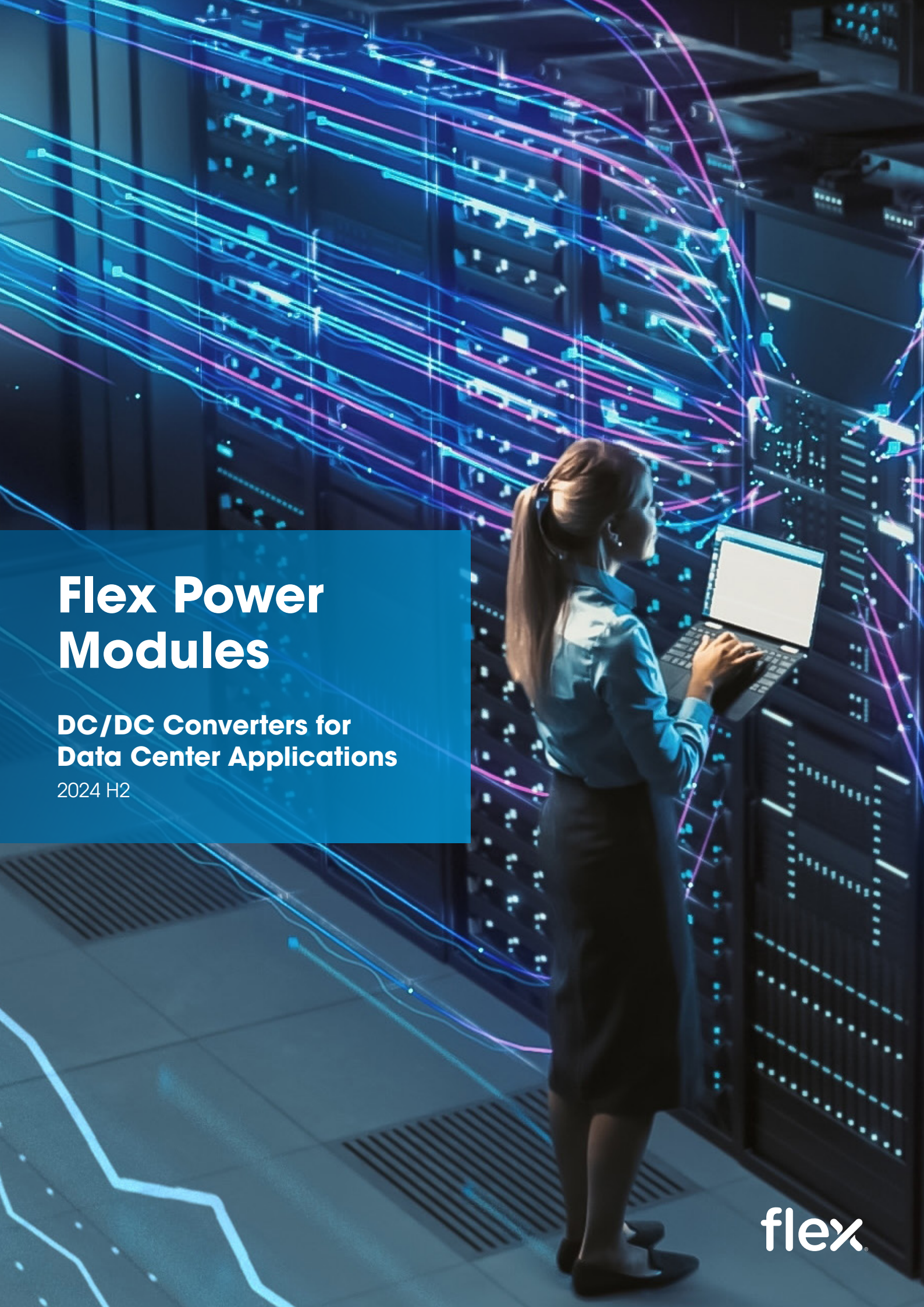

Flex Power Modules

DC/DC Converters for Data Center Applications

2024 H2

flex

flex®

Power Modules

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Powering your innovation

About Flex Power Modules

Flex Power Modules specializes in designing and manufacturing scalable DC/DC converter solutions that enhance efficiency across Data Center, Telecom, Industrial, and Transportation markets. As a global leader in digitally enabled DC/DC converters, we offer a broad spectrum of both isolated and non-isolated solutions. Our products are distinguished by PMBus compatibility, supported by our powerful and free software design tool – Flex Power Designer, ensuring that our solutions are not only powerful but also easy to integrate and optimize for maximum efficiency.

Data center applications

Our extensive product portfolio is tailored for the unique power requirements of data centers, which typically operate within a narrow 40-60V supply voltage range, distinct from the wider 36-72V input voltage required in telecom applications. In the data center market, we provide highly efficient power solutions for cloud, storage, hyperscale computing, AI, and network security applications. We lead innovation in this sector by employing advanced LLC and SCC topologies and cutting-edge components to achieve exceptional power densities. Additionally, our Vertical Power Delivery (VPD) designs facilitate direct underside connections to the power pins of processors and ASICs, further enhancing efficiency and performance in demanding data center environments.

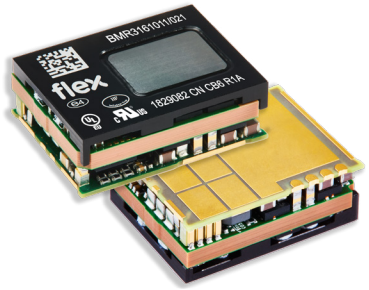
Vertical Power Delivery is really transforming the way data centers manage their power needs, offering a groundbreaking approach that significantly reduces energy losses and enhances overall efficiency. Traditional lateral power delivery methods often result in substantial power dissipation across the printed circuit board (PCB), leading to higher energy costs and increased thermal management challenges. By contrast, VPD minimizes the distance power travels by positioning voltage regulators directly beneath high-demand processors, such as those used in generative AI (GenAI) applications. This proximity reduces power plane resistance and improves current density, leading to a dramatic decrease in power losses and a more reliable, efficient power supply.

For technical support, please email pm.info@flex.com

48V Non-isolated unregulated DC/DC converters

ULTRA-SMALL INTERMEDIATE BUS CONVERTER

BMR313 / BMR316 (1000W / 3000W$_{pk}$)



Main features

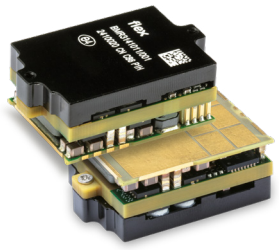
- Unregulated 4:1 fixed ratio converter
- Continuous power 1 kW; peak power 3kW
- Efficiency up to 97.3%
- High density IBC up to 15,528W/in^3 (942W/cm^3)
- Non-isolated DC/DC converter
- Digital PMBus interface
- LGA industry standard footprint and pinout
- Optimized thermal design for cold wall mounting

Dimensions

23.4 x 17.8 x 7.65mm / 0.92 x 0.7 x 0.3 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} RANGE (V)	P_{OUT} (W)	P_{OUT_PEAK} (W)	η (%)
BMR3131011/001	38-60	9.5-15	1000	3000	97.3
BMR3161011/021	38-60	9.5-15	1000	3000	97.7

BMR314 (800W / 1500W$_{pk}$)



Main features

- Unregulated 4:1 fixed ratio converter
- Continuous power 800W; peak power 1.5kW
- High efficiency up to 97.4% at half load
- Non-isolated DC/DC converter
- Digital interface compatible with PMBus

Dimensions

23.4 x 17.8 x 9.6 mm / 0.92 x 0.7 x 0.38 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	P_{OUT} (W)	$P_{OUT\ PEAK}$ (W)	η (%)
BMR3141011/001	38-60	9.5-15	800	1500	97.4

DIGITAL IBC CONVERTER WITH A FIXED RATIO 8:1

BMR320 (400W / 740W$_{pk}$)

Main features

- Unregulated 8:1 fixed ratio converter
- Continuous power 400W
- Peak power variant delivers up to 740W
- High efficiency up to 97.7% half load
- Non-isolated DC/DC converter
- Digital interface compatible with PMBus
- Parallelable up to 3 units
- Excellent price/performance ratio
- New technology low voltage bus ideal for AI

Dimensions

27 x 18 x 6.4 mm / 1.06 x 0.71 x 0.25 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} RANGE (V)	P_{OUT} (W)	$P_{OUT\ PEAK}$ (W)	η (%)
BMR3201000/001	40-60	5-7.5	400	—	97.7
BMR3201001/002	40-60	5-7.5	400	740	97.6

BMR321 (750W / 1500W$_{pk}$)

Main features

- Unregulated 8:1 fixed ratio converter
- Continuous power 750W; peak power 1.5kW
- High efficiency above 98%
- Non-isolated, digital
- Digital interface compatible with PMBus
- Parallelable up to 3 units
- New technology low voltage bus ideal for AI
- Following Open Compute Project standard OAM V2.0

Dimensions

41.47 x 17.67 x 6.9 mm / 1.63 x 0.69 x 0.27 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	P_{OUT} (W)	$P_{OUT\ PEAK}$ (W)	η (%)
BMR3211000/001	40-60	5-7.5	750	1500	98.05

48V Non-isolated regulated DC/DC converters

DIGITAL DC/DC CONVERTER

Quarter brick | BMR350 (up to 1300W / 1700W$_{pk}$)

Main features

- Fully regulated output
- Continuous power from 600W, peak power up to 1.7kW
- High efficiency up to 98%
- Non-isolated converter in quarter brick format
- Digital interface and compatible with DOSA 7-pin standard
- Event data recorder
- Both ACS and DLS parallelable options available

Dimensions

58.4 x 36.8 x 12.5 mm / 2.3 x 1.45 x 0.47 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	P_{OUT_PEAK} (W)	η (%)
BMR3502100/031*	40-60	12	72	860	1200	97.7
BMR3504102/002**	40-60	12	72	860	1200	97.8
BMR3504250/531*	40-60	12	108	1300	1700	97.8
BMR350x253/803**	40-60	12.2	108	1300	1700	97.7
BMR3502101/801*	40-60	12.12	72	860	—	97.8
BMR3502102/802	40-60	12.12	50	600	—	98.1

*Active Current Sharing **Droop load share

Quarter brick | BMR351 (up to 1600W / 2320W$_{pk}$)

Main features

- Fully regulated output of 12V
- Continuous power 1.6kW, peak power 2.3kW for < 1 sec
- Efficiency 97.8%
- Non-isolated DC/DC in quarter brick format
- Event data recorder
- Paralleling with Droop Load Sharing (DLS) and Active Current Sharing - model dependent
- Available as open frame and baseplated
- MTBF up to 6.26 Mhrs

Dimensions

58.4 x 36.8 x 14.2-14.7 mm / 2.3 x 0.89 x 0.56-0.58 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	P_{OUT_PEAK} (W)	η (%)
BMR3512202/002	40-60	12.2	136	1600	2320	97.8
BMR3512201/031*	40-60	12.2	136	1600	2320	97.8

*Active Current Sharing

Quarter brick | BMR352 (2000W / 3000W$_{pk}$)

Main features

- Fully regulated output of 12.2V
- Continuous power 2kW, peak power 3kW for < 0.5 sec
- Efficiency up to 97.7%
- Non-isolated DC/DC in quarter brick
- Event Data Recorder
- Parallel operation with ACS

Dimensions

58.4 x 36.8 x 14.5 mm / 2.30 x 1.45 x 0.58 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	P_{OUT_PEAK} (W)	η (%)
BMR3522200/031	40-60	12.2	167	2000	3000	97.7

48V Isolated regulated DC/DC converters

DIGITAL DC/DC CONVERTER

Eighth brick | BMR492 (up to 800W / 1100W_{pk})

Main features

- Fully regulated output of 12V, 10.4V or 9V
- Continuous power up to 800W, peak power 1.1kW
- HRR (hybrid regulated ratio) available for selected models
- Efficiency up to 97.5%
- 1500V isolation
- Eighth brick form factor with through hole mount package
- Pre-bias start up
- Digital interface in 7 pin DOSA standard

Dimensions

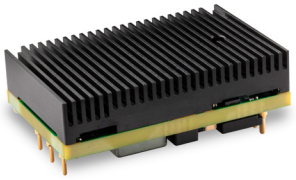
58.4 x 22.7 x 12.7 mm / 2.3 x 0.89 x 0.5 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	P_{OUT_PEAK} (W)	η (%)
BMR4920302/861	8-13.2	12	40-60	600	—	96.7
BMR4920303/862	9.5-12	12	40-60	504	—	96.8
BMR4920300/864	8-12	12	40-60	800	1100	97.5
BMR4920300/001	8-1.2	10.4	40-60	700	960	97.1
BMR4920302/863	8-13.2	9	40-60	450	—	96.7

Quarter brick | BMR491 (up to 1540W / 2450W$_{pk}$)

Main features

- Fully regulated output of 12V or 24V
- Hybrid regulated ratio (HRR)
- Continuous power up to 1.5kW, peak power up to 2.4kW < 1 sec
- High efficiency up to 98%
- 1500V isolation
- Excellent thermal behavior
- Digital interface available in 4 and 7 pin DOSA standard
- Some variants are available with heatsink
- Paralleling with ACS and DLS



Dimensions

58.4 x 36.8 x 14 mm / 2.3 x 1.45 x 0.57 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	V_{OUT} RANGE (V)	P_{OUT} (W)	P_{OUT_PEAK} (W)	η (%)
BMR4910203/851**	40-60	12	8-13.2	1300	—	97.4
BMR491xx02/853*	40-60	12	8-13.2	1300	—	97.2
BMR4912408/857(HRR)	48-60	12	8-13	1540	2450	97.5
BMR491xx07/856 (HRR)	48-56	12	8-13.2	1400	2400	97.5
BMR491x511/858**	40-60	12	8-13	1300	1800	97
BMR491xx06/855**	40-60	12	8-13.2	1300	—	97.3
BMR491xx14/880*	40-60	12	8-13	1400	2400	97.5
BMR491x510/871	40-60	24	16-26.4	1300	—	96.8

*Active Current Sharing **Droop load share

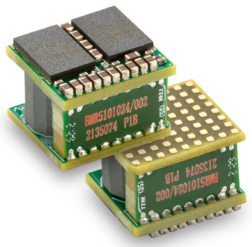
Integrated Power Stages (VRM)

DIGITAL 2-PHASE MODULE

BMR510 (up to 80A / 140A$_{pk}$)

Main features

- Continuous current 80A, peak current up to 160A < 1 sec
- Efficiency up to 92%
- Non-isolated, digital converter
- Optimized for top-side cooling
- Current and temperature sense
- Accepts tri-state PWM signals
- Over-temperature and current limit protection
- Available as LGA and BGA mount
- Power stage on top of module
- Halogen-free
- AI design compatible due to high power and tight board space requirements
- BMR5101041/002 contains on-board output capacitance



BMR510x034/002

BMR5101041/002

Dimensions

BMR510x034/002: 10 x 9 x 7.6 mm / 0.406 x 0.362 x 0.29 in
BMR5101041/002: 10 x 9 x 9.5 mm / 0.406 x 0.362 x 0.37 in

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	I_{OUT_PEAK} (A)	η (%)
BMR510x034/002	4.5-15	0.5-1.3	80 (TDC)*	140 total peak	92
BMR5101041/002	6-15	0.4-1.3	80 (TDC)*	160 total peak	>90

* Thermal design current

Vertical Power Delivery

A solution to offset environmental impact of AI- chips

Vertical Power Delivery (VPD) offers a promising solution to mitigate the environmental impact of GenAI chips by significantly improving power efficiency within data centers. GenAI chips are known for their high-power demands, often requiring thousands of amperes of current. Traditional power delivery methods result in significant power losses due to the PDN (Power Delivery Network) resistance, leading to increased energy consumption. VPD addresses this issue by positioning voltage regulators directly beneath the processors, minimizing the distance electricity must travel and thereby reducing resistance and power losses.

By enhancing power delivery efficiency, VPD reduces the overall energy consumption of data centers, leading to lower carbon dioxide emissions. This reduction in emissions directly impacts the amount of carbon tax a data center would need to pay, resulting in significant cost savings. Moreover, the decreased energy consumption contributes to the global effort to reduce greenhouse gas emissions, aligning with sustainability goals and helping to combat climate change. Implementing VPD in data centers not only enhances performance but also plays a crucial role in reducing the environmental impact of the rapidly growing GenAI industry.

Eco-friendly innovation for a sustainable future

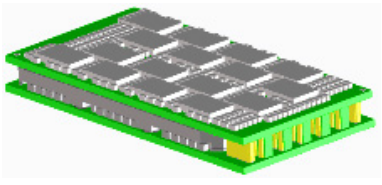
Adopting VPD not only boosts performance but also aligns with environmental sustainability goals. By lowering energy consumption, VPD helps data centers reduce their carbon footprint, offering a greener solution that supports global efforts to combat climate change. Additionally, the enhanced efficiency of VPD can lead to substantial cost savings, including lower electricity bills and reduced carbon taxes. As data centers continue to expand and their power demands grow, implementing VPD is a strategic move toward a more sustainable, cost-effective, and environmentally friendly future.

Increasing demands for ever higher current delivery driven by power hungry applications such as AI/ Machine Learning require new approaches to the IC power distribution networks.

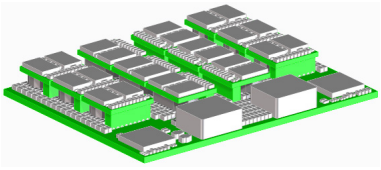
The challenges posed to supply high current, low voltage and extremely fast load transient response is solved by moving the voltage regulators to be placed directly under the processor on the bottom of the PCB, and is commonly referred to as Vertical Power Delivery (VPD).

By further optimizing the pinout of the VPD modules to match that of the processor it is feeding, connection resistance and inductance can be minimized to allow much lower voltage variation and power dissipation.

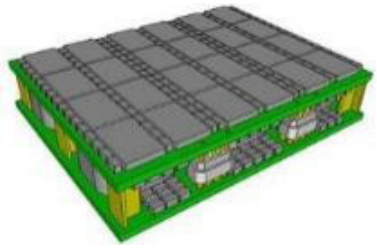
Complex custom VPD modules have been developed to feed various types of CPUs, GPUs, FPGAs, ASICS etc. Our VPDs offer solutions from 1-7 rails across 8-32 phases, and can include up to 2400 solder ball connections.



VPD | 16 phases, 1 rail



VPD | 48 phases, 5 rails



VPD | 24 phases, 5 rails

Point of Load Converters (4-80A)

We also have a wide range of Point of Load (PoL) products. Here is a selection of our PoL options applicable for data center applications. The BMR families below incorporate a digital interface for easy monitoring, configuration and control.

PRODUCT NO.	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	η (%)	PACKAGE	SIZE
PMU8218	4.5-17	0.6-5	4	95	LGA	7.5 x 7.5 x 5.4 mm / 0.3 x 0.3 x 0.21 in
PMU8318	4.5-17	0.6-5	6	95	LGA	7.5 x 7.5 x 5.4 mm / 0.3 x 0.3 x 0.21 in
PMU8418	4.5-17	0.6-5	8	95	LGA	7.5 x 7.5 x 5.4 mm / 0.3 x 0.3 x 0.21 in
BMR461	4.5.-14	0.6-5	6/12/18	96	LGA (BGA)	12.2×12.2×8 mm / 0.48×0.48×0.31 in
BMR463	4.5.-14	0.6-3	25	97	TH/SMD/SIP	25.65×13.8×8.2 mm / 1.01×0.54×0.32 in
BMR464	4.5.-14	0.6-3.3	50	97	TH/SMD/SIP	30.85×20×8.2 mm / 1.21×0.79×0.32 in
BMR466	4.5.-14	0.6-1.8	60	95	LGA (BGA)	25.1×14.1×7 mm / 0.99×0.56×0.28 in
BMR4696001	7.5-14	0.6-5.5 (dual)	2x25	94	BGA	50.8×19.05×10 mm / 2×0.75×0.39 in
BMR4690000	7.5-14	0.6-5.5 (dual)	2x40	93	SMD	25.4×12.7×11.6 mm / 1×0.5×0.46 in
BMR4742002/001	6-15	0.6-3.3	80	95	SIP	33 x 8.6 x 19 mm / 1.3 x 0.34 x 0.75 in
BMR4732x01/001	6-15	0.6-5	40	95.1	SIP	26.3 x 8.8 x 15.6 mm / 1.04 x 0.35 x 0.61 in
BMR4731001/001	6-15	0.6-5	40	95.6	SMD	19×13×7.5 mm / 0.75×0.51×0.3 in

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