
- High switch frequency :Operating frequency range up to 2MHz
- Full soft-switching: Main circuit， Drive Circuit
- Reduced EMI : Pass CISPR25-Class3 without filter
- Bidirectional： operate as physical transformers
- Fixed –ratio voltage output



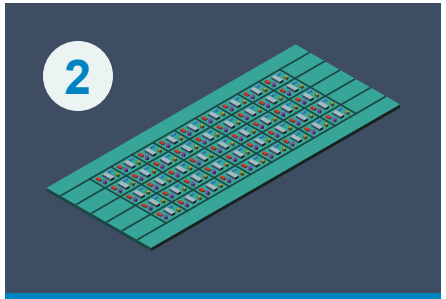


ChiP is analogous to semiconductor fabrication



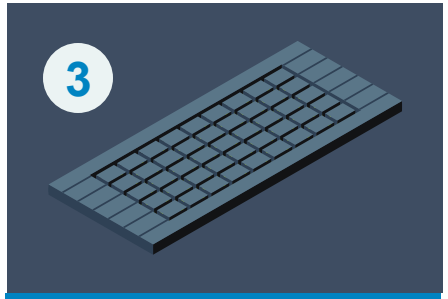
Bare panel

The process begins with a bare panel, ready for multiple instances of the same high-performance module, analogous to a silicon wafer



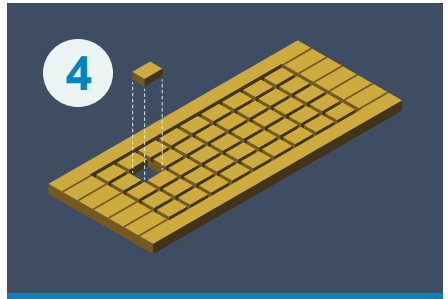
Surface mounting

High-quality power components, including magnetics, are mounted and soldered via state-of-the-art pick-and-place tools



Overmolding

A plastic compound encases the panel, protecting the components and creating a flat surface that makes the final product easier to handle



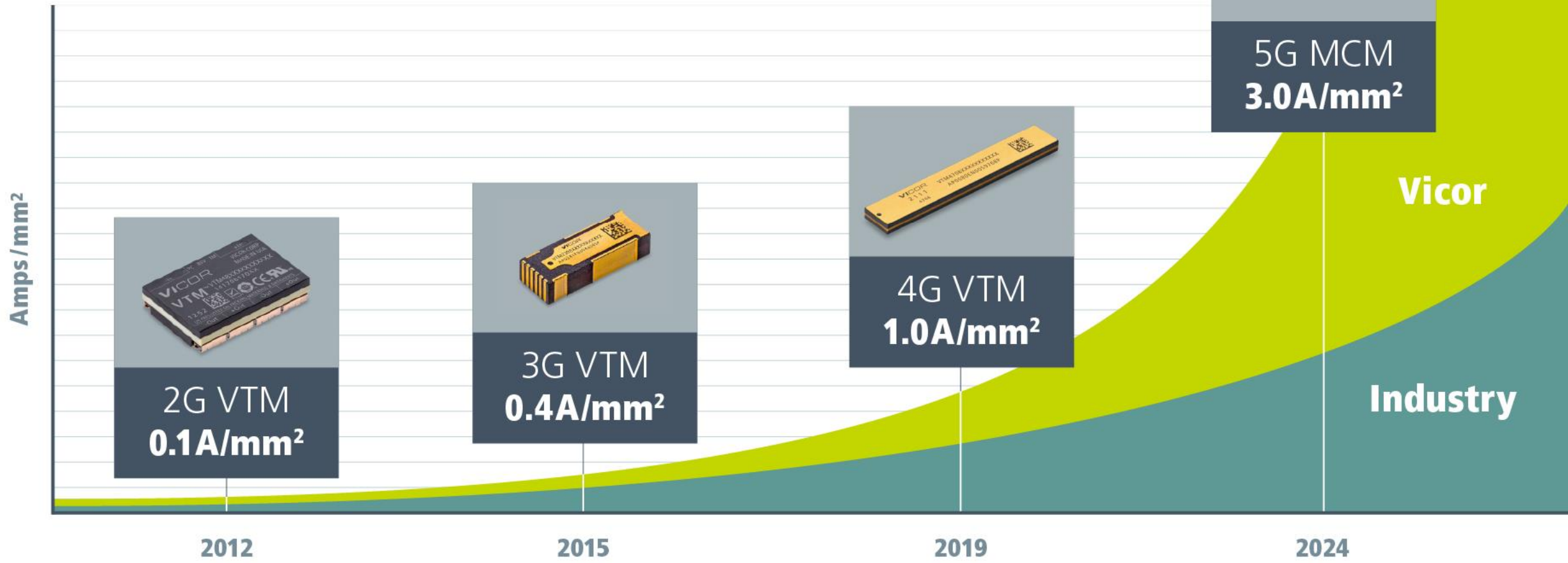
Plating

Heat conducting metals are plated onto the panel to enable a thermally efficient and reliable finished product

CHiP modules

Split the individual modules and tested for conformance to data sheet specifications

Continually providing the highest density power solutions



Aviation Class Reliability

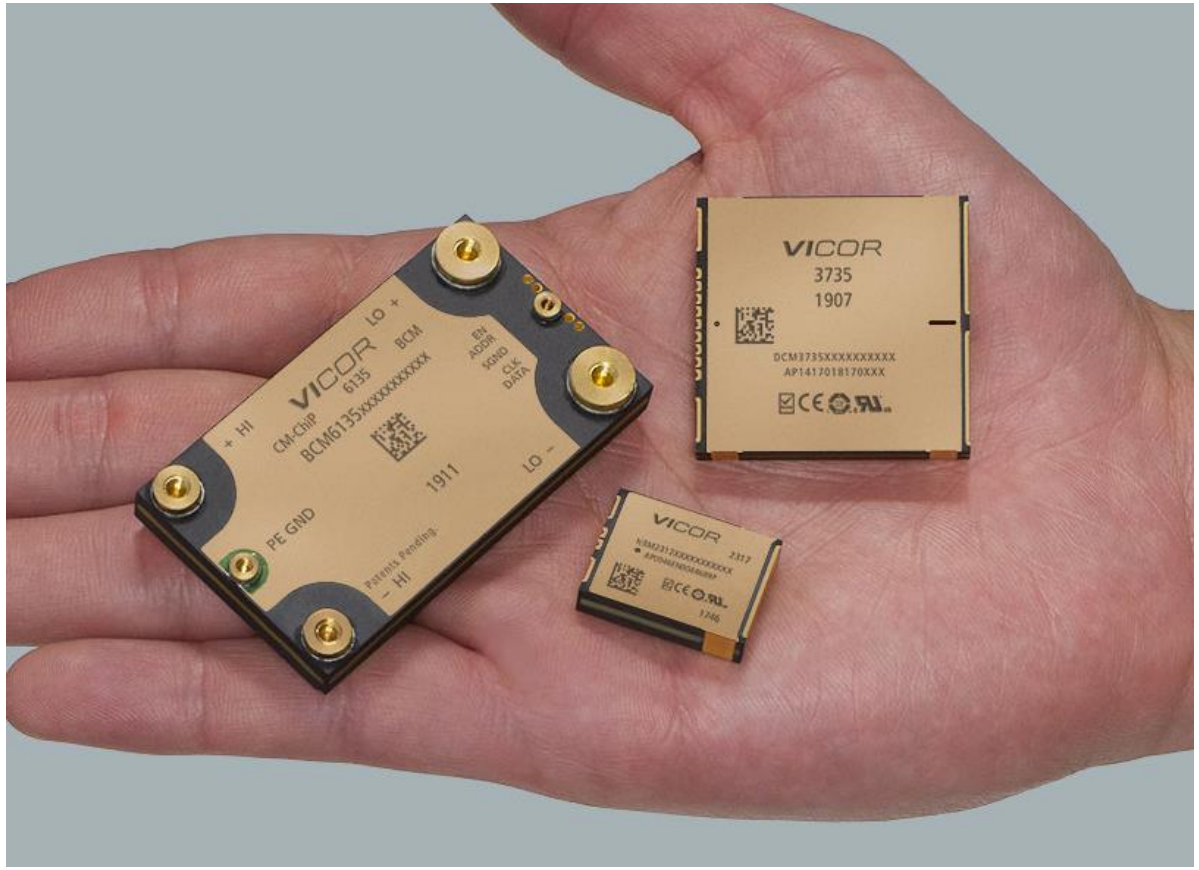
- Vicor has 40+ years of proven quality and reliability supporting demanding applications
  - AI computing
  - Automotive
  - Medical
  - Defense
- Vertically integrated manufacturing
  - TS16949
  - ISO ..
  - List certifications

Vicor vertically integrated ChiP fab in Andover, MA USA

VICOR

High Performance Power Modules

- Highest power density
  - Up to 10 kW/in^3
  - Up to 173 W/g
- Highest efficiency
  - Up to 99%
- Highest flexibility and scalability
  - Complete modular solution



The application and characteristics of Vicor products in eVTOL

High efficiency

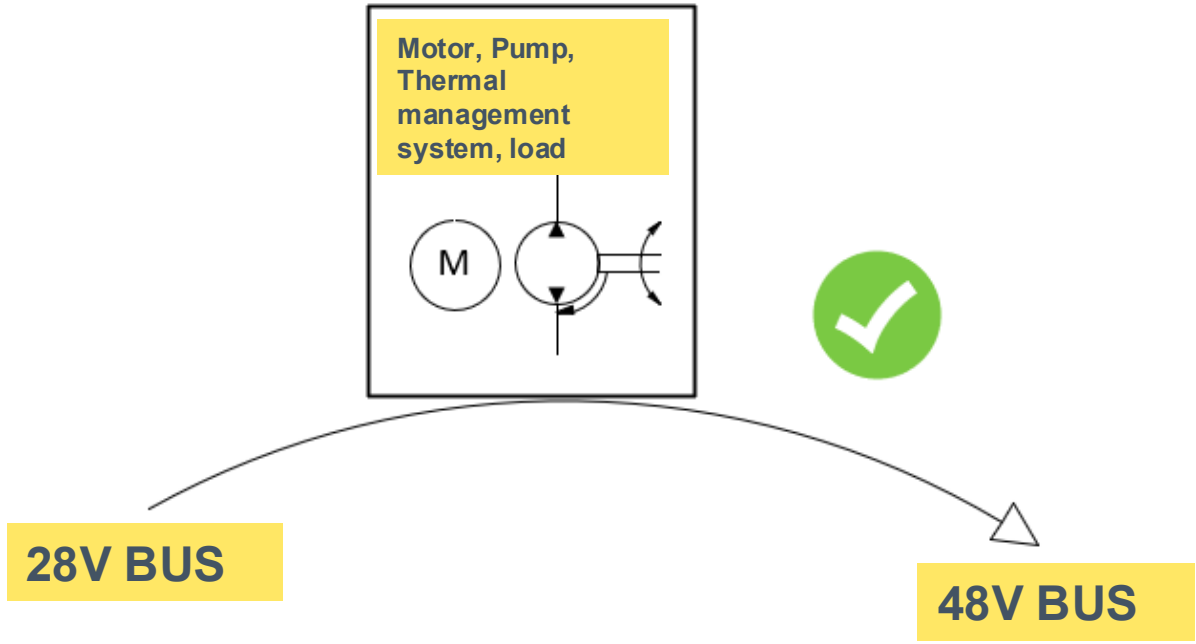
Light weight

Reliability and Safety

Fast time to market

The Imperative for Adopting 48V System Buses

- As eVTOL aircraft designs scale up, they require increased power allocation for critical subsystems such as flight control actuators, tiltrotor motor directional control, and cooling system pump operations
- The limitations of 28V systems become evident at peak power levels reaching 5kW,
- Excessive peak currents** (>170A) challenge conductor ampacity and connector reliability
- High dynamic fluctuations,introduce EMI noise into flight control, navigation, and communication systems.
- 40%. The high-dynamic part is isolated from the 28V part by a DCDC to ensure low noise in the 28V part.



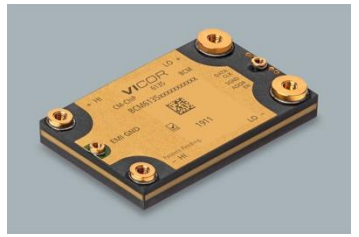
The application and characteristics of Vicor products in eVTOL

- Substitution and upgrade of the golden combination of the 48V lithium battery and DCDC: The overall weight provided by the SAC technology is approximately 20% of that of the traditional combination
- Benefiting from the switching frequency of 1.x MHz, the open-loop working mode, and characteristics such as the output impedance at the milliohm level, Vicor BCM products offer dynamic response characteristics comparable to those of lithium batteries.
- With the SAC technology's inherent ability of two-way operation in the automatic single working mode, the energy feedback and absorption during the motor braking process become incredibly smooth.
- Benefiting from Vicor`s patented SAC technology, which deeply taps into the potential of power devices and features long-duration high-peak current handling characteristics, it delivers high rates of capacitance charging and discharging capabilities

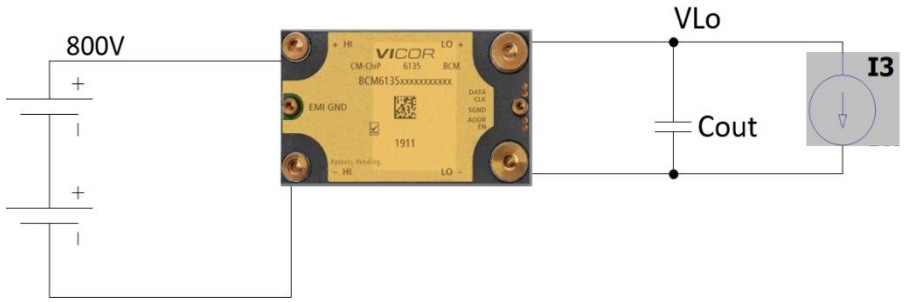
Provide around 5kW peak power while weight is around 10kG

Provide around 5kW peak power while weight is around 1kG

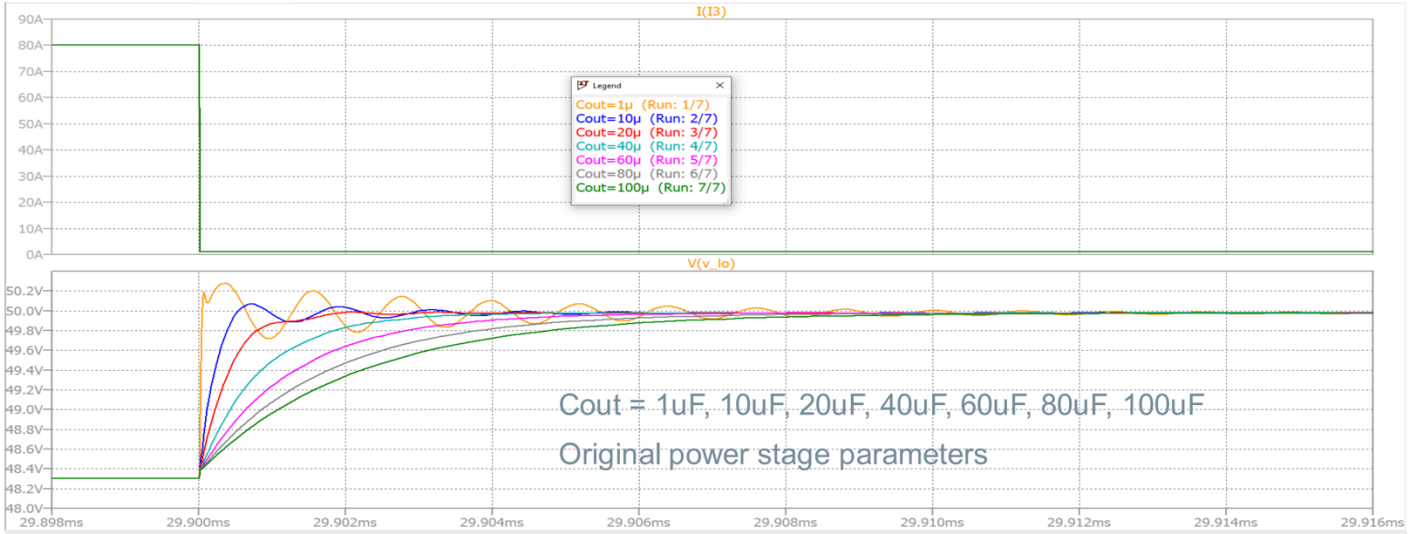
型号	Vin	K	Vout	Power
BCM6123	384	1/8	48	2800W
BCM6135	384	1/8	48	3200W
BCM6135	720	1/16	45	3600W



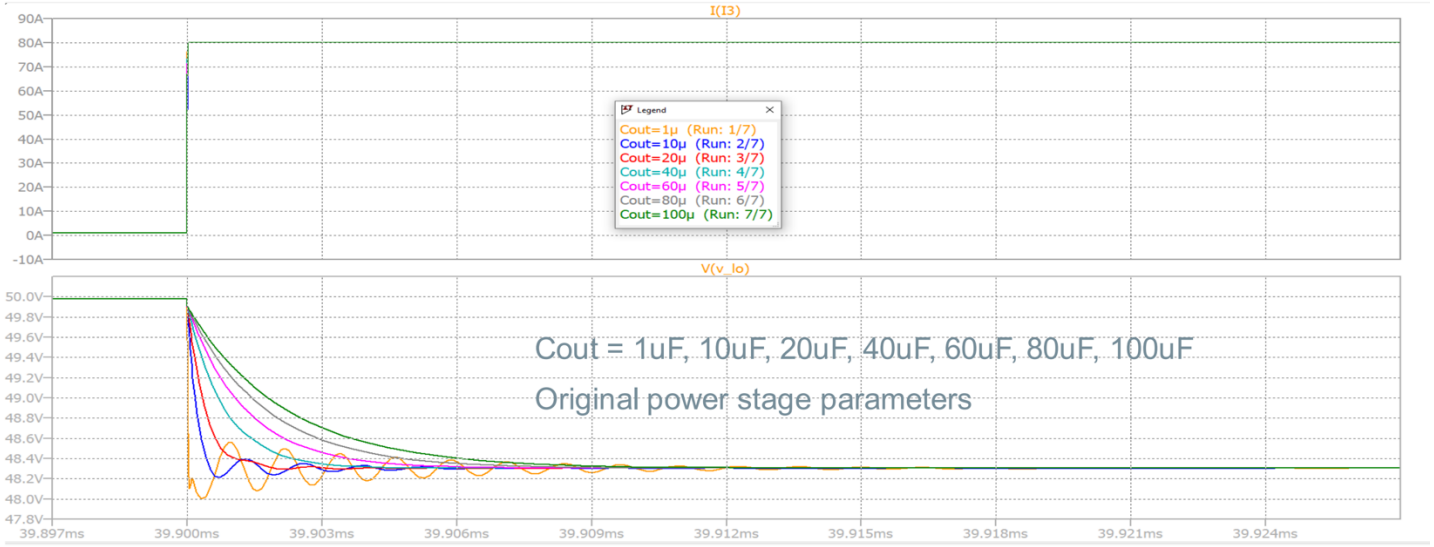
Fast dynamic response



Vin=800V, Iout: 80A to 1A /10ns Fall time



Vin=800V, Iout: 1A to 80A /10ns Rise time

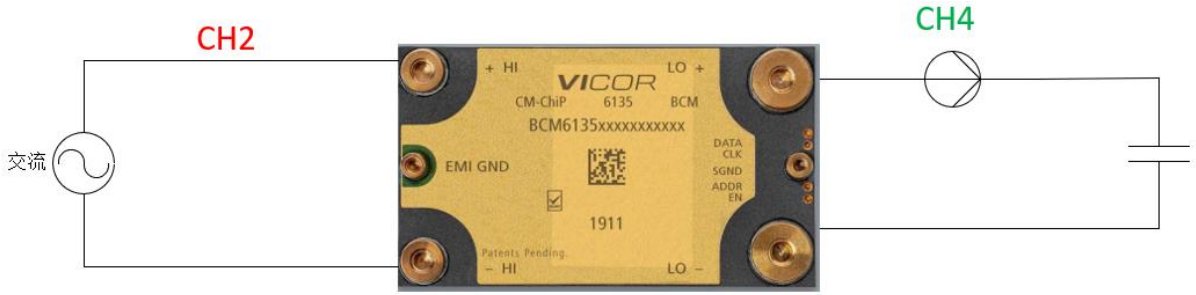


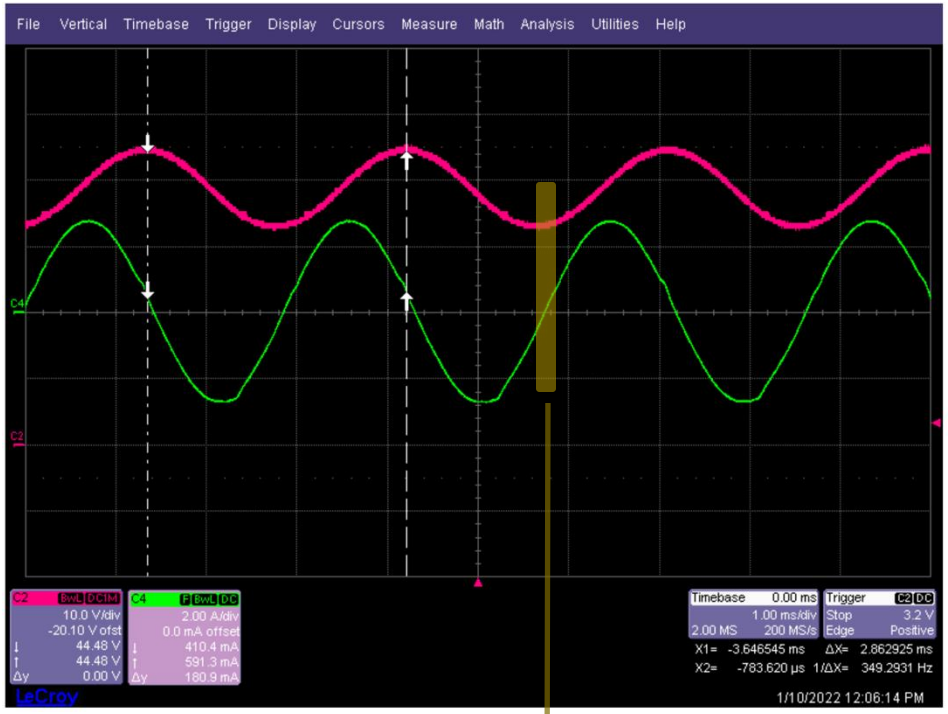
Bidirectional

- Use BCM(base on SAC technology) to do the testing
- Charge-discharge switching_Sine wave

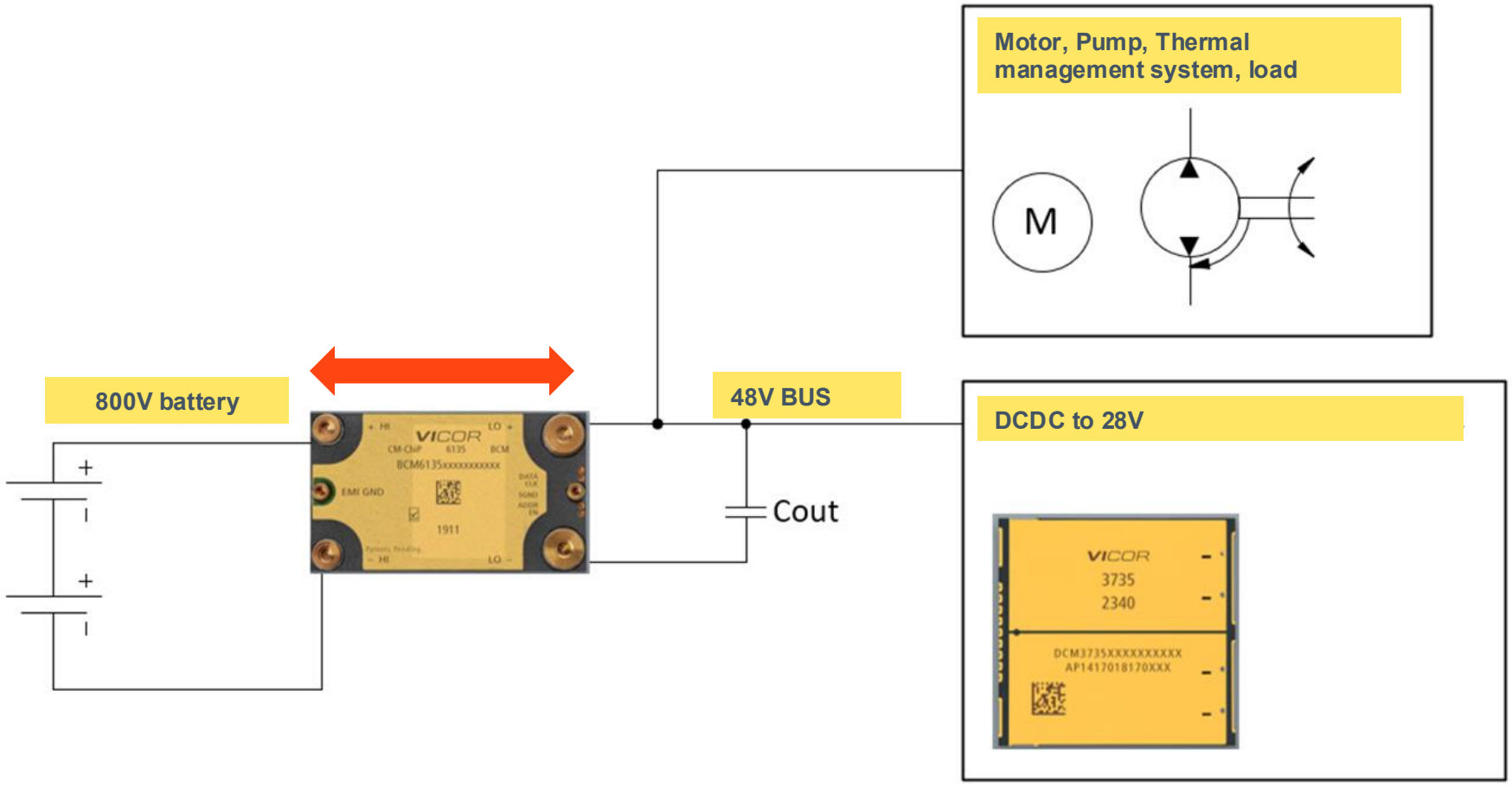
Ch2 = Sine wave voltage source output

Vout Ch4 = Output capacitor current

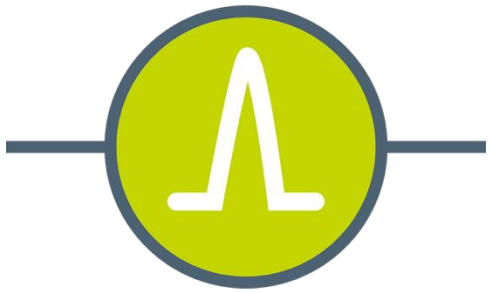




VICOR application in advanced eVTOL



The value Vicor brings



Fast transience

Lightweight

Power density

Faster time to market

Eliminate battery

High efficiency

High reliability

Thank you