

Flex Power Modules

DC/DC Converters for Data
Center Applications

2024

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Power Modules

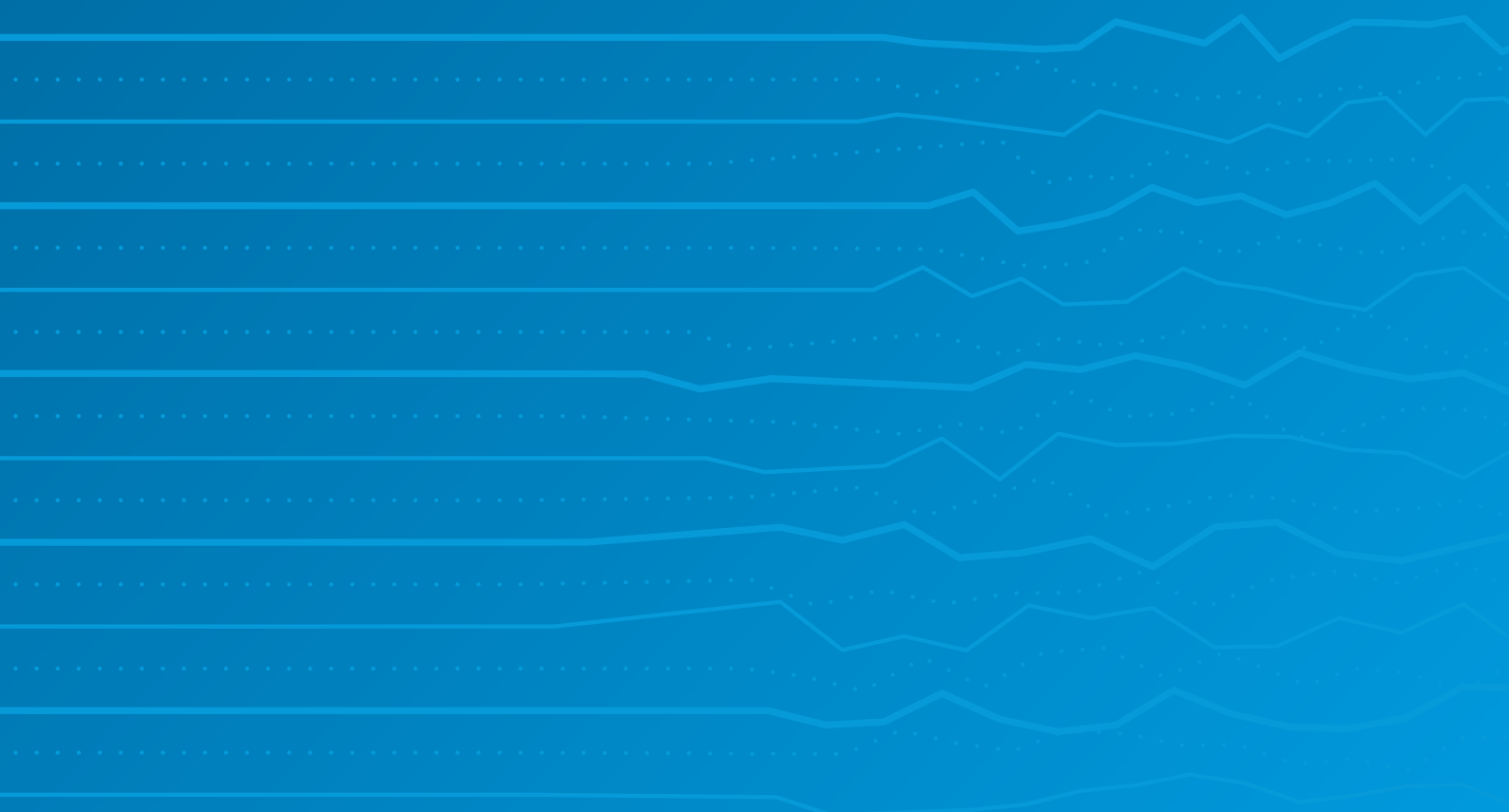


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Powering your innovation



About Flex Power Modules

Flex Power Modules designs and manufactures scalable DC/DC converter solutions primarily for the Datacenter, Teelcom, Industrial & Transportation markets.

Offering a wide range of both isolated and non-isolated solutions, we are world leaders in digitally enabled DC-DC converters. In particular, we deliver PMBus compatibility which is supported by our powerful free software design tool – [Flex Power Designer](#).

Datacom applications

We have a comprehensive product portfolio of power solutions for data centers – which typically run on a narrow 40-60V supply voltage. This is different from telecom which requires a wider 36-72V input voltage range.

In the datacom market, we offer solutions for cloud, storage, hyperscale computing, AI and network security applications. We innovate in this market with the use of LLC and SCC topologies and leading-edge components to deliver extremely high levels of power densities. We also apply Vertical Power Delivery (VPD) designs to enable direct underside connections to the power pins of associated processors and ASICs

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

Digital DC/DC Converters

We have an outstanding track record in digital power, and the products presented below represent the very latest generation of products. They achieve exceptionally high efficiency levels as well as offering superior thermal behavior.

Thermal power and peak power

We distinguish between thermal design power and peak power. Thermal design power (TDP) is the continuous output power, which does not exceed the maximum reference temperature. Whereas peak power is an even higher power which is time limited typically less than 1 second. Over a 10-second interval the average powerloss shall not exceed the TDP level powerloss.

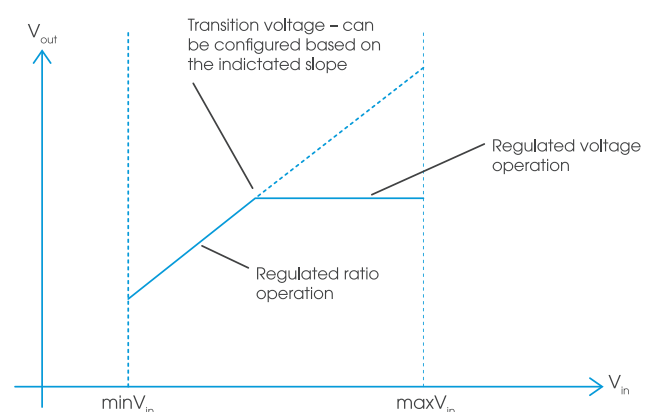
Hybrid Regulated Ratio IBCs

Many of our products mentioned in this category have the capability of Hybrid Regulated Ratio (HRR) performance.

HRR is a concept that adds the benefit of regulation to fixed ratio DC/DC conversion. Traditional fixed ratio conversion operates at a fixed duty cycle which can lead to power train optimization for efficiency and filtering. Using a fixed duty cycle leads to an output to input voltage relationship that is a fixed scalar, typically a divide by an integer value such as divide by 4 or divide by 5.

Adding ratio regulation to the fixed ratio conversion can be accomplished by making the duty cycle a control element. A relatively small range is required to allow operation that controls the duty cycle to maintain a regulated ratio. Now, the benefits of regulation can be accrued where the ratio can be maintained as the load varies from no load to full load and much improved transient response can be achieved.

Further advantage can be gained by introducing the ability to transition from regulating the ratio to regulating a constant output voltage, this is called hybrid regulated ratio (HRR). Combining the regulation schemes with the flexibility to choose the transition voltage provides improved efficiency and filtering performance and reduces the variation of the output voltage over the input voltage range.



BMR313

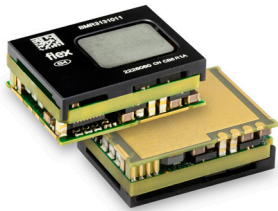
Ultra-small Intermediate Bus Converter (1000W / 3000W_{pk})

Main features

- Compact non-isolated fixed ratio DC/DC converter
- Unregulated 4:1 fixed ratio converter
- Peak power capabilities of up to 3000W
- High density IBC up to 15,528W/in³ (942W/cm³)
- Digital PMBus interface
- LGA industry standard footprint and pinout
- Optimized thermal design for cold wall mounting
- High efficiency > 97.3% at 54V

BMR313 Dimensions

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



BMR313

PRODUCT NO.	V _{OUT} RANGE (V)	V _{IN} (V)	P _{OUT} (W)	P _{OUT_PEAK} (W)	η (%)
BMR3131011/001	9.5-15	38-60	1000	3000	97.3

BMR314

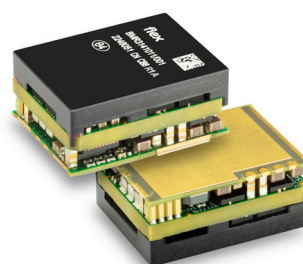
Ultra-small Intermediate Bus Converter (800W / 1500W_{pk})

Main features

- Same footprint as BMR313
- Unregulated 4:1 fixed ratio converter
- Peak power capabilities of up to 1500W
- Non-isolated, digital
- High efficiency - 97.4% at half load
- Digital interface compatible with PMBus

Dimensions

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



BMR314

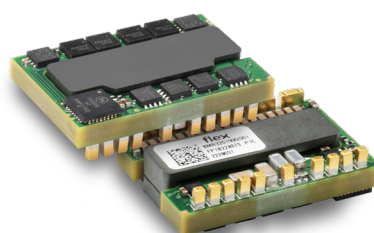
PRODUCT NO.	V _{IN} (V)	V _{OUT} (V)	P _{OUT} (W)	P _{OUT PEAK} (W)	η (%)
BMR3141011/001	38-60	9.5-15	800	1500	97.4

BMR320/BMR322

Digital IBC converter with a fixed ratio 8:1 (900W_{pk})

Main features

- New technology intended for AI applications: Low Voltage Bus
- Unregulated 8:1 fixed ratio converter
- BMR320 output power 60A / 400W at 54V_{in}
- BMR322 comes with peak power capabilities up to 900W
- Non-isolated
- High efficiency up to 97.7% at half load
- Digital interface compatible with PMBus
- BMR320 is parallelable up to 3 units
- BMR322 is parallelable up to 4 units
- Excellent price/performance ratio
- Small form factor 4.86 sq cm (0.75 sq in)



BMR320

Dimensions

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

PRODUCT NO.	V _{OUT} RANGE (V)	V _{IN} (V)	P _{OUT} (W)	P _{OUT PEAK} (W)	η (%)
BMR3201000/001	5-7.5	40-60	400		97.7
BMR3201001/002	5-7.5	40-60	400	740	97.6
BMR3221000/001	5-7.5	40-60	500	900	97.6

BMR321

Digital IBC converter with a fixed ratio 8:1 (750W / 1500W_{pk})

Main features

- New technology intended for AI applications: Low Voltage Bus
- Unregulated 8:1 fixed ratio converter
- Non-isolated, digital
- High efficiency with more than 98%
- Digital interface compatible with PMBus
- Parallelable up to 3 units
- 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



BMR321

PRODUCT NO.	V _{IN} (V)	V _{OUT} (V)	P _{OUT} (W)	P _{OUT PEAK} (W)	η (%)
BMR321 1000/001	40-60	5-7.5	750	1500	98.05

BMR350

Digital quarter brick DC/DC converter (up to 1300W / 1700W_{pk})

Main features

- High-power DC/DC converter with an efficiency of 98%
- Fully regulated output
- Digital interface and compatible with DOSA 7-pin standard
- Event data recorder
- Parallelable / Active Current Share up to 3 units

Dimensions

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



BMR350

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

* Active current share **Droop load share

BMR351

Digital quarter brick DC/DC converter (up to 1600W / 2320W_{pk})

Main features

- Peak power capabilities to 2320W for < 1 sec
- Non-isolated DC/DC
- Fully regulated output of 12V
- Event data recorder
- Paralleling with Droop Load Sharing (DLS)
- 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 0.5 in



BMR351

PRODUCT NO.	V _{OUT} (V)	V _{IN} (V)	I _{OUT} (A)	P _{OUT} (W)	P _{OUT_PEAK} (W)	η (%)
BMR3512202/002	12.2	40-60	136	1600	2320	97.8

BMR492

Digital eighth brick DC/ DC converter (up to 800W / 1100W_{pk})

Main features

- Efficiency up to 97.3%
- HRR (hybrid regulated ratio) available for selected models
- Digital interface in 7 pin DOSA standard
- Through hole mount package
- Pre-bias start up
- 1500V isolation
- MTBF up to 6.6 Mhrs

Dimensions

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



BMR492

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

BMR491

Digital quarter brick DC/DC converter (up to 1540W / 2450W_{pk})

Main features

- High efficiency up to 98%
- Hybrid regulated ratio (HRR)
- Peak power capabilities: <1 sec up to 2450W
- Fixed regulated 12V output voltage
- Excellent thermal behavior
- Digital interface available in 4 and 7 pin DOSA standard
- Some variants are available with heatsink
- 1500V isolation
- MTBF up to 7.7 Mhrs

Dimensions

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



BMR491 with heatsink



BMR491

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

* Active current share **Droop load share

BMR510

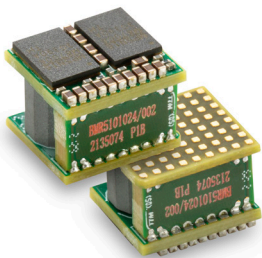
Digital 2-phase module (up to 80A / 140A_{pk})

Main features BMR510

- Wide input range of 4.5 – 15V
- 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
- Halogen-free
- AI design compatible due to high power and tight board space requirements

BMR510 Dimensions

10 x 9 x 7.6 mm / 0.406 x 0.362 x 0.29 in



BMR510

PRODUCT NO.	V _{OUT} (V)	V _{IN} (V)	I _{OUT} (A)	I _{OUT_PEAK} (A)	η (%)
BMR510x034/002	0.5-1.3	4.5-15	80 (TDC)*	140 total peak	92

* Thermal design current

BMR511

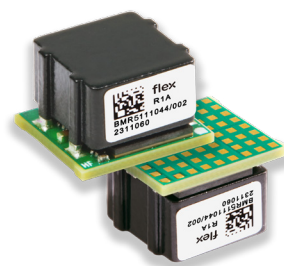
Digital, 2-phase module (up to 80A / 140A_{pk})

Main features

- Fixed output ratio 4:1
- Optimized for bottom side cooling with the inductor on top of the module
- Total peak output current up to 140A
- Non-isolated DC/DC
- Digital interface
- Halogen-free
- LGA and solde bump mount available
- Controller externally located

Dimensions

10 x 9 x 8 mm / 0.39 x 0.35 x 0.31 in



BMR511

PRODUCT NO.	V _{OUT} (V)	V _{IN} (V)	I _{OUT} (A)	I _{OUT_PEAK} (A)	η (%)
BMR5110044/002	0.5-1.8	5-15	80 (TDC)	140 total peak	94.5

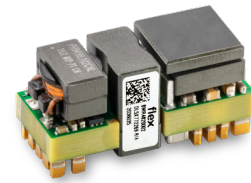
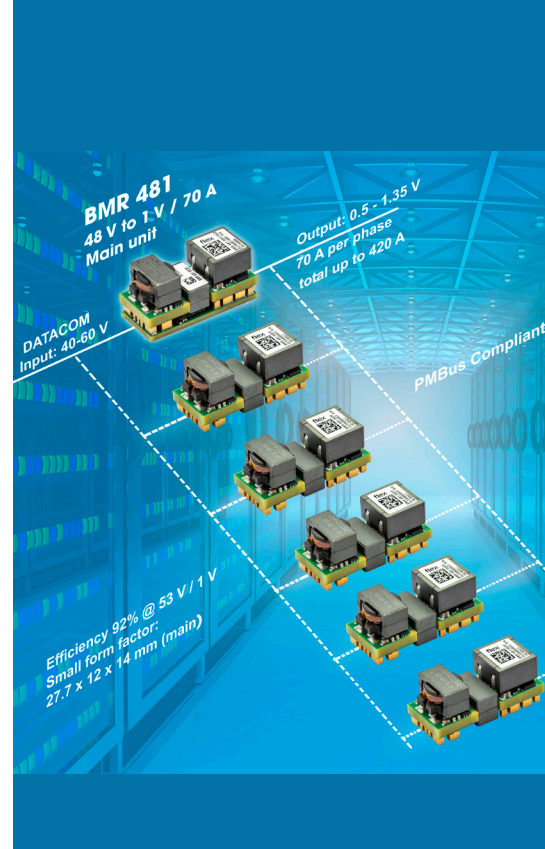
48V to Load Direct Conversion (110A)

BMR482

Our direct conversion products convert 48V directly to silicon core voltages as low as 0.5V_{DC}, thereby optimizing system level efficiencies and board space. The complete power system includes 1 main unit and up to 5 satellites.

Main features

- 2-3% higher efficiency over dual stage conversion from 48V to 12V to 1V
- Reduction in board space due to the elimination of IBC and several power components
- Scalability through paralleling up to 6 modules delivering up to 600A+
- Supported by Flex Power Designer Tool
- Power Stamp Alliance compatible



BMR482/Satellite

BMR482 Dimensions

Main: 30 x 12.7 x 16.8 mm / 1.18 x 0.5 x 0.66 in

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

PRODUCT NO.	V _{OUT} (V)	V _{OUT} RANGE (V)	V _{IN} (V)	I _{OUT} (A)	P _{OUT} (W)	η (%)
BMR4820001/003 (main unit)	0.8	0.5-1.35	40-60	110	—	91.3
BMR4820002 (satellite unit)	0.8	0.5-1.35	40-60	110	—	91.3

Vertical Power Delivery

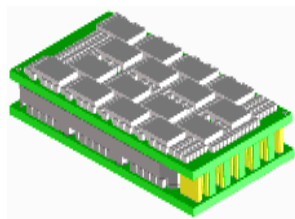
Increasing demands for ever higher current delivery driven by power hungry applications such as AI/Machine Learning require new approaches to the IC power distribution networks.

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.

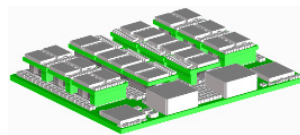
Complex custom VPD modules have been developed to feed various types of CPUs, GPUs, FPGAs, ASICs etc. Our VPDs offer solutions from 1-7 rails across 8-32 phases, and can include up to 2400 solder ball connections.

Some examples:



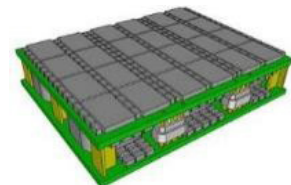
VPD

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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Flex (Reg. No. 199002645H) is the manufacturing partner of choice that helps a diverse customer base design and build products that improve the world. Through the collective strength of a global workforce across 30 countries and responsible, sustainable operations, Flex delivers technology innovation, supply chain, and manufacturing solutions to various industries and end markets.

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<u>BMR350 2101/801</u>	<u>BMR3131011/001</u>	<u>BMR350 2050/531</u>	<u>BMR3512202/002</u>	<u>BMR350 2102/002</u>	<u>BMR350 2253/803</u>
<u>BMR350 2320/802</u>	<u>BMR350 2100/031</u>	<u>BMR3201000/001</u>	<u>BMR350 4250/531</u>		