High density DC-DC power modules maximize ATE throughput

Vicor

Dec 2025

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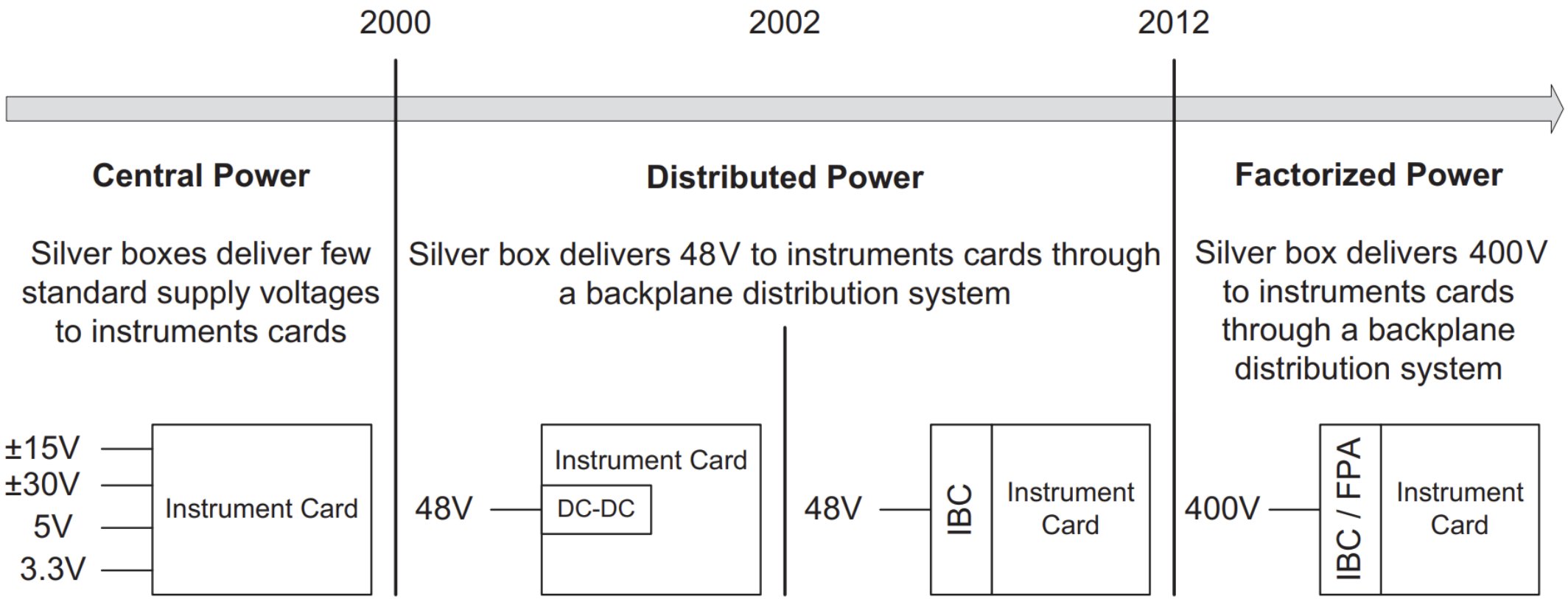
ATE power evolution



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Challenge

- 400V IBC/FPA isolation in cards while keep small PCB size
- How to handle high heat flux density.
- Noise suppression becomes harder to handle while the power is increasing a lot

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Design tradeoffs

Objective	Primary Lever
Minimize BOM	Raise backplane voltage (↓ copper)
Optimize Thermals	Reduce current → 400 V preferred > 80 kW
Maximize Flexibility	IBA: 400/48 → 12 V intermediate → POL Bucks
Ensure Reliability	De-rate, redundant modules, hot-swap, telemetry
Control EMI	Local filtering, confine switching loops

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Power vs. voltage guideline

Backplane or intermediate distribution DC voltage	Optimal Power Range
12V	Up to 5kW
48V	4 – 80kW
380V	Greater than 80kW

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Reference implementation

- 400 V input card (left)
- 400-to-12 V BCM bus converter (center)
- Multi-phase 12V buck VRM placed at load (right)

Result: >95% path efficiency, 50% copper reduction vs. 48V

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The most advanced ATE – real case

- Double the test density in the same volume
- Upgrade the bus voltage from 48V to 400V
- A single DPS card meets all power requirements
- Power supply from mA level to kA level
- Ultra-thin board: the thickness of the power module is aligned with that of the FPGA

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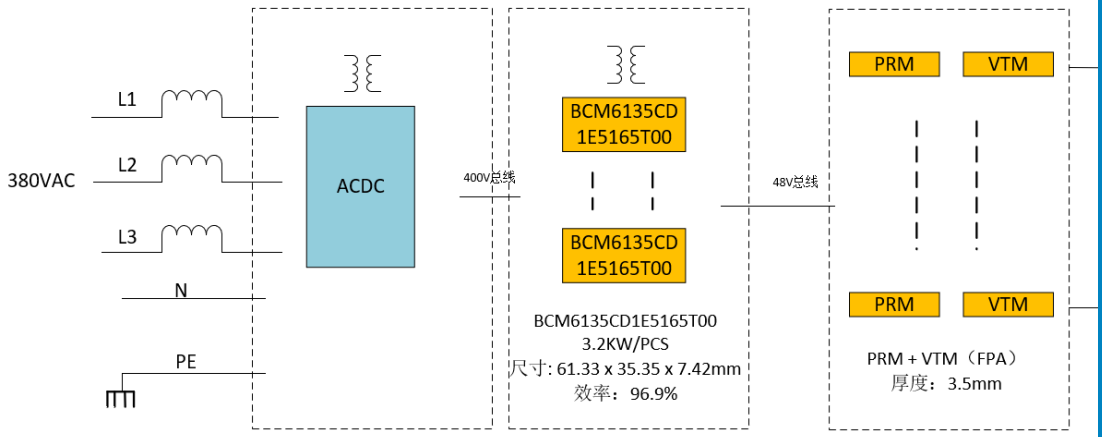
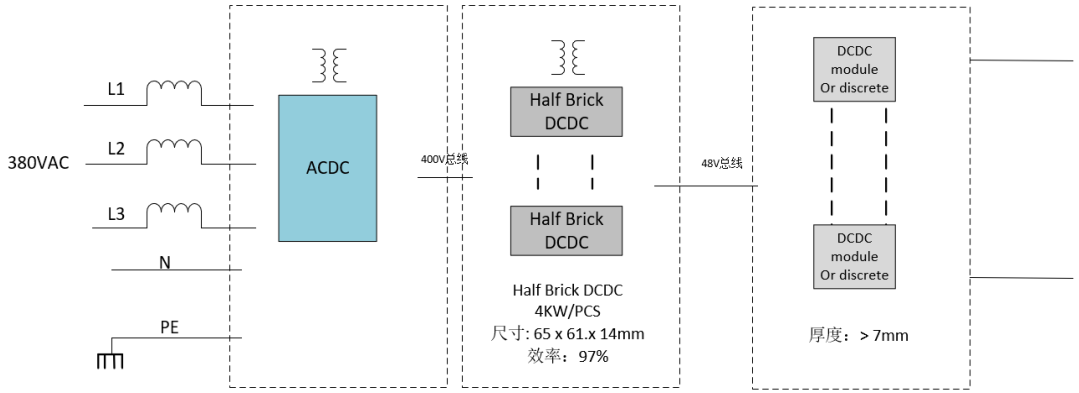
A complete solution from a high voltage bus to a secondary power supply

Vicor solution power density is 250% higher than competitor





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How Vicor achieves these features

- SAC technology
  - N:1 fix ratio DCDC bus converter
  - Sine wave
  - Excellent EMC performance
- ZVS phase shift buck-boost
  - Minimum the inductor current
  - ZVS for high side MOSFET
- FPA structure
  - Decrease the power loss in PCB
  - Improve the total power structure efficiency
- Advanced manufacturing process ensures product consistency

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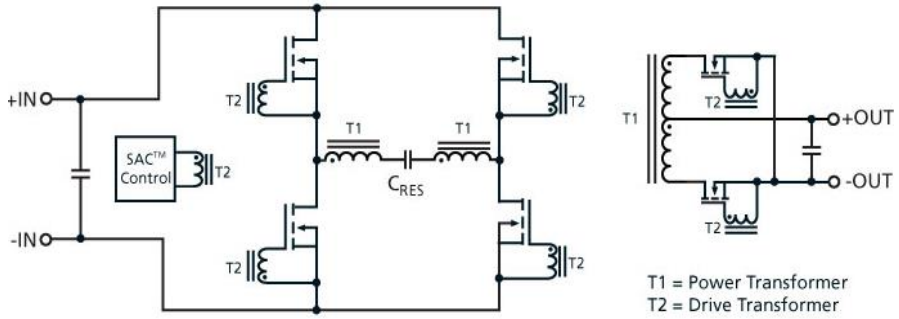
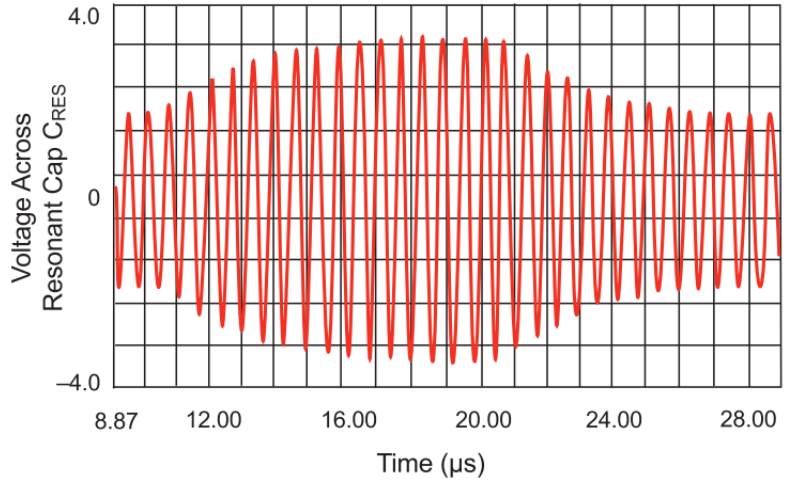
Sine Amplitude Converter (SAC)

- Almost no switch loss: peak efficiency 99%
- Extremely high switching frequency up to 2MHz
- Soft switching for main power circuit and drive circuit
- Excellent EMI performance: The best state without filters can pass CISPR25-Class3
- Common mode noise; Using common mode inductor and Y cap through the PE
- Fixed ratio output





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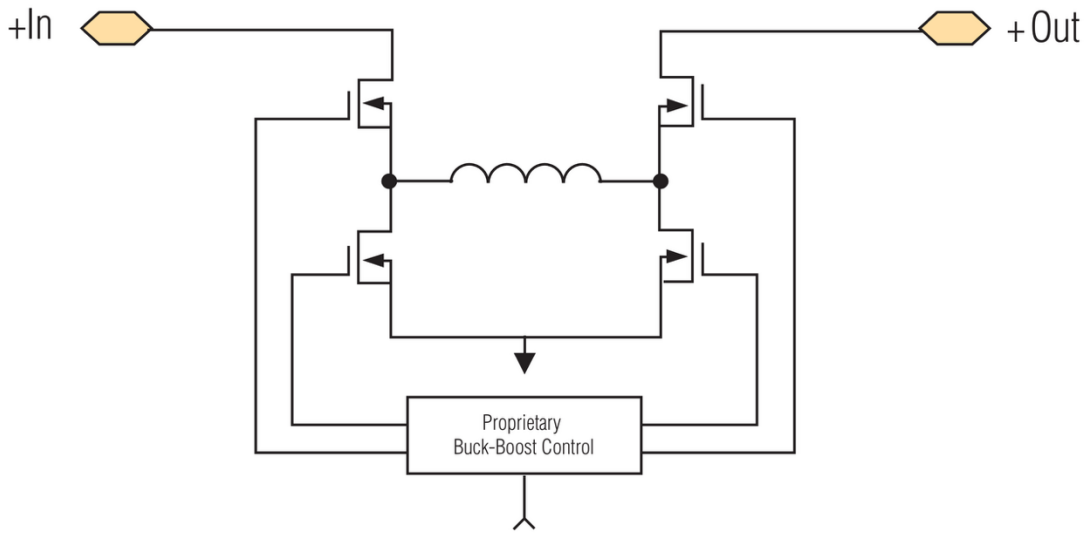
ZVS buck-boost regulator

- Almost no switching loss: efficiency up to 99%
- Extremely high switching frequency: operating frequency up to 2MHz
- Low inductance current
- All MOSFET are working with soft switching (ZVS)
- Differential noise / use differential inductor and differential Caps.
- Adjustable output
- Compatible with SAC module, providing non-standard output for the testing machine industry



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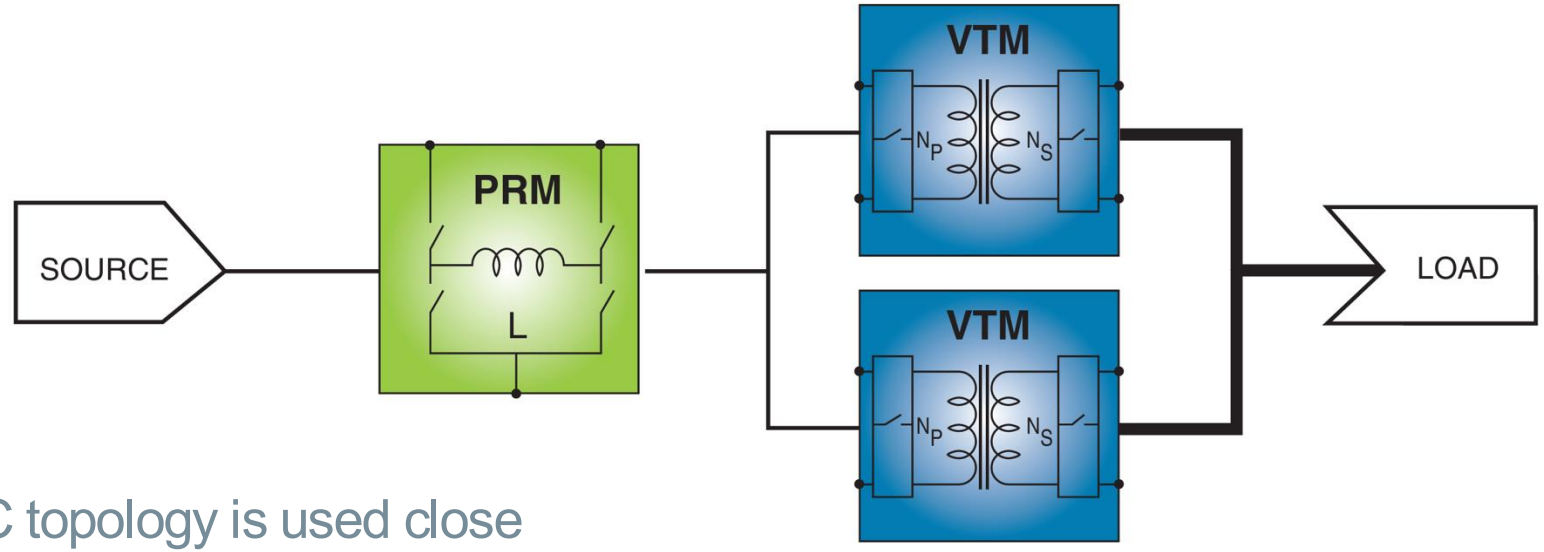
Factorized Power Architecture™ (FPA)

- Up to 97% efficiency
- Low PCB loss: small bus current, high current close to load, and short PCB path for high current
- All MOSFET are working with soft switching (ZVS)



- Low noise performance: SAC topology is used close to the load, with minimal impact on the load
- Adjustable output for non-standard voltages widely used in the ATE industry
- Modular design (PRM and VTM) can be adjusted separately to meet different inputs and outputs.
- 3.5mm low profile

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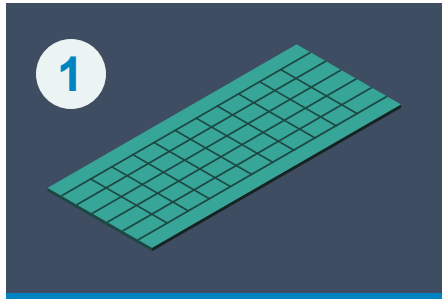
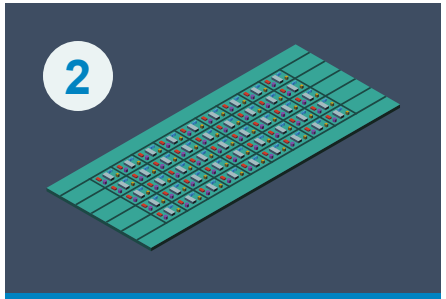
Advanced manufacturing process



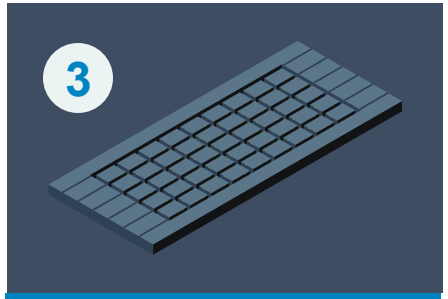
Bare panel

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



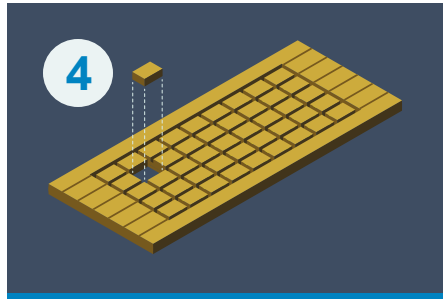
Surface mounting

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

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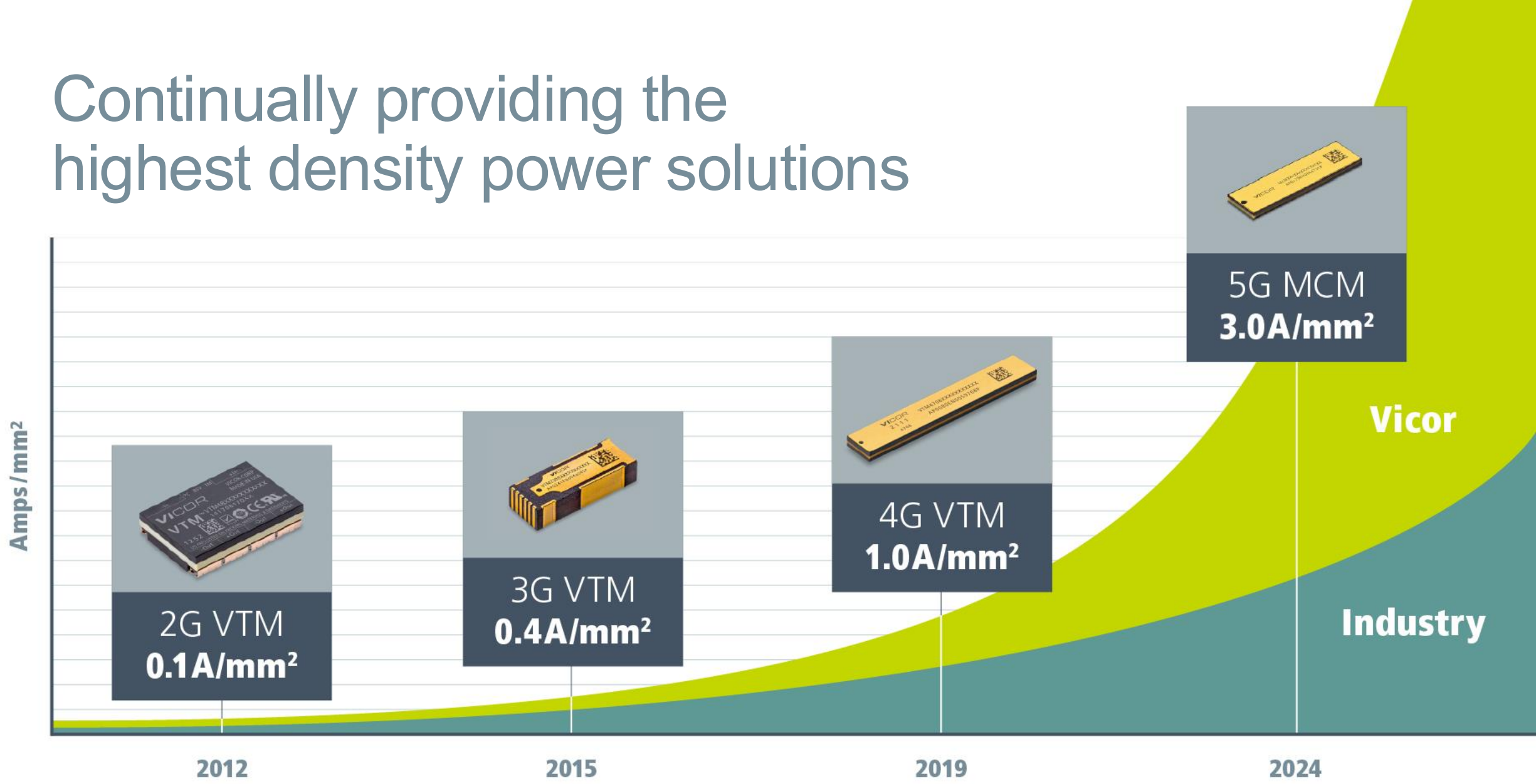
Continually providing the highest density power solutions



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Advanced Manufacturing

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

Vicor vertically integrated ChiP fab in Andover, MA USA

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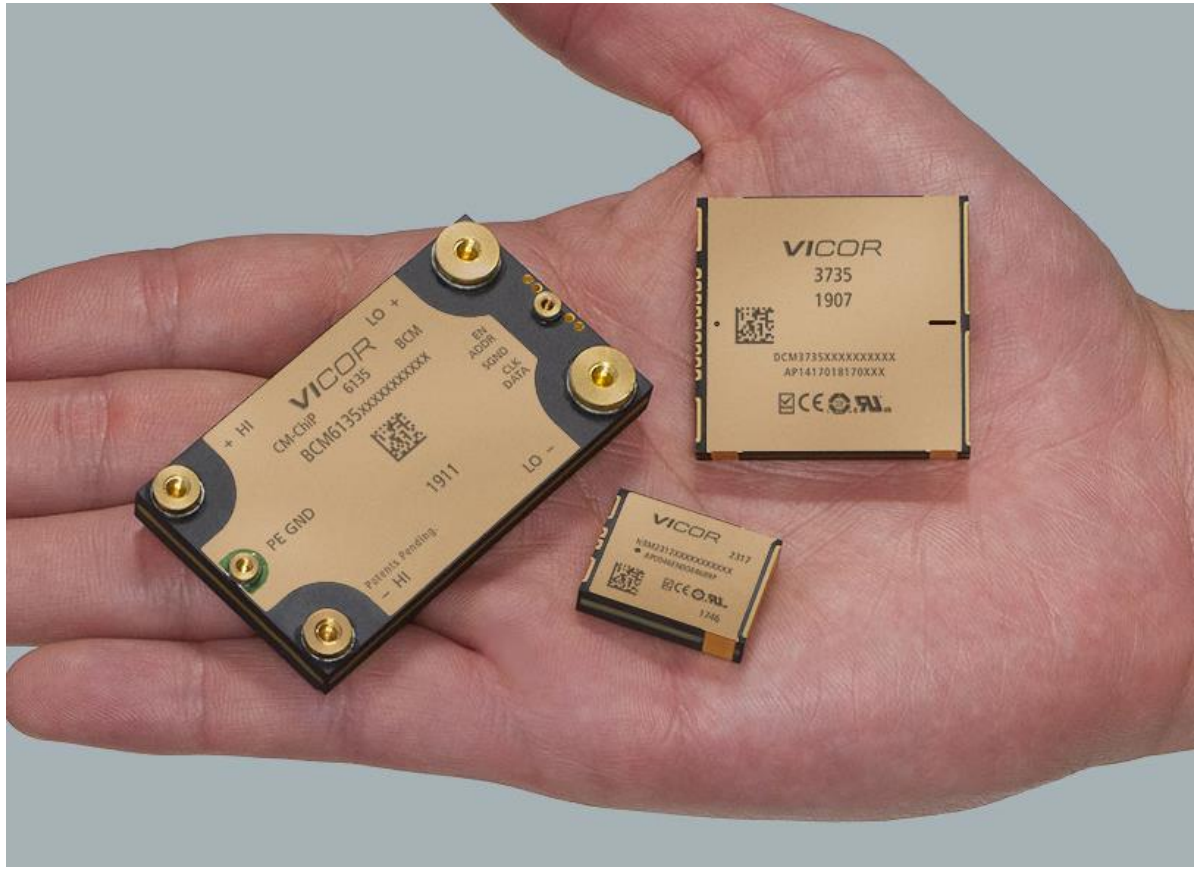
High Performance Power Modules

- 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



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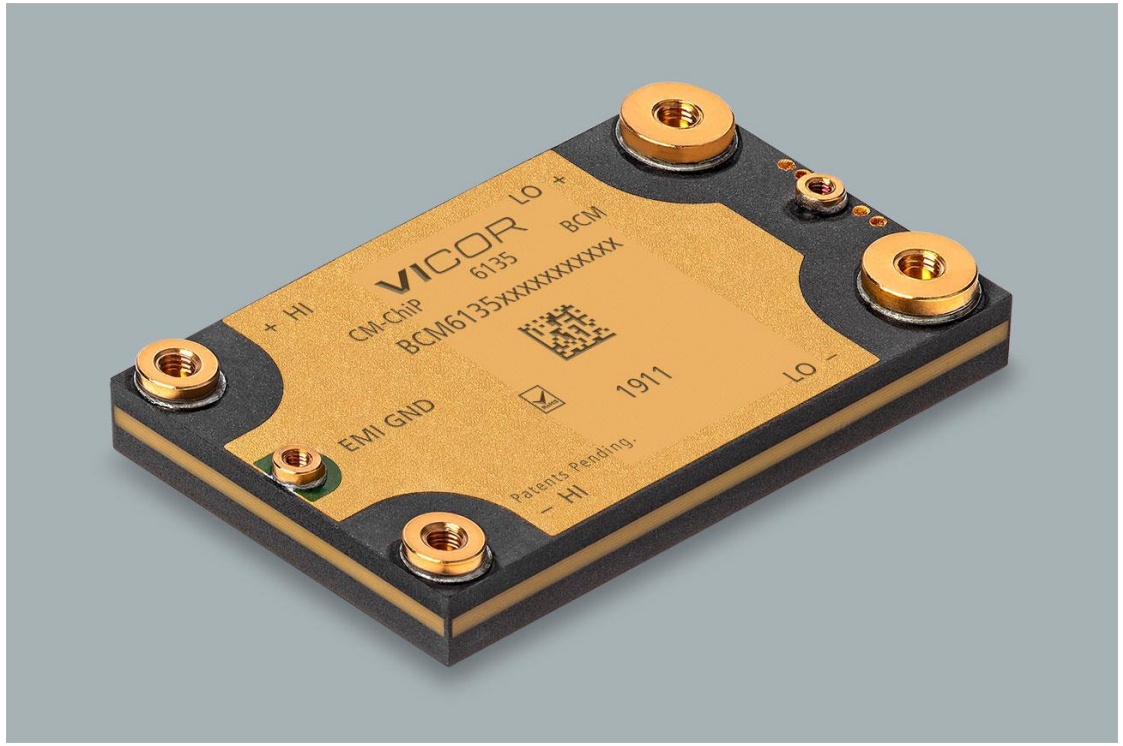
BCM6135CD1E5165T00 isolated, fixed-ratio (8:1) bus converter

- Vin：260 – 410V
- Vout: 32.5 – 51.3V
- IOUT (avg): 65 A
- Peak Efficiency: 97.9%
- Parallel capable
- PMBus programmable
- 4242VDC Isolation
- 61.33 x 35.35 x 7.42 mm



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PRM2610S55D60F0TL0 non-isolated regulator

- PRM regulation for downstream VTM
- Adapted Loop Control
- VIN (full power): 43V – 55V, 48VNOM
- VOUT: 20V – 60V, 48VNOM
- POUT (avg): 600W, VIN > 43V
- Efficiency: 98.5%
- Programmable soft start
- PMBus programmable
- SM-CHiP surface mount package
- 26.1 x 9.8 x 3.5mm

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VTM3110 (different K Factors) isolated, fixed-ratio DC-DC converter

- VIN: 20 – 60V
- VOUT: 10 – 30V, 24VNOM (example K=1/2)
- IOUT (avg): 15A
- IOUT (peak): 22.5A (10ms duration)
- Target efficiency: 96.5%
- Parallel capable
- 550V isolation
- Stackable (150V max working voltage)
- Inrush current control
- All VTMs packaged in 31.1 x 9.8 x 3.5mm SM-ChiP surface mount package

Multiple VTM modules, top picture is VTM3408 closest to VTM3110 size

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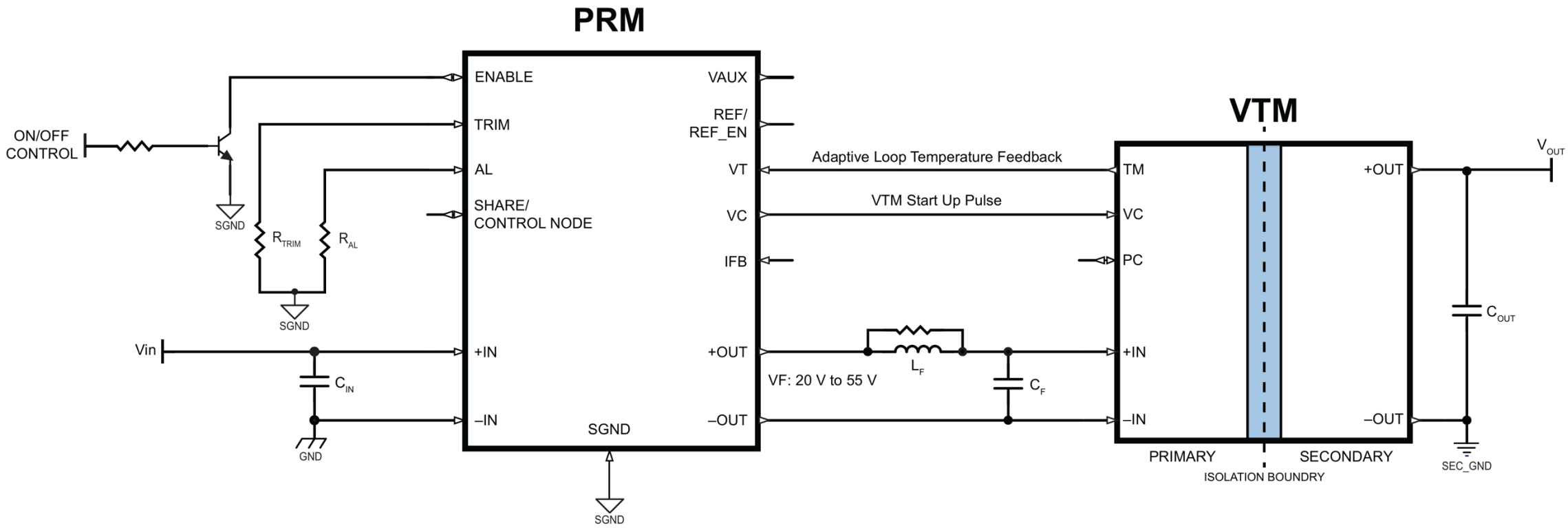
Detailed Isolated PRM/VTM application



ITRIM will be connected to ground with a resistor and will be set at maximum. User can trim is down as desired. VTRIM can be connected with a pull-up (connect to OUT) or pull-down resistor (connect to SGND). User can trim it down or up as desired

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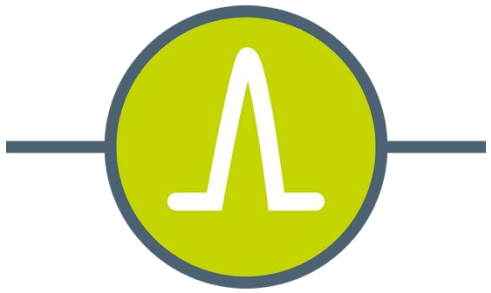
The value Vicor brings



Fast transience Response

Lightweight

Power density

Faster time to market

Optimize storage performance

High efficiency

High reliability

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Thank you

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