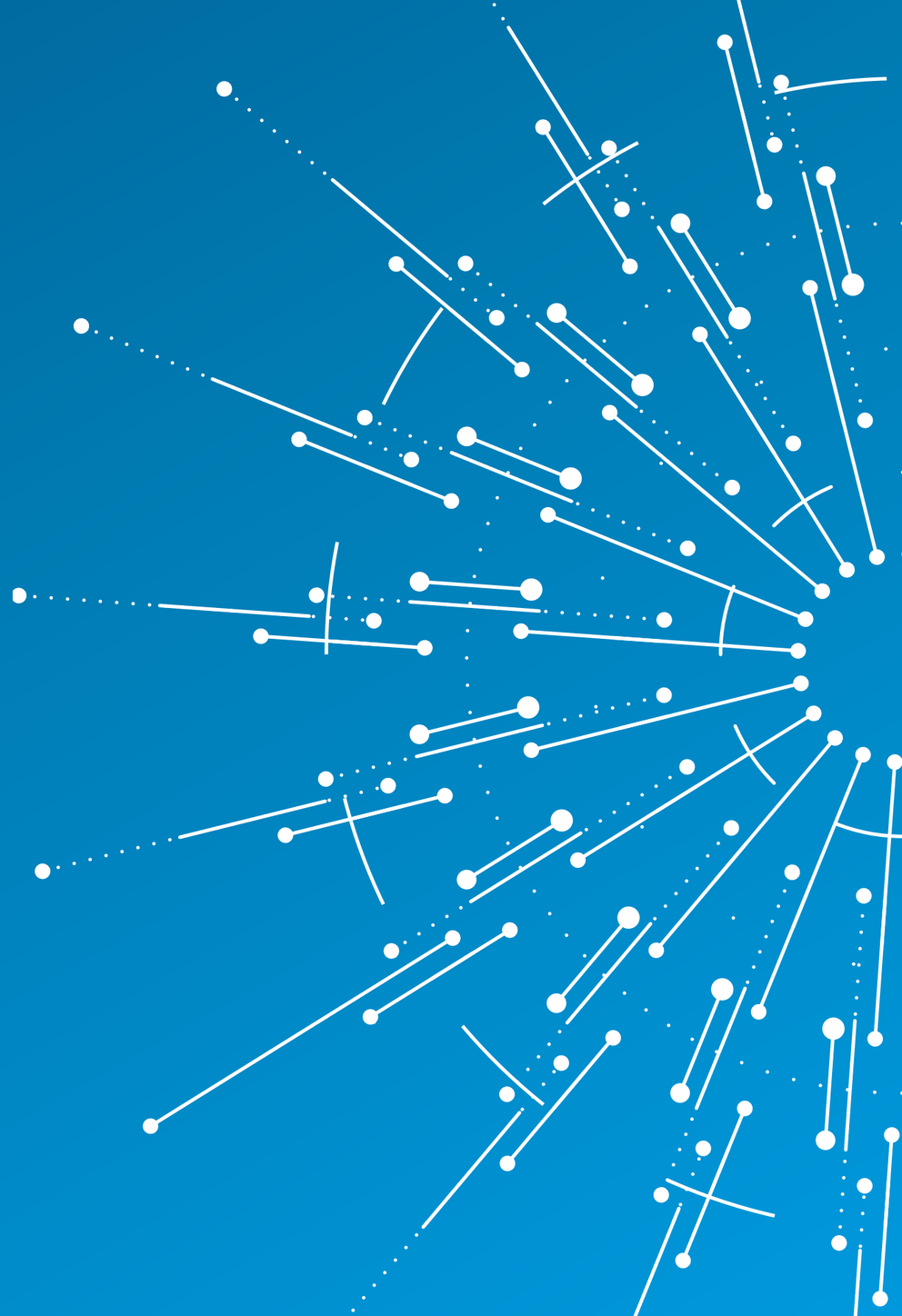
Innovative DC/DC solutions for datacom

21IC event |04.09.2021| Shenzhen

David Xie

Director R&D and Product Management
Flex Power Modules

flex



Flex Power Modules • Shanghai

- Subsidiary for Power Modules
  (former Ericsson Power Modules)
- Located in Jiading, China
- 350 employees
  (>100 highly educated employees)
- Technology focus
- High quality standards
- Mass production capabilities with high product mix
- Agile to market demands

Flex Power Modules • Shanghai

- Full Power Modules Functional Site
  - E2E Supply Chain
  - Manufacturing
  - R&D, Product Management, Sales
  - NPI and Test Development
  - Quality Management and Customer Services
- Certifications
  - ISO9001
  - ISO14001
  - OHSAS18001
  - C-TPAT
  - IEC/EN/UL 60950-1
  - IEC/EN/UL 62368-1

Our global reach

Americas

- San Jose, CA, USA
- Miami, USA
- Dallas, USA
- Boston, USA
- Seattle, USA
- Jackson-Hole, USA
- Los Angeles, USA

Europe

- Stockholm, Sweden, HQ
- Kalmar, Sweden
- Paris, France
- London, UK

Asia Pacific

- Shanghai, China
- Shanghai, China
- Shanghai, China
- Shenzhen, China
- Tokyo, Japan
- Bangalore, India

Sales:	13
Research & Design:	2
Production:	1

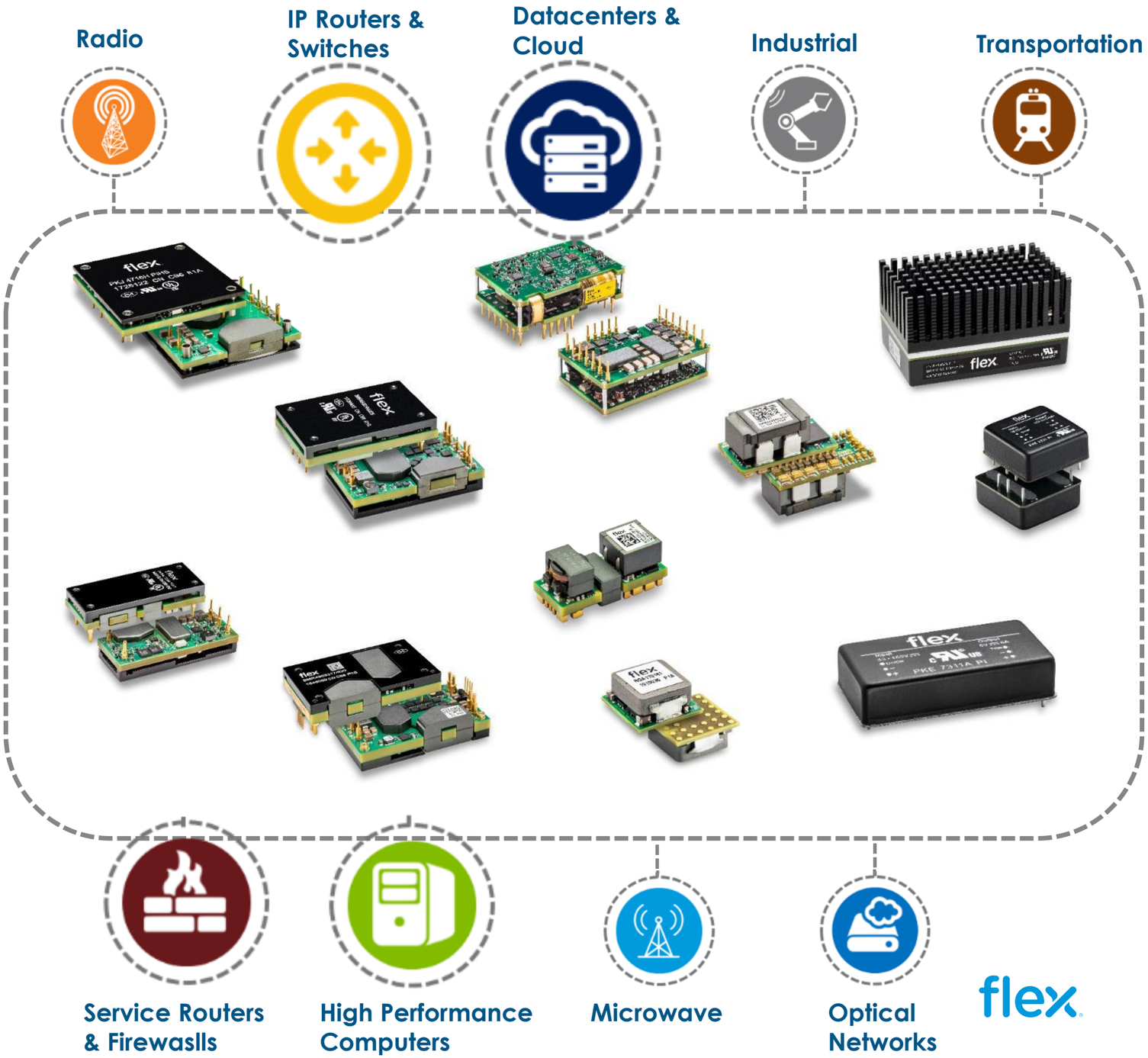
Datacom applications

Datacom solutions designed to meet the needs of increasing data capacity, high speed networks and tomorrow's applications

flex

Product & application overview

DC/DC converter solutions that ensure maximum reliability, performance and cost effectiveness for the most demanding applications.



Datacom applications

Cloud

Data Center

Network Security

IoT

AI

Big Data

Deep Learning

Autonomous Vehicles

Machine Learning

Datacom portfolio

Point of Load
- High current/high performance
- Intermediate current
- Digital Control
- PMBus
- Low current/low cost

48V

12V

PIM
- Hot Swap
- EMI Filtering
- Reverse polarity protection

IBC
- 30W to 1500W
- High Efficiency
- Digital Control
- PMBus
- QB, EB, SB

12V Bus Voltage

Distribution

High Current Rails

100A to 600A Thermal
1000A Peak
- High end processors
- ASIC/FPGA

Medium Current Rails

6A-100A
- Memory
- Low-level processors

Low Current Rails

2A – 8A
- Non-core Loads
- (drives/stdby chipset)

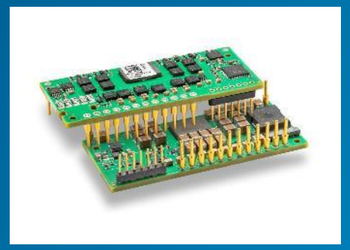
48V

Direct Conversion

70-600A
- Processors
- ASIC/FPGA

Direct Conversion
- Digital Control
- PMBus

Technology leader DC/DC solutions for datacom



Switched Capacitor IBC

Intermediate Bus Converter based on switched capacitor technology

Power Surface Multiplier Package

The blade concept going vertical

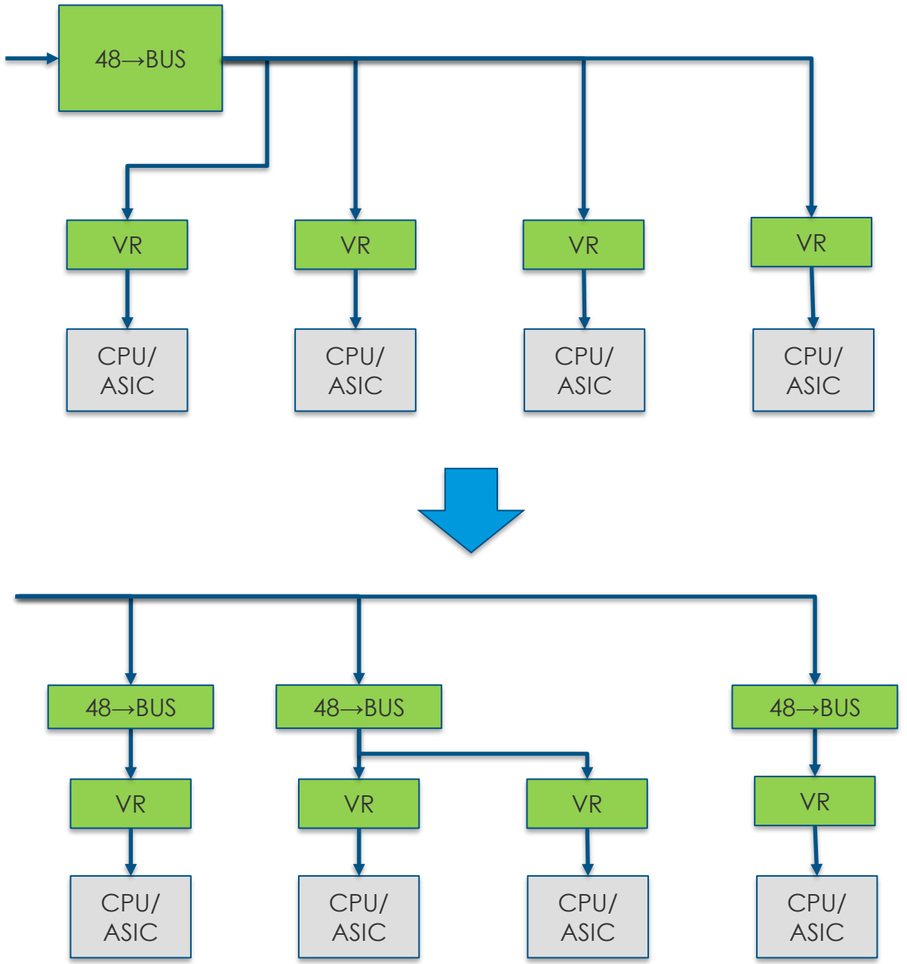
Direct conversion

Direct conversion concept converting directly down to 1 Vout

Switched Capacitor concept

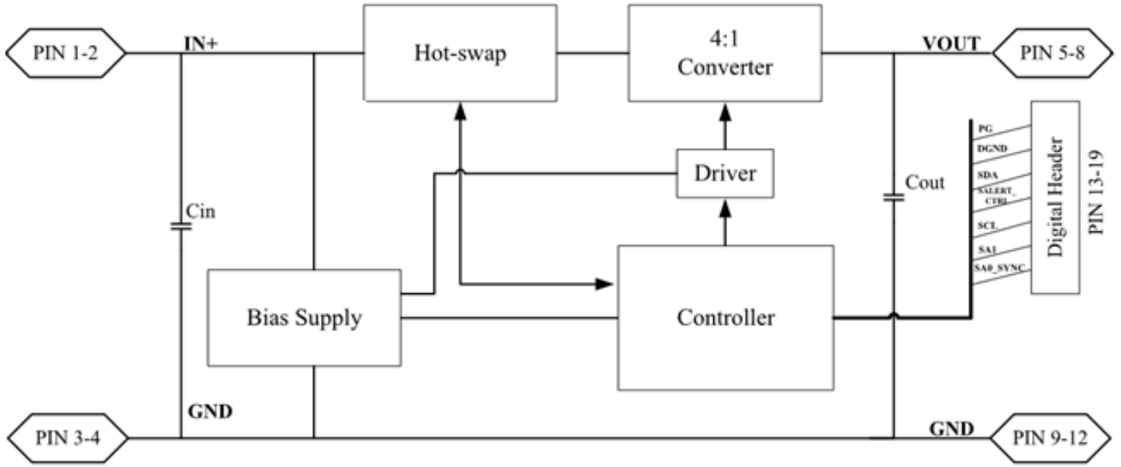
Target datacenter applications

- High power systems - moving from a 12 V bus architecture to a 48 V architecture.
- 48V systems - moving from a central 48 V to multiple bus voltages closer to the VR solutions.
- Need for extreme efficiency and power density from 1st stage conversion, providing improved board space utilization and TCO reduction.
- Low Profile - systems require low profile solutions (<6.9 mm) due to large heatsinks or cold-plates covering the majority of the board.



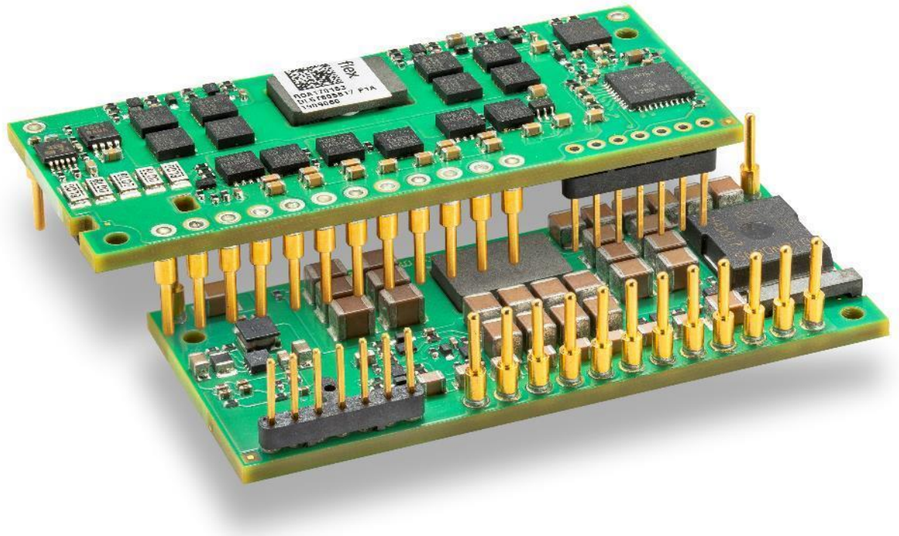
Fundamental circuit diagram and function

- **Non-Isolated** - the chosen converter topology does not support galvanic primary to secondary isolation, which is largely accepted in the datacenter industry today.
- **Unregulated** - SC converter is non-regulated and offers a very low internal AC and DC impedance, therefore system features like ramp-up and OCP are handled by a pre-regulator hotswap together with the system controller.
- **Stand-alone unit** with integrated bias supply.



Product presentation • BMR310

- Vertically or horizontally mountable IBC
- Continout power up to 900 W (lay down)
- High efficiency up to 98%
- Paralleling is supported via passive Droop Load Sharing
- High power density 1432 W/in³
- Unregulated V_{out}; divided by 4
- Digital communication and control with PMBus
- Low height profile with only 6.9 mm



Dimensions horizontal:
58 x 25 x 6.9 mm
(2.3 x 0.98 x 0.27 in)

Dimensions vertical:
58 x 6.9 x 25 mm
(2.3 x 0.27 x 0.98 in)

Key features • BMR310*

	SCC
Part number	
	BMR310
Electrical	
Input voltage range	40-60 V
Output voltage	10-15 V
Output current	45 A
Output power/peak power	600/900 W with heatsink (SIP, laydown)
Output peak power	1000 W
Efficiency	98.3 % half load, V_{in} 54V

* To be released in Q4/2021

Power surface multiplier concept

PSMP/blade concept

WHY DID WE DEVELOP THE PSMP CONCEPT?

- There are limitations in board space availability for power
- There is the desire to improve cooling conditions
- To use the height availability and make use of the z-dimension

PSMP blade unit

PSMP controller assembly

BMR520

- First vertically mountable IBC
  - Consists of blade unit and controller assembly
- 1 controller assembly can control up to 3 blades
- Blade unit has 300 W power
  - Up to 900 W with 3 x blades in parallel
- Heatsink on both sides
- Non-resonant full bridge technology
- 3 blade units equial app. 1 quarter brick footprint

Dimensions blade unit:
40 x 17 x 20 mm
(1.57 x 0.67 x 0.8 in)

Dimensions controller assembly:
17 x 17 x 11.6 mm
(0.67 x 0.67 x 0.46 in)

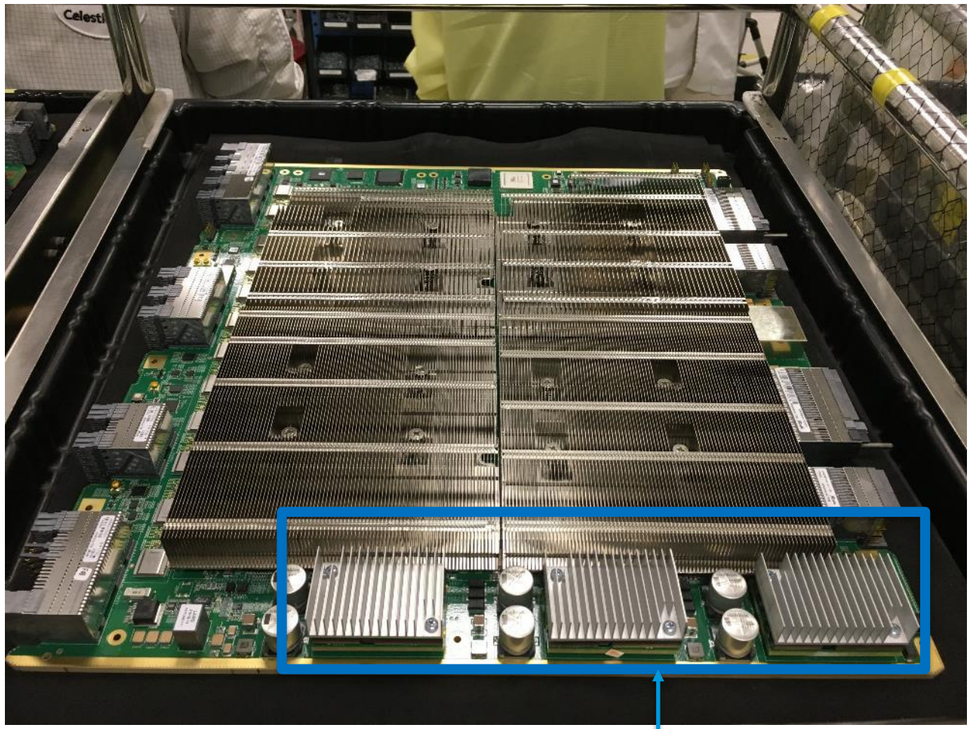
Key features

	Blade unit
Part number	
	BMR520
Electrical	
Input voltage range	36-75 V
Output voltage	12 V
Output current	25 A
Output power	300 W/ 900 W
Efficiency	94.9 % half load, V_{in} 48V
Isolation	1500 V

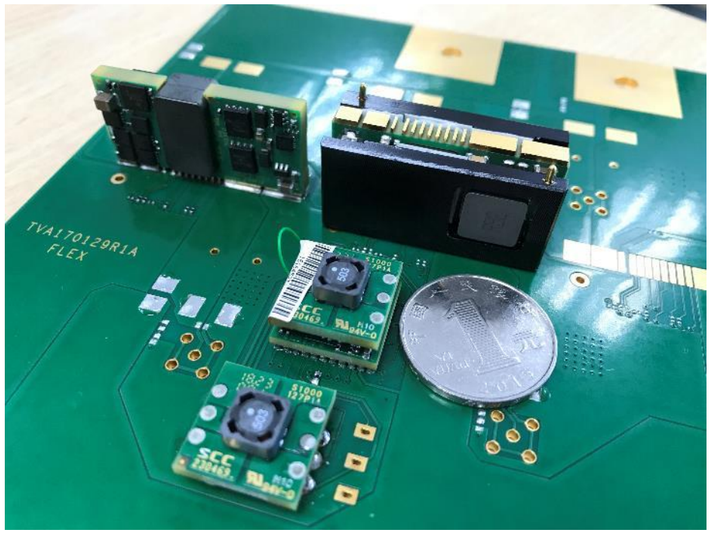
Unique selling points

- Scalability
  - Parallel design up to 3 modules
- More useable power
- Lower input ripple
- Lower cost for input capacitors
- Board efficient design
- More flexible to expand to up to 6 phase interleave
- Innovative solution with vertical layout and SMT

Application view



Replacement area for BMR520

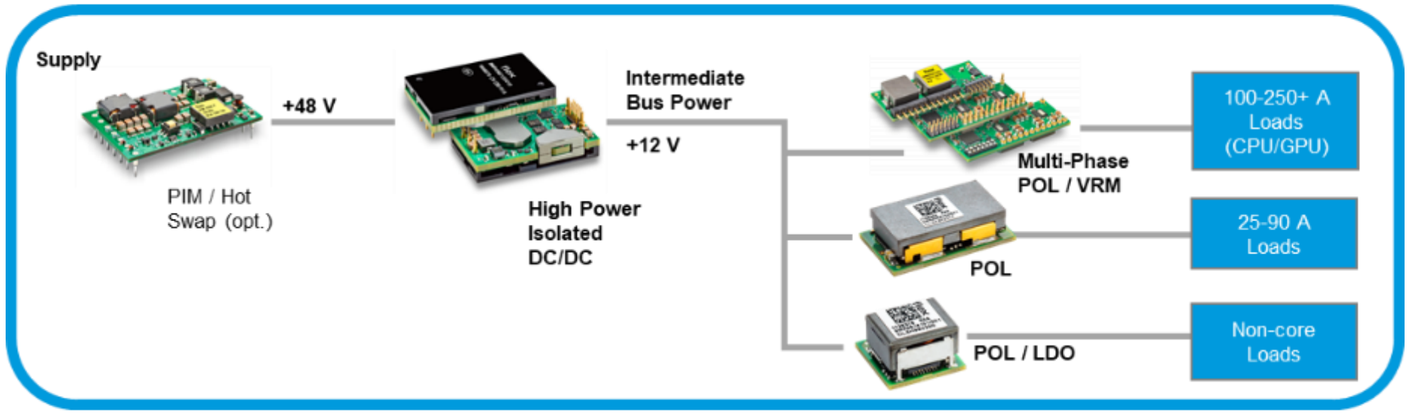


BMR520 on evaluation board

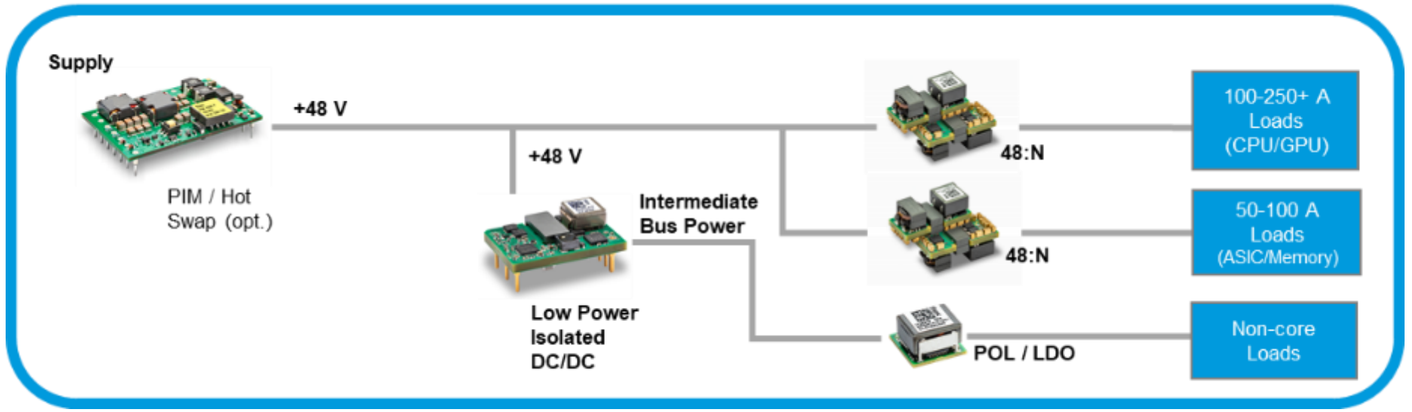
Direct conversion concept

Before and with Direct Conversion

Before Direct Conversion



With Direct Conversion



- **Higher efficiency** app. 2-3% than traditional dual stage
- **Reduction** of board space
- Mechanically & electrically designed to meet **server aplications**
- Full **digital** controll
- Compliant with PMBus, AVSBus and Intel SVID
- Supported by **Flex Power Designer**

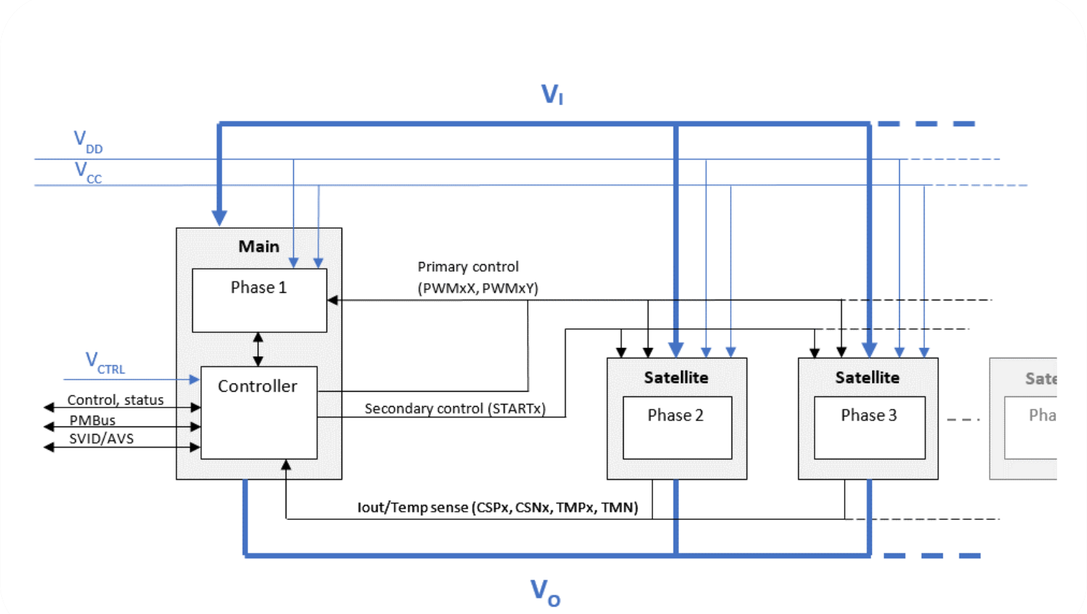
48 V to load direct conversion

Challenges and opportunities

- Next generation data center applications require higher power
- 3-4 kW boards testing limits of IBC / PoL power architecture
- Challenge for next generation data centers to distribute the current, especially at 12 V
- Our solution: converters capable of operating directly from the system bus voltage (48 V or 54 V) to PoL voltage (< 2 V)

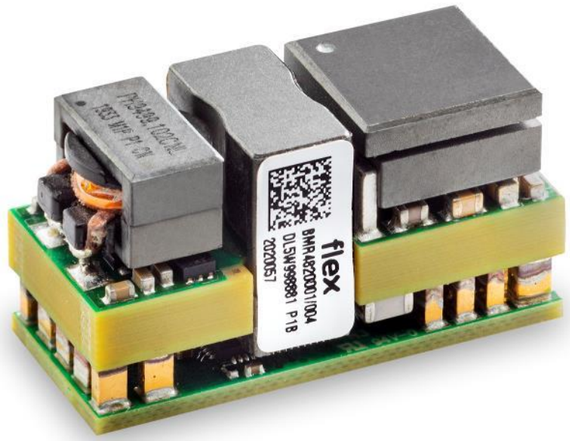
Benefits

- Reduced need for Intermediate Bus in 48 V supplied systems for the highest current rails - offering up to 50% reduction in board area over IBC approach
- Increased board level efficiencies typically 2-3% higher than a leading-edge IBA solution
- Better dynamic performance/less capacitance required
- Scalable solution for modularity
- Programmable via digital Interface (PMBus)

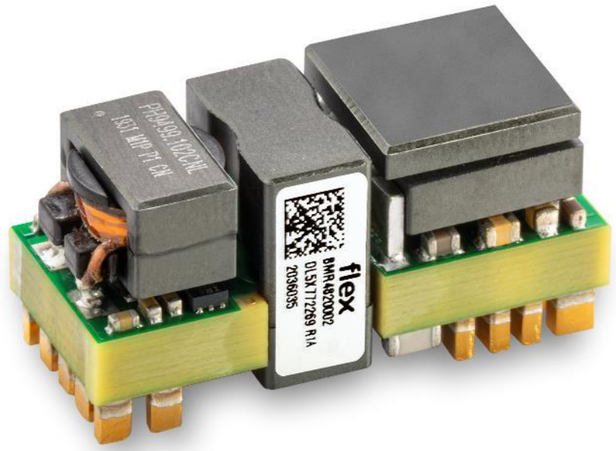


Introducing BMR482

Main unit: BMR482 0001/004

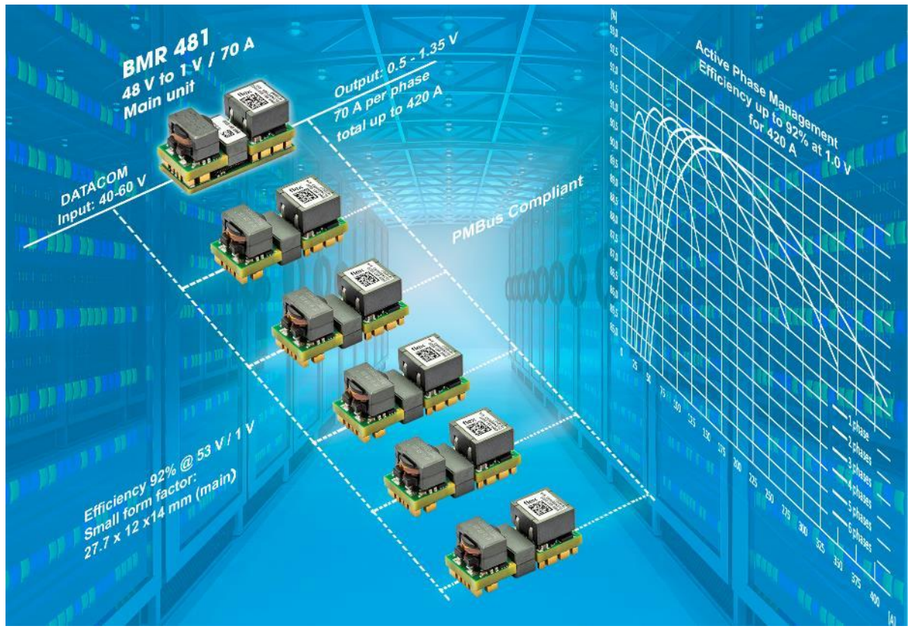


Satellite: BMR482 0002



BMR482

- Second generation of Direct Conversion products
- Input 40-60 V
- Output 0.5-1.35 V, 100 A per module
- High efficiency with up to 92%
- Multi-phase design - up to 6 modules in parallel for up to 600 A
- 1500 V isolation

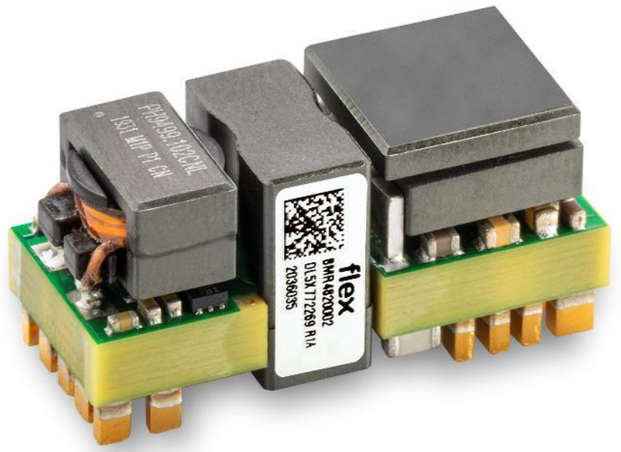


Dimensions Main Unit:
30 x 12.7 x 16.8 mm
1.18 x 0.5 x 0.66 in

Dimensions Satellite:
30 x 12.7 x 15.4 mm
1.18 x 0.5 x 0.61 in

BMR482

- Small 1/2 inch^2 footprint size
- Fast load transient response
- High current monitoring accuracy
- Digital Interfaces: PMBus v1.3, AVSBus, Intel SVID compliant
- Excellent thermal performance
  - designed with optimal cooling for terminals, footprint and component placement
- Supported by Flex Power Designer version 4.2



Key features

	BMR482
Mechanical	
	• *30 x 12.7 x 16.8 (main)* • *30 x 12.7 x 15.4 (satellite)*
Electrical	
Input voltage range	*40-60 V*
Output voltage	*1 V*
Output voltage range	*1.2 – 2.4 V*
Output current/total	*100 A /600 A*
Efficiency	*92 % at 53 V/ 0.8 V*
Isolation	*1500 V*

Power Stamp Alliance (PSA)

- Collaborative approach to ensure multiple-sourced product solutions for direct conversion
- Flex is a founding member of Power Stamp Alliance
- Key features:
  - Standard product footprint & functions
  - Specific to direct conversion “Power Stamps” from 48 V_{in} to low voltage outputs for high current applications (e.g. GPU/CPU/DDR/ASIC/FPGA)
  - Drives innovation, lowers costs and reduces supply chain risks for the customers
- More information under

http://www.powerstamp.org/

Point of Load

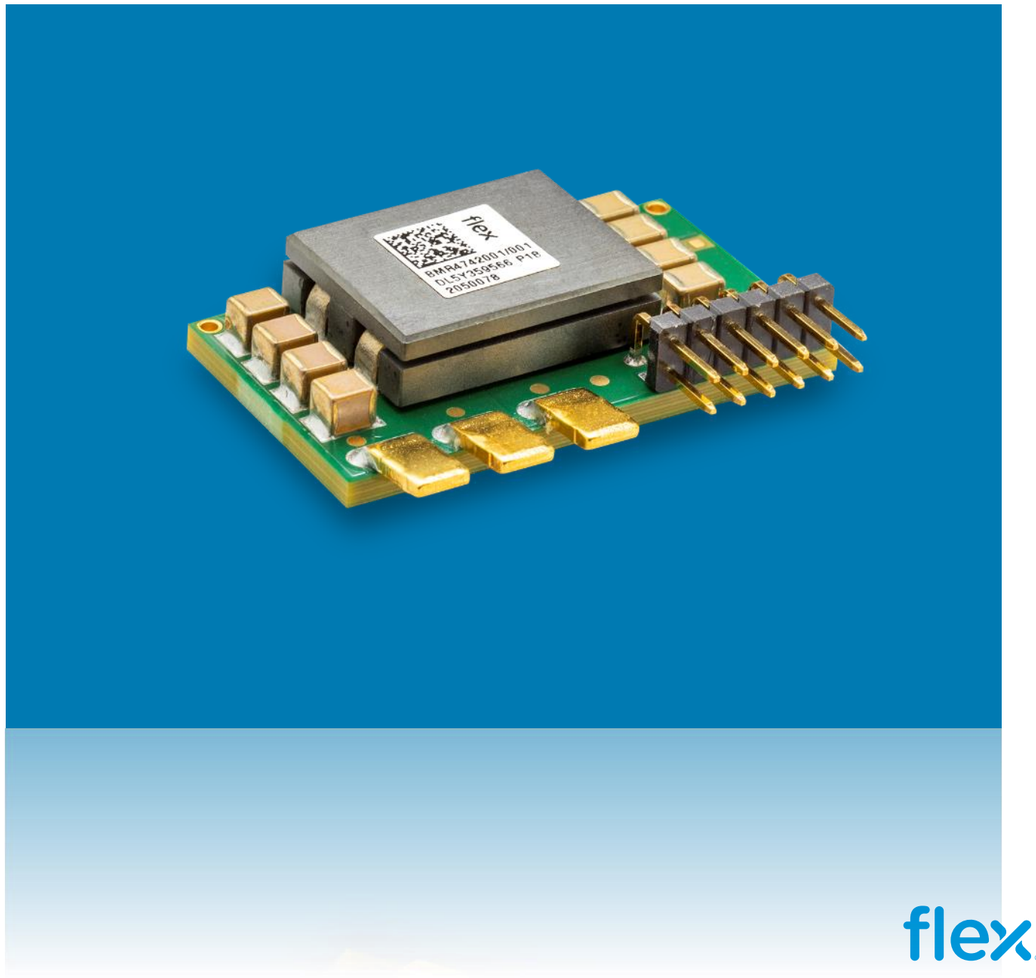
Presenting our latest module

flex

Product info • BMR474

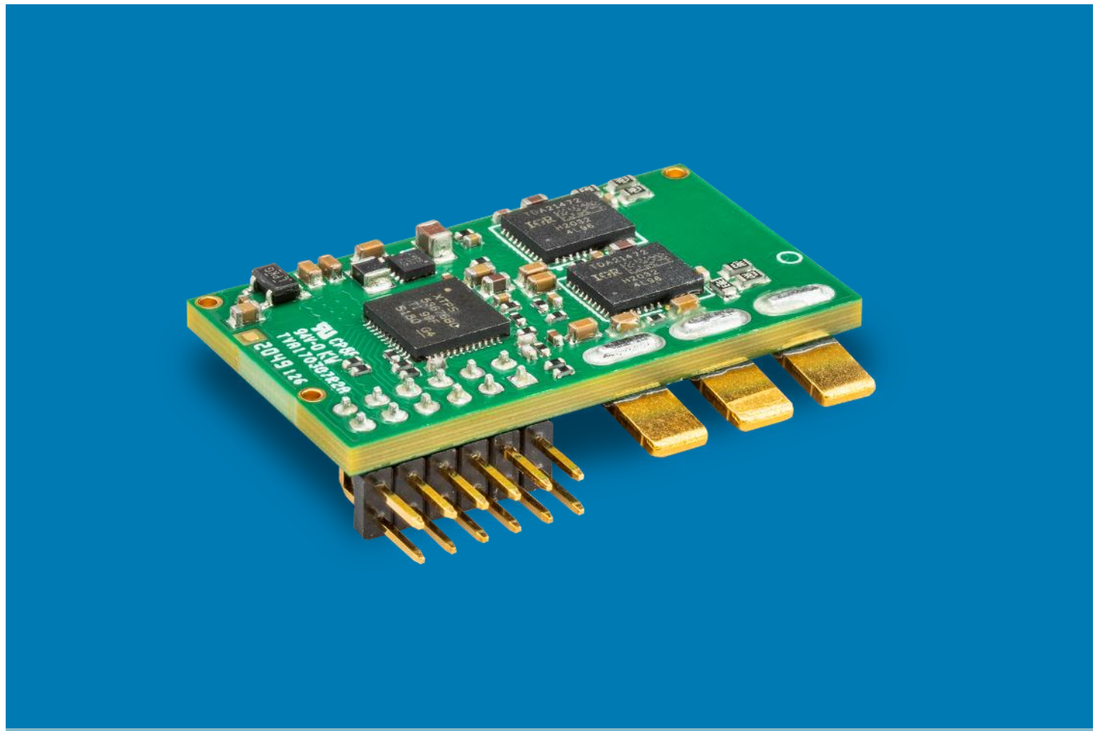
- Digital Point of Load (PoL)
- Non-isolated
- Output current/power: 80 A/ 198 W
- Input: 6-15 V
- Outputs: 0.6-3.3 V
- Efficiency 95.1% full load V_{in} 12 V, V_{out} 3.3 V
- Heatsink available
- MTBF > 23 MHrs

Dimensions:
33 x 8.6 x 19 mm
1.30 x 0.34 x 0.75 in



Unique selling points

- Board space efficient design with vertical SIP mount and small footprint with 2.84 cm^2
- Adjustable output range with 0.6-3.3 V
- High efficiency with 95.1% full load V_{in} 12 V, V_{out} 3.3 V
- Synchronisation to external clock
- Improved fast load transient response
- Excellent thermal behavior
- Output voltage setting through pin-strap: 10 mV step
- Configuration and monitoring via PMBus
- Supported by Flex Power Designer



High power digital converters

The latest and greatest

flex

Introducing BMR491

Variant 1: BMR491 xx05/852

Variant 2: BMR491 xx07/856

Variant 3: BMR491 xx08/857

- Hybrid regulated ratio
- Continous P_{out}: 1300 W/ 1400/ 1540 W
- Peak power: 1850 W / 2400 / 2450 W
- 48-60 V_{in}
- paralleling

Variant 4: BMR491 xx03/851

- Fixed output voltage regulation
- Continous P_{out}: 1300 W
- 40-60 V_{in}
- 12 V full V_{in} range
- paralleling

Product info • BMR491

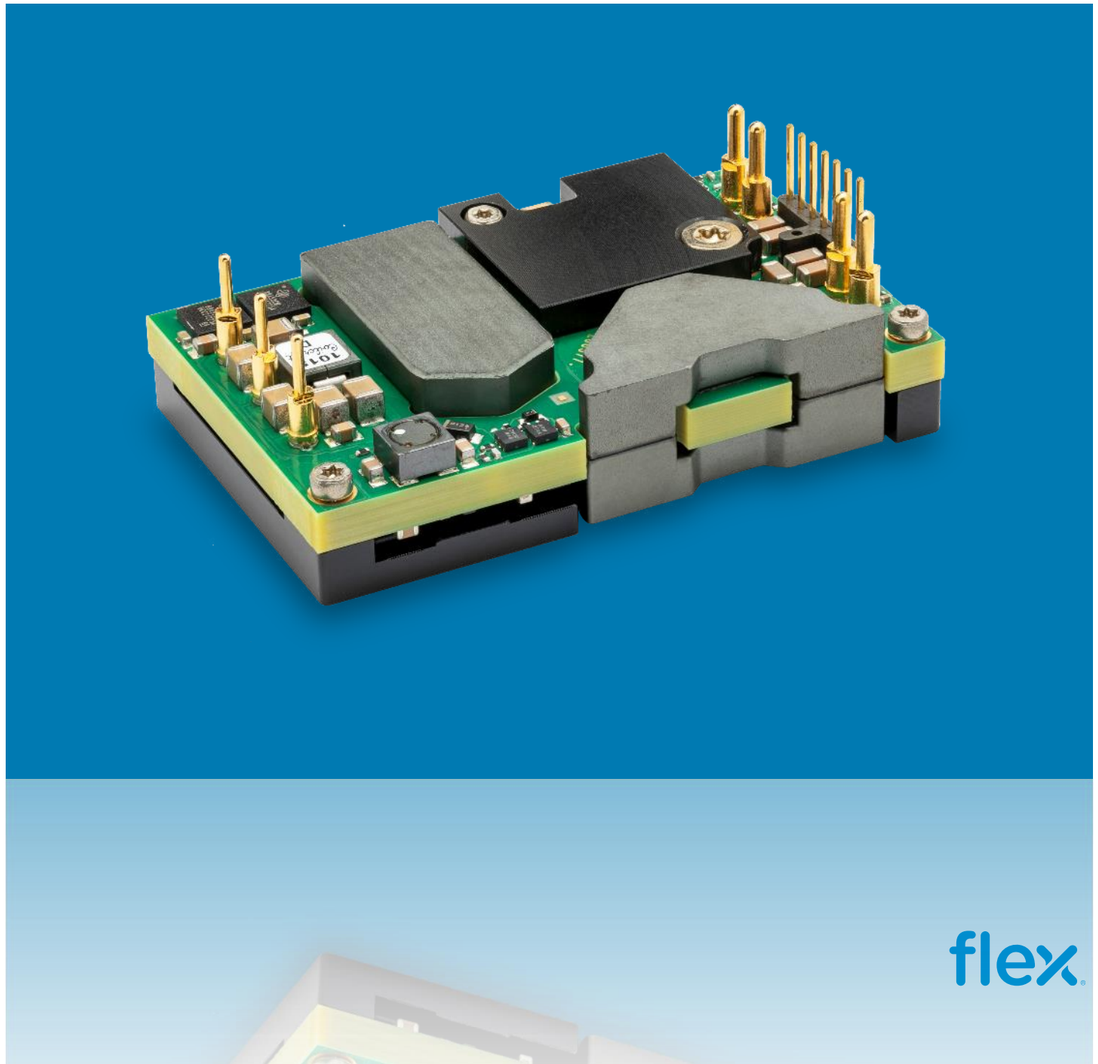
- 6th generation of digital DC/DC converter
- Designed for datacom applications
- High power DC/DC with peak P_{out} up to 2450 W*
- High efficiency with 97.7%
- Digital interface available with PMBus
- HRR – hybrid ratio regulation & fixed regulated versions *
- 1500 V isolation
- Heatsink available*

Dimensions:
58.4 x 36.8 x 14.5 mm
2.3 x 1.45 x 0.57 in

* model dependent

Unique selling points

- High power DC/DC with continous power up to 1540 W
- Extended peak power duration (t ≤ 1 sec)
- Excellent thermal behavior
- High efficiency due to HRR
- Paralleling (active and droop load share)
- Compatible with Flex Power Designer
- Compliant to PMBus
- Own proven firmware
- Thermal models available



BMR491 • digital high-power DC/DC

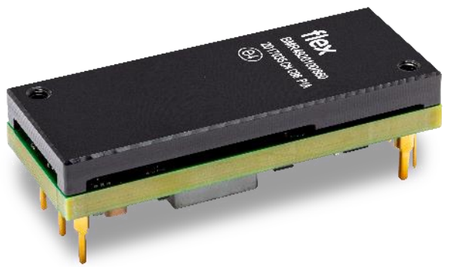
BMR491					
Product number	**BMR491 0203/851**	**BMR491 2205/852**	**BMR491 3206/855***	**BMR491 2307/856**	**BMR491 2408/857**
Mechanical	QB	QB	QB	QB	QB
Dimensions/ form factor	58.4 x 36.8 x 14.5 mm 2.3 x 1.45 x 0.57 in	58.4 x 36.8 x 14.5 mm 2.3 x 1.45 x 0.57 in	58.4 x 36.8 x 14.5 mm 2.3 x 1.45 x 0.57 in	58.4 x 36.8 x **13.4 mm** 2.3 x 1.45 x 0.55 in	58.4 x 36.8 x 14.5 mm 2.3 x 1.45 x 0.57 in
Electrical specs					
Input voltage range	40-60 V	48-60 V	45-60 V	48-60 V	48-60 V
Output voltage	12 V	12 V, HRR	**10.4 V,** HRR	12 V, HRR	12 V, HRR
Output power/peak power	1300 W	1300 W /**1850 W**	1300 W	1400 W /**2400 W**	1540 W /**2450 W**
Efficiency	97.4% at half load	97.6% at half load	97.6% at half load	97.6% at half load	97.6% at half load
Isolation	1500 V	1500 V	1500 V	1500 V	1500 V
Other features	• Fixed output voltage regulation • 7 pin dig header • Paralleling ACS • Halogen free	• HRR • 4 pin dig header	• HRR • 4 pin dig header	• HRR • 4 pin dig header • Low building height	• HRR • 4 pin dig header • Optional integrated heatsink

* To be released in Q3/2021

Introducing BMR492

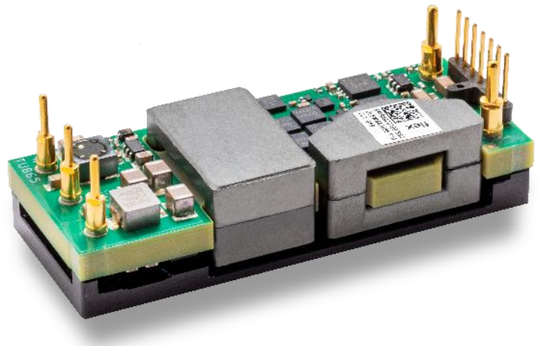
Variant 1 : BMR492 0302/861

- Regulated
- V_{out}: 12 V
- Continuous P_{out}: 600 W
- No peak power



Variant 2: BMR492 (10.4 V)*

- *Hybrid regulated ratio*
- *V_{out}: 9.5-10.4 V*
- *Continuous P_{out}: 800 W*
- *Peak power: 1100 W*



Variant 3: BMR492 (12 V)*

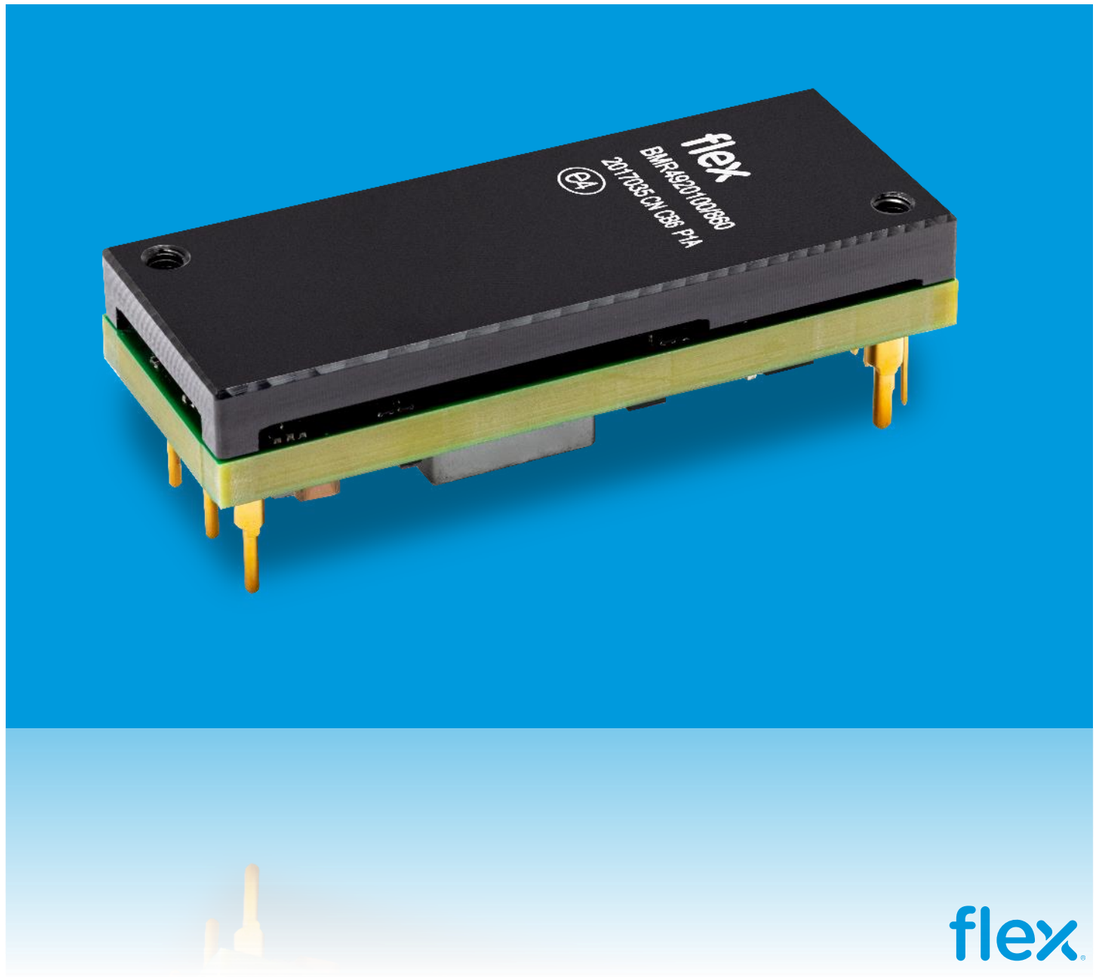
- *Hybrid regulated ratio*
- *V_{out}: 9.5-12 V*
- *Continuous P_{out}: 700 W*
- *Peak power: 950 W*

* Possible variants

Product info • BMR492

- Digital DC/DC converter in an eighth brick format
- Designed for datacom applications
- High power DC/DC with peak P_{out} up to 1100 W*
- High efficiency up to 97.4%
- Digital interface available via PMBus
- HRR – hybrid ratio regulation*
- Baseplated version – baseplate connected with press fit (very similar to screwed baseplate)

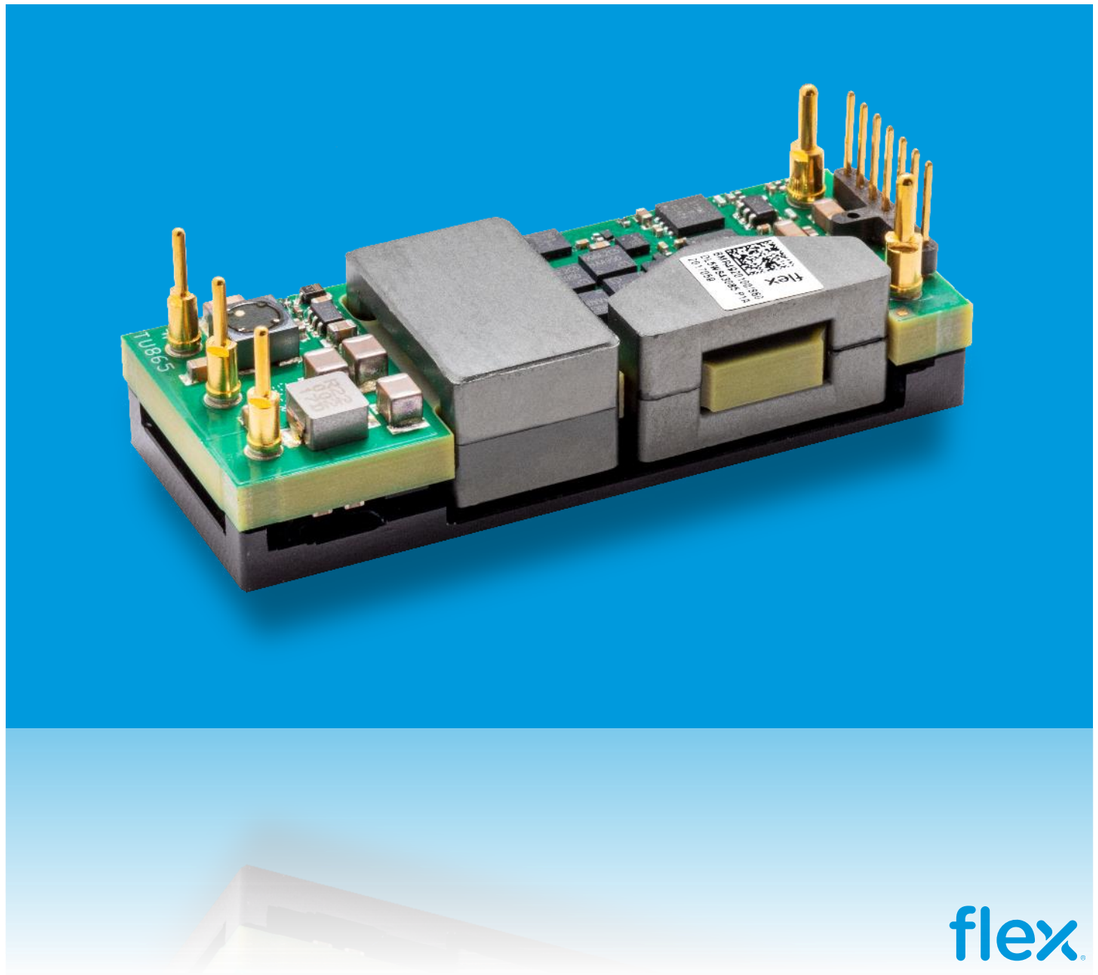
Dimensions with baseplate:
58.4 x 22.7 x 13.2/14.5* mm
2.3 x 0.89 x 0.52/ 0.57* in



* model dependent

Unique selling points

- High power DC/DC with continuous power **up to 800 W**
- Impressive performance **in an eighth brick**
- Peak power capabilities*
  - Extended peak power duration (t ≤ 1 sec)
- Excellent thermal behavior
- High efficiency due to HRR*
- Compatible with Flex Power Designer
- **Digital interface available in 7-pin DOSA standard**
- Halogen-free
- Pin compatible with BMR458*



* Model dependent

Key features

	BMR492 0302/861	BMR492 (12 V)*	BMR492 (10.4 V)*
Mechanical			
Dimensions	58.4 x 22.7 x 13.2 mm max 2.3 x 0.89 x 0.52 in max	58.4 x 22.7 x 14.5 mm max 2.3 x 0.89 x 0.57 in max	58.4 x 22.7 x 14.5 mm max 2.3 x 0.89 x 0.57 in max
Electrical			
Input voltage range	40-60 V	40-60 V	40-60 V
Output voltage	12 V	9.5-12 V	9.5-10.4 V
Output voltage adjust range	8-13.2 V	8–13.2 V	8-13.2 V
Output power/peak power TDP > 45 V_{in}			700 / 950 W
Output power/peak power TDP > 48 V_{in}		800 W / 1100 W	
Output power max	600 W		
Efficiency	96.7 % at half load V_{in} 48 V	97.3 % at TDP power	97.4 % at half load, V_{in} 48 V
Isolation	1500 V	1500 V	1500 V

* Possible variants

More information and your contacts

Where to find more info

- flexpowermodules.com
- Brochure DC/DC solutions for datacom
- Article about high-power density solutions

Where to buy

- Our partners

Where to send questions

- Your regional partner, FAE or sales contact
- Pm.support@flex.com
- Pm.info@flex.com

Where to ring

- Your regional partner or sales contact

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Powering your innovation