High Performance Modules Enable the Low-Altitude Economy

Vicor

May 2024

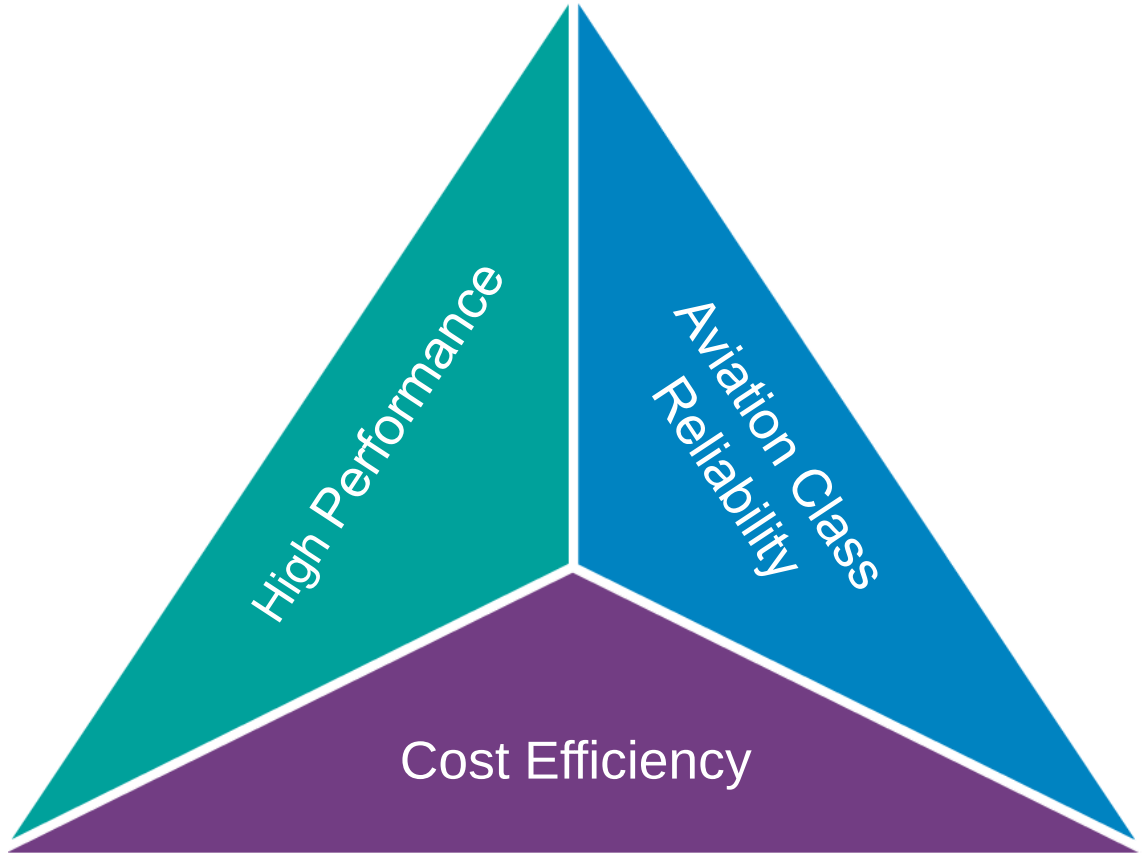
eVTOL is Poised for Growth in the Low Altitude Economy

- Electrification and autonomy are key enablers for eVTOL
  - Battery and power distribution technology
  - AI for autopilot functionality
- eVTOL has considerable advantages for passenger transportation
  - Fast and comfortable passenger experience
  - Environmentally sound
  - Low noise
  - Low operating costs
  - Mature supply chain

“Impossible triangle” jeopardizes eVTOL adoption

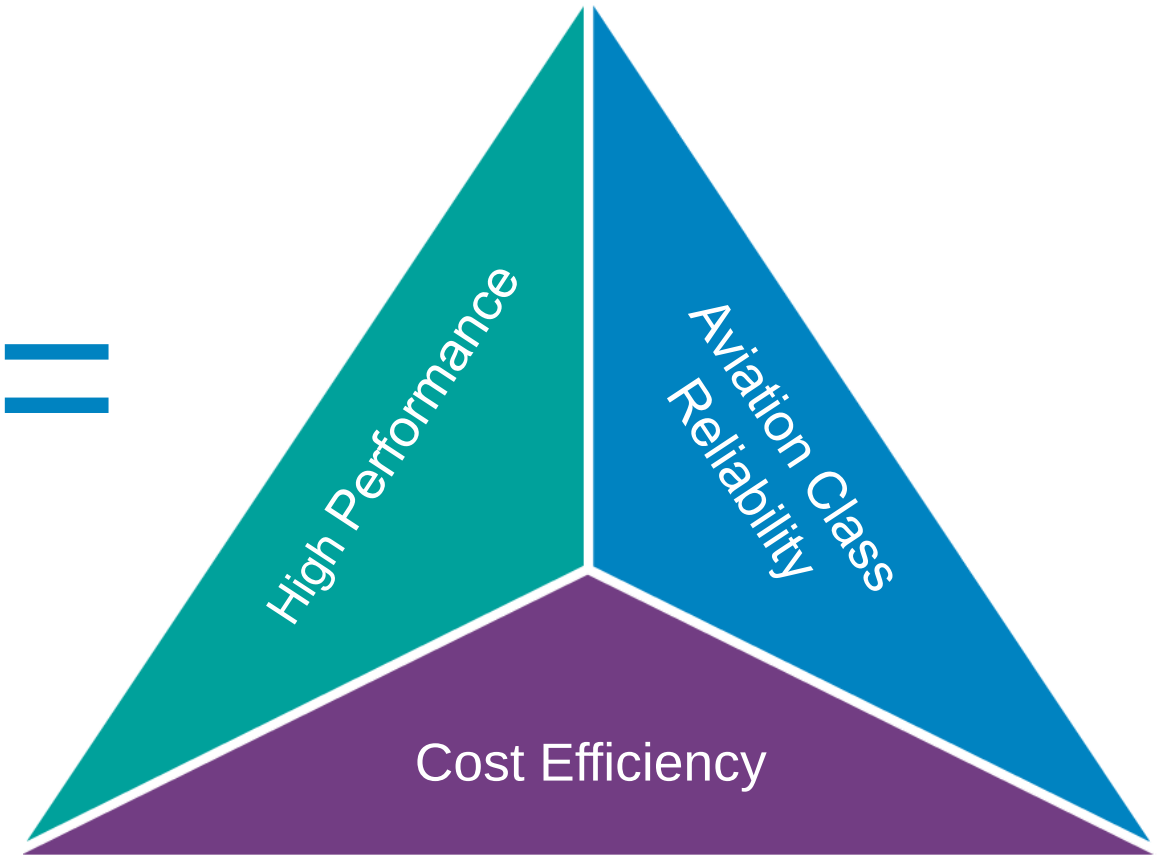
eVTOL requires three opposing qualities to be true at the same time

- High peformance
  - Power density
  - Efficiency
- Aviation class reliability
  - Equal or better than aviation class for personal safety
- Cost efficiency
  - Commensurate with industrial grade solutions



Vicor has solved the “impossible triangle”

VICOR =



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

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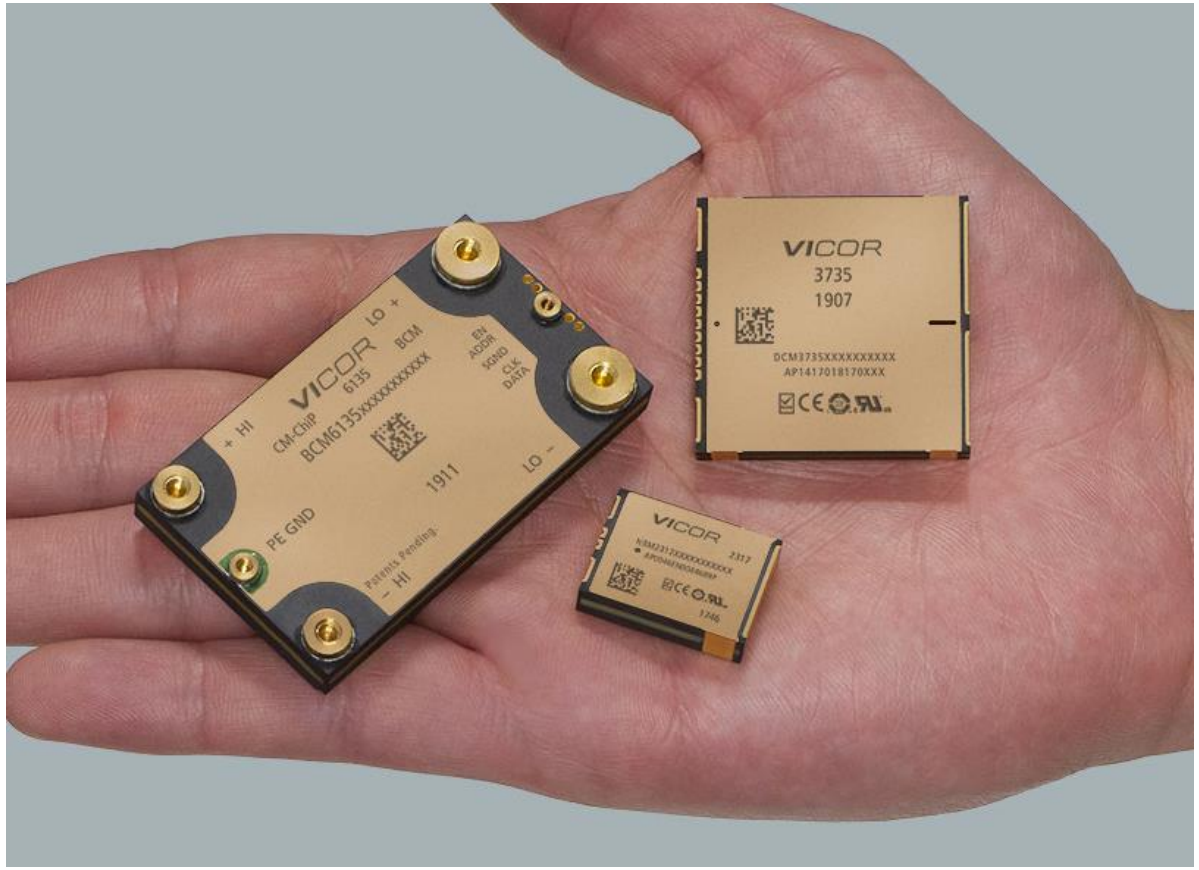
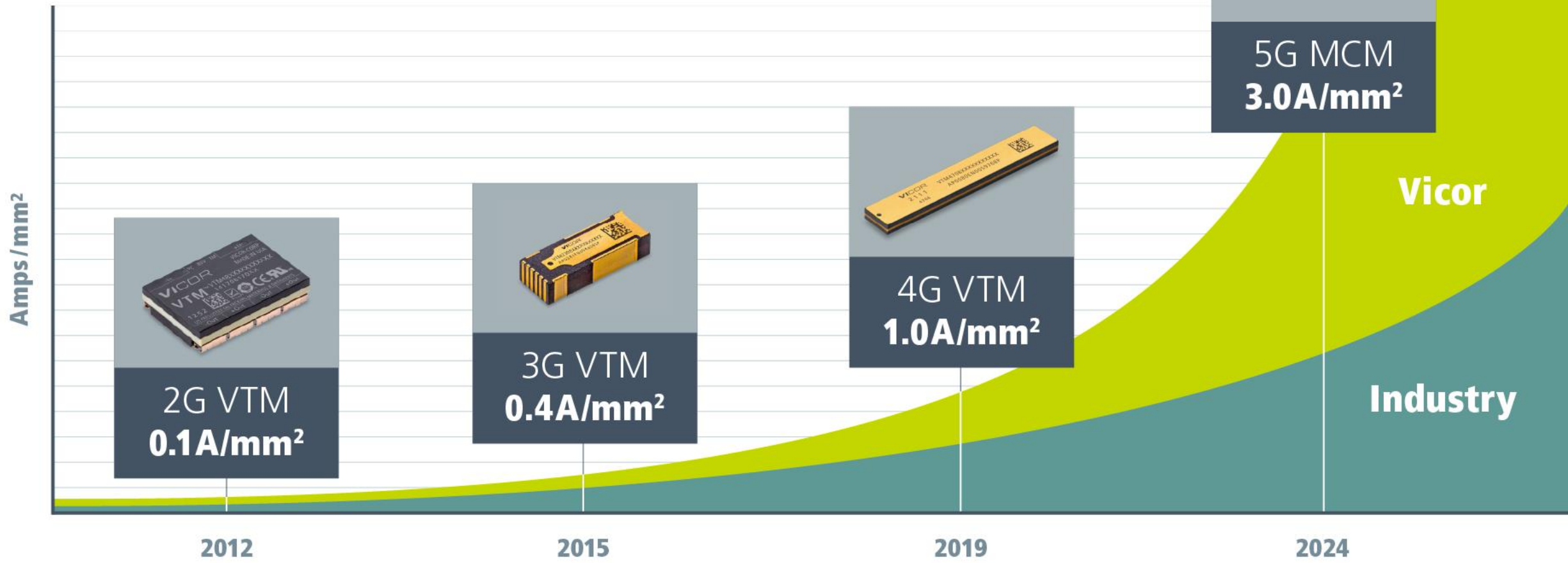
High Performance Power Modules

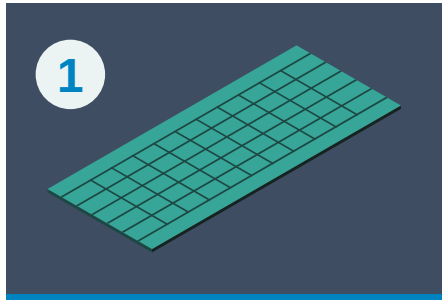
- Highest power density
  - Up to 10 kW/in^3
  - Up to 173 W/g
- Highest efficiency
  - Up to 99%
- Highest flexibility and scalability
  - Complete modular solution



Continually providing the highest density power solutions

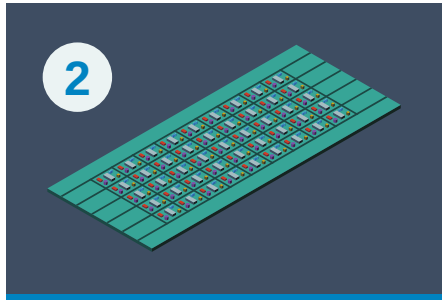


ChiP is analogous to semiconductor fabrication



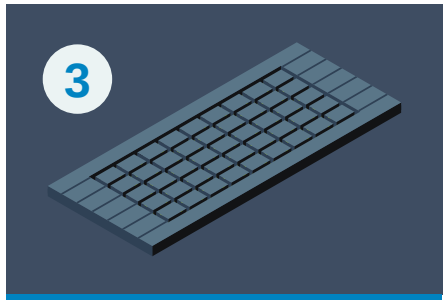
Bare panel

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



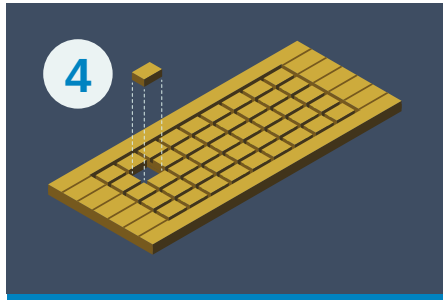
Surface mounting

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

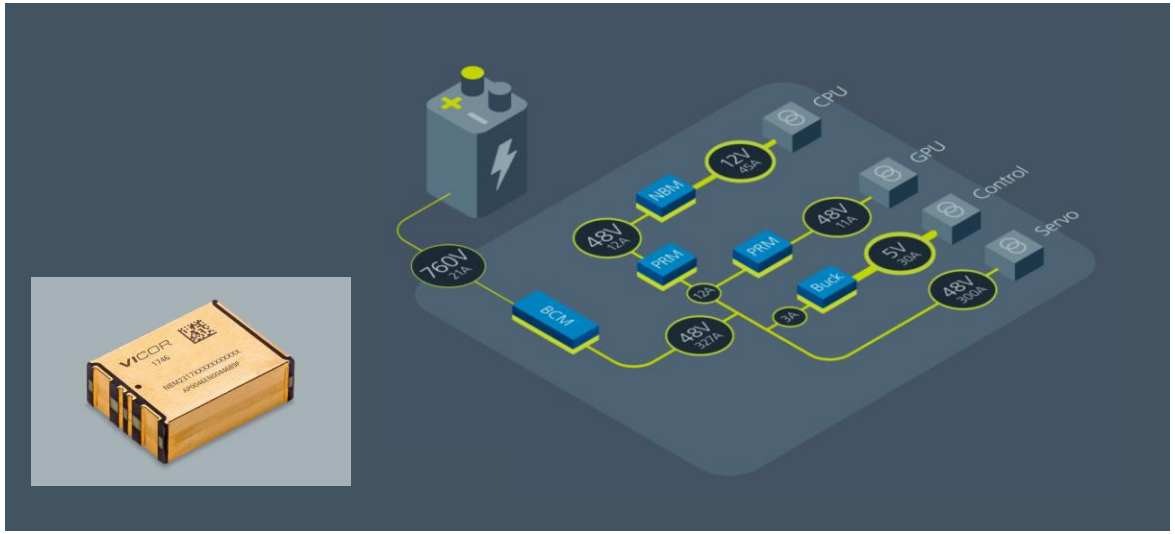
The panels are singulated into individual modules and tested for conformance to data sheet specifications

48V bus enables eVTOL autopilot

- Onboard AI processing demands power efficiency
- The 48V bus reduces PDN loss compared to traditional 12V bus
- NBM2317 fixed-ratio converter efficiently bridges the 48V bus to 12V AI systems

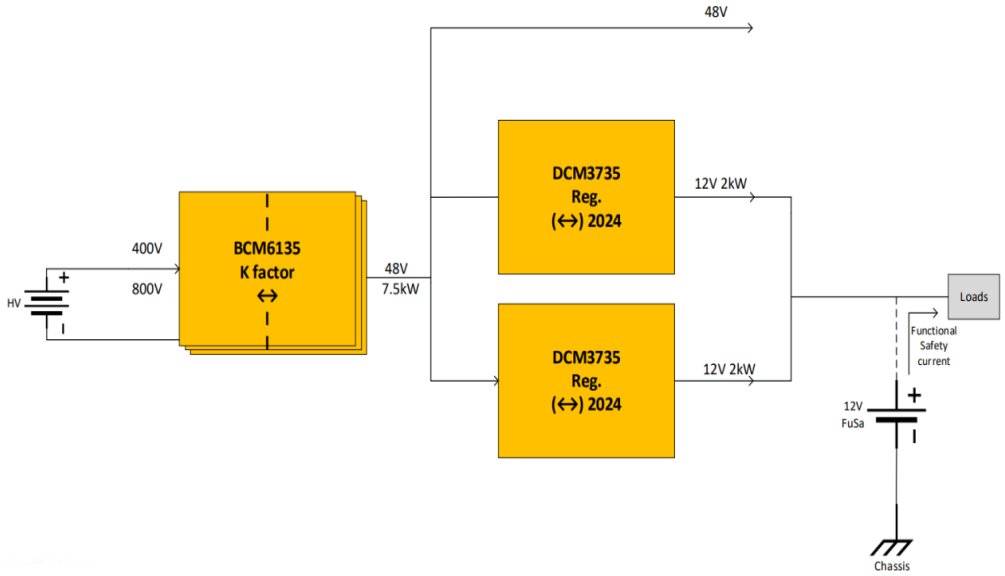
	600W@12V		600W@48V	
导线材料	铜	铝	铜	铝
电流	50A	50A	12.5A	12.5A
导线截面积	10mm^2	17mm^2	1.5mm^2	2.5mm^2
导线重量	108g/m	74g/m	17g/m	11g/m
功率损耗	4.5W/m	3.8W/m	1.8W/m	1.6W/m

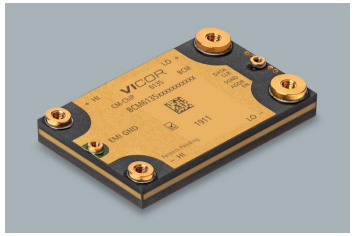
型号	Vin (nom)	K factor	Vout (nom)	Max Power
NBM2317	48	4	12	1000W



Virtual battery eliminates 48V physical battery

- The physical 48V battery powering AI and auxiliary systems adds weight and consumes valuable space
- Vicor fixed ratio converters can replicate the 48V battery via the the eVTOL's main 400V or 800V powertrain battery
  - Vicor modules deliver the same transition speed as LiIon batteries with better reliability





型号	Vin	K	Vout	Max Power
BCM6123	384	1/8	48	2800W
BCM6135	384	1/8	48	3200W
BCM6135	720	1/16	45	3600W
NBM6123	800	1/2	400	6400W
NBM9280	800	1/2	400	30kW
DCM3735	48		12	1000W
DCM3717	48		12	2000W

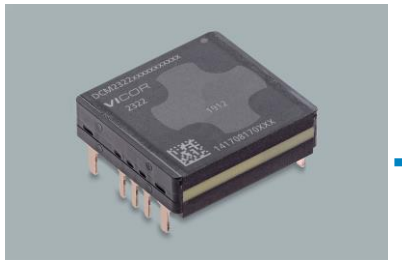
Reliable FMS and FCS power supply

- Vicor DCM isolated, regulated DC-DC converter modules are used in aviation applications such as C919 to DO-160 standards
- DCMs achieve EMI standards up to 1 MHz switching frequency with simple, small footprint filtering

48V →  → 48V/28V

PI3740-00-LGIZ
Buck-Boost Regulator

- 输入8V – 60V
- 输出10V- 50V
- 最大功率 140W
- 开关频率 1MHz
- 封装 10x14x2.5mm LGA

48V →  → 48V/28V

DCM2322 Regulator

Vin range (nom)	3.3Vout	5Vout	12Vout	15Vout	24 Vout	28Vout	48Vout
43-154	40W	60W	120W	120W	120W	120W	120W
14-72	35W	50W	100W	100W	100W	100W	100W
9-50			60W	60W	60W	60W	60W

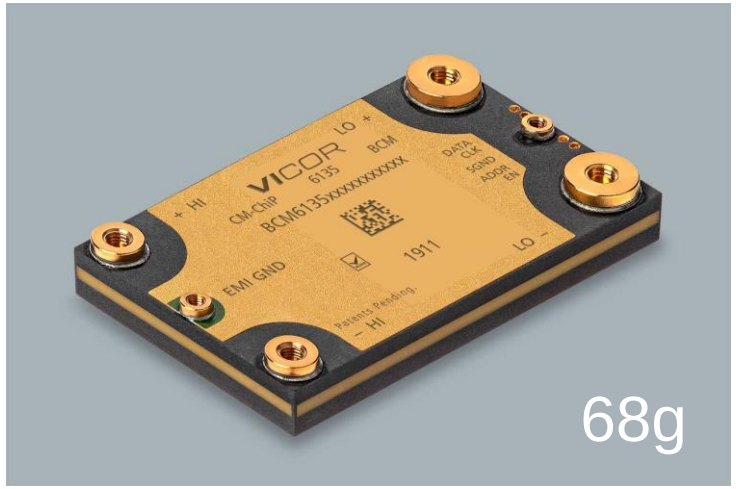
Beyond eVTOL – Vicor enables UAVs

- Tethered and untethered UAVs utilize 400V and 800V power delivery networks
- Power density and efficiency are critical to enabling UAVs

Power modules for UAVs

BCM6123/400VDC ChiP

- Output 35A continues current
- Power density up to 2735W/in^3
- 98% peak efficiency
- 4,242V DC isolation
- Parallelable
- OV, OC, UV, short circuit, OTP
- Size: 63.34 x 22.80 x 7.21mm
- PMBus™



BCM6135/400VDC ChiP

- Output 65A continues current
- Power density up to 3400W/in^3
- 98% peak efficiency
- 4,242V DC isolation
- Parallelable
- OV, OC, UV, short circuit, OTP
- Size: 61.33 x 35.35 x 7.42mm
- PMBus™

BCM4414/800VDC VIA

- Output 35A continues current
- Power density up to 797W/in^3
- 97.7% peak efficiency
- EMI filter and surge protection integrated
- Parallelable
- OV, OC, UV, short circuit, OTP
- PMBus™

The value Vicor brings

Fast transience

Lightweight

Power density

Faster time to market

Eliminate battery

High efficiency

High reliability

Kevin Ni

倪进，1994 年硕士毕业于东南大学无线电系。毕业后工作于中兴通讯、朗科技和光桥科技研发部门，从事过 CDMA 网络和光通信系统的研发工作。

之后进入美国 EXAR 公司从事半导体芯片的市场推广，并于 2011 年加入美 国 Vicor 公司，筹备建立中国公司和中国区团队，致力于高可靠性高性能的电源产品的市场推广工作。

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Thank you