Flex Power Modules
DC/DC Converters for Data Center Applications
2020
Introduction

Flex Power Modules, formerly Ericsson Power Modules, has a long, successful track record in DC/DC power solutions with more than 30 years in this business area.

In the field of digital power, we are one of the leading players driven by innovations, technical know-how and open standard software.

One of our main business areas is data center applications, which typically runs on a 40V-60V supply voltage compared to Telecom which uses a 48V supply voltage that typically requires a 36V-72V input voltage range. We have developed a comprehensive product portfolio of power solutions for this market segment.

In this brochure we provide an overview of our latest power solutions for data center applications, including:

- Digital DC/DC converters
- Direct Conversion
  - 48V to core voltage (< 1.0V) in a single conversion stage
- Switched capacitor intermediate bus converter
- Multi-phase VR Modules - High Density 8-phase for High Current Loads

You can find more technical and other information on our webpage: www.flexpowermodules.com
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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.

**HYBRID REGULATED RATIO IBCs = Higher Power Density**

Many of our products mentioned in this category have the capability of Hybrid Regulated Ratio (HRR), which we would like to explain in some more detail.

Hybrid Regulated Ratio 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 then 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 the HYBRID REGULATED RATIO (HRR). Combining the regulation schemes with the flexibility to choose the transition voltage provides the improved efficiency and filtering performance and reduces the variation of the output voltage over the input voltage range.

![Diagram showing transition voltage and regulation operation](diagram.png)
BMR480 – Digital quarter-brick DC/DC (900-1300W)

Main features

- Efficiency 97% at 53 V_in and half load
- Hybrid Regulated Ratio (HRR) technology
- Paralleling with two or more BMR480 modules via Droop Load Sharing (DLS) or Active Current Sharing (ACS)
- Digital interface and PMBus compliant
- Isolation 1500 V
- MTBF up to 6.2 Mhrs

Dimensions

58.4 x 36.8 x 14.5 mm; 2.3 x 1.45 x 0.57 in.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>V_out (V)</th>
<th>V_in (V)</th>
<th>I_out (A)</th>
<th>P_out (W)</th>
<th>η (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR4800114/003</td>
<td>10.4</td>
<td>40-60</td>
<td>96.2</td>
<td>1000</td>
<td>97.3</td>
</tr>
<tr>
<td>BMR4800100/001</td>
<td>10.4</td>
<td>45-56</td>
<td>96.2</td>
<td>1000</td>
<td>97.3</td>
</tr>
<tr>
<td>BMR4801102/xxx</td>
<td>12</td>
<td>40-60</td>
<td>75</td>
<td>900</td>
<td>96.7</td>
</tr>
<tr>
<td>BMR4800106/xxx</td>
<td>12</td>
<td>45-60</td>
<td>108.3</td>
<td>1300</td>
<td>97.3</td>
</tr>
</tbody>
</table>
BMR490 – Digital quarter-brick DC/DC (1300W)

Main features
• DC/DC converter with high power and high efficiency up to 97.7%
• Excellent thermal behavior
• Paralleling: two or more BMR490 modules can be connected in parallel either via Droop Load Sharing (DLS) or Active Current Sharing (ACS)
• Currently available as non-isolated version
• MTBF up to 6 Mhrs

Dimensions
58.4 x 36.8 x 14.5 mm; 2.3 x 1.45 x 0.57 in.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>( V_{\text{OUT}} ) (V)</th>
<th>( V_{\text{IN}} ) (V)</th>
<th>( I_{\text{OUT}} ) (A)</th>
<th>( P_{\text{OUT}} ) (W)</th>
<th>( \eta ) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR4903317/820</td>
<td>12</td>
<td>40-60</td>
<td>139</td>
<td>1300</td>
<td>97.7</td>
</tr>
<tr>
<td>BMR4904318/033*</td>
<td>12</td>
<td>40-60</td>
<td>139</td>
<td>1300</td>
<td>97.7</td>
</tr>
</tbody>
</table>

*Active Current Sharing
BMR491 – Digital quarter-brick DC/DC (1500W)

BMR491 is the latest generation of high-power digital DC/DC with continuous power up to 1500W and a peak capability up to 2200W.

**Main features**
- BMR491 HRR
  - Peak power < 1 sec up to 2200 W
- 1500V isolation
- BMR491 fixed regulated 12V output voltage
- Digital interface available in 7 pin DOSA standard

**Dimensions**
58.4 x 36.8 x 14.5 mm; 2.3 x 1.45 x 0.57 in.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>V_{OUT} (V)</th>
<th>V_{OUT} range (V)</th>
<th>V_{IN} (V)</th>
<th>I_{OUT} (A)</th>
<th>P_{OUT} (W)</th>
<th>η (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR491 (HRR)</td>
<td>12</td>
<td>9.2-12.3</td>
<td>40-60</td>
<td>200</td>
<td>1500</td>
<td>TBD</td>
</tr>
<tr>
<td>BMR491 (Fixed 12V)</td>
<td>12</td>
<td>11.7-12.3</td>
<td>40-60</td>
<td>—</td>
<td>1300</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Graphs refer to BMR491 (HRR)
BMR492 – Digital eighth-brick DC/DC (700W)

Main features
• High power module with peak power up to 950W < 1 sec
• Employs HRR
• Digital interface in 7 pin DOSA standard
• Surface-mount package
• 700V isolation

Dimensions
58.4 x 22.7 x 14.5 mm; 2.3 x 0.9 x 0.57 in.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>V\textsubscript{OUT} (V)</th>
<th>V\textsubscript{OUT} range (V)</th>
<th>V\textsubscript{IN} (V)</th>
<th>I\textsubscript{OUT} (A)</th>
<th>P\textsubscript{OUT} (W)</th>
<th>η (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR4921000/860</td>
<td>10.4</td>
<td>9.2-10.6</td>
<td>40-60</td>
<td>67</td>
<td>700</td>
<td>96.5</td>
</tr>
</tbody>
</table>

Photo: BMR 492
48V to Load Direct Conversion

High Performance Computing cloud applications, such as big data analytics, autonomous vehicles, AI and deep learning will demand an exponential increase in data center performance and on-board power requirements. Our direct conversion products convert 48V directly to silicon core voltages as low as 0.5 Vdc, thereby optimizing system level efficiencies and board space.

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

• BMR482 is Power Stamp Alliance compatible

Dimensions BMR481

Main: 27.7 x 12.0 x 14.0 mm; 1.07 x 0.47 x 0.55 in.
Satellite: 27.7 x 12.0 x 12.6 mm; 1.1 x 0.47 x 0.49 in.

Dimensions BMR482

Main: 30 x 12.7 x 16.8 mm; 1.18 x 0.5 x 0.66 in.
Satellite: 30 x 0.5 x 0.61 mm; 1.18 x 0.5 x 0.61 in.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>$V_{\text{out}}$ (V)</th>
<th>$V_{\text{out}}$ range (V)</th>
<th>$V_{\text{in}}$ (V)</th>
<th>$I_{\text{out}}$ (A)</th>
<th>$P_{\text{out}}$ (W)</th>
<th>$\eta$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR4810021/002 (main unit)</td>
<td>1.0</td>
<td>0.5-1.35</td>
<td>40-60</td>
<td>70A</td>
<td>70</td>
<td>91.6</td>
</tr>
<tr>
<td>BMR4810022 (satellite unit)</td>
<td>1.0</td>
<td>0.5-1.35</td>
<td>40-60</td>
<td>70A</td>
<td>70</td>
<td>91.6</td>
</tr>
<tr>
<td>BMR482 0001/003 (main unit)</td>
<td>0.75</td>
<td>0.5-1.35</td>
<td>40-60</td>
<td>100A</td>
<td>75</td>
<td>92.0</td>
</tr>
<tr>
<td>BMR482 0002 (satellite unit)</td>
<td>0.75</td>
<td>0.5-1.35</td>
<td>40-60</td>
<td>100A</td>
<td>75</td>
<td>92.0</td>
</tr>
</tbody>
</table>
Power Surface Multiplier Package (PSMP)/ Vertical Blade IBC 300W

Main features

- BMR520 combines 1 Controller Assembly (CA) unit with 1, 2, or 3 Blades for 300W, 600W, or 900W operation
- 3 PSMP Blades mounted in parallel equals footprint of 1 quarter-brick
- Integrated heatsinks on both sides for self-contained thermal management
- Phase shifted full bridge technology

Dimensions

Blade: 40 x 17 x 20 mm; 1.57 x 0.67 x 0.8 in.
CA: 17 x 17 x 11.6 mm; 0.67 x 0.67 x 0.47 in.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>V_OUT (V)</th>
<th>V_IN (V)</th>
<th>I_OUT (A)</th>
<th>P_OUT (W)</th>
<th>η (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR520 2010 001 (blade unit)</td>
<td>12</td>
<td>36-75</td>
<td>25</td>
<td>300</td>
<td>95</td>
</tr>
<tr>
<td>BMR4810022 (controller assembly unit)</td>
<td>-</td>
<td>36-75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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Introducing the BMR310, an Intermediate Bus Converter based on switched capacitor technology providing >98% efficiency and power levels up to 900W continuous in compact laydown and vertical mount package.

**Main features**
- 6.5 mm height is ideal for low-profile systems with large heatsinks / cold plates
- Maximum power density improves board space utilization
- Vertical and horizontal mounting options
- Open-frame, base-plated, or integrated heatsink options
- Parallel design via passive **Droop Load Sharing**
- Digital communication and control with PMBus
- Non-isolated

**Dimensions**

**Laydown:** 58.0 x 25 x 6 mm; 2.28 x 0.98 x 0.23 in.
**Vertical:** 58.0 x 6 x 25 mm; 2.28 x 0.23 x 0.98 in.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>$V_{out \text{ range}}$ (V)</th>
<th>$V_{in}$ (V)</th>
<th>$I_{out}$ (A)</th>
<th>$P_{out}$ (W)</th>
<th>$\eta$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR310 0100/001 (SIP)</td>
<td>10-15*</td>
<td>40-60</td>
<td>45A</td>
<td>600W</td>
<td>&gt;98</td>
</tr>
<tr>
<td>BMR310 0000/001 (laydown)</td>
<td>10-15*</td>
<td>40-60</td>
<td>70A</td>
<td>900W</td>
<td>&gt;98</td>
</tr>
</tbody>
</table>

*Divide by 4
Multi-phase Power Module
320A VR Solution

The BMR510 is a multi-phase power module for VR applications. The power module includes 8 buck power stages with built-in drivers, MOSFETs, inductors and capacitors.

Main features
- Multi-phase buck power stages with 8 phases delivering 480A peak current
- Current and temperature sense
- Current limit and over temperature protection
- Accepts tri-state PWM signals
- Halogen-free

Dimensions
10.35 x 37.5 x 10.9 mm; 0.4 x 1.48 x 0.29 in.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>V_{\text{OUT}} \text{ range} (V)</th>
<th>V_{\text{IN}} (V)</th>
<th>I_{\text{OUT}} (A)</th>
<th>P_{\text{OUT}} (W)</th>
<th>\eta (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR5100001/008</td>
<td>0.5-1.5</td>
<td>4.5-16</td>
<td>480 peak</td>
<td>&gt;300</td>
<td>&gt;88*</td>
</tr>
</tbody>
</table>

* Vin=10.4V, Vout=1.0V, Iout=300A

* Photo: BMR 510

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Other High Performance DC/DC Converters

We also have a wide range of standard DC/DC converters with an input voltage range of 40V-60V offering different form factors and power levels.

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>V_{in} (V)</th>
<th>V_{out} (V)</th>
<th>P_{out} (W)</th>
<th>I_{out} (A)</th>
<th>Eff (%)</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>PKU4217D</td>
<td>36-60</td>
<td>10.4</td>
<td>260</td>
<td>62</td>
<td>94.4</td>
<td>Sixteenth brick</td>
</tr>
<tr>
<td>PKB 4413DPIHS</td>
<td>36-60</td>
<td>12</td>
<td>450</td>
<td>37.5</td>
<td>96</td>
<td>Eighth brick</td>
</tr>
<tr>
<td>BMR 458</td>
<td>40-60</td>
<td>12.2</td>
<td>650</td>
<td>54.2</td>
<td>96.6</td>
<td>Quarter brick</td>
</tr>
<tr>
<td>PKM4817NH</td>
<td>40-60</td>
<td>10.8</td>
<td>756</td>
<td>70</td>
<td>97</td>
<td>Quarter brick</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>PRODUCT NO.</th>
<th>V_in (V)</th>
<th>V_out (V)</th>
<th>I_out (A)</th>
<th>η (%)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMU8218</td>
<td>4.5-17</td>
<td>0.6-5</td>
<td>4</td>
<td>95.3</td>
<td>LGA</td>
</tr>
<tr>
<td>PMU8318</td>
<td>4.5-17</td>
<td>0.6-5</td>
<td>6</td>
<td></td>
<td>LGA</td>
</tr>
<tr>
<td>PMU8418</td>
<td>4.5-17</td>
<td>0.6-5</td>
<td>8</td>
<td></td>
<td>LGA</td>
</tr>
<tr>
<td>BMR461</td>
<td>4.5-14</td>
<td>0.6-5</td>
<td>6/12/18</td>
<td></td>
<td>LGA (BGA)</td>
</tr>
<tr>
<td>BMR462</td>
<td>4.5-14</td>
<td>0.6-5</td>
<td>12</td>
<td></td>
<td>TH/SMD/SIP</td>
</tr>
<tr>
<td>BMR463</td>
<td>4.5-14</td>
<td>0.6-3</td>
<td>20/25</td>
<td></td>
<td>TH/SMD/SIP</td>
</tr>
<tr>
<td>BMR464</td>
<td>4.5-14</td>
<td>0.6-3.3</td>
<td>40/50</td>
<td></td>
<td>TH/SMD/SIP</td>
</tr>
<tr>
<td>BMR466</td>
<td>4.5-14</td>
<td>0.6-1.8</td>
<td>60</td>
<td></td>
<td>LGA (BGA)</td>
</tr>
<tr>
<td>BMR465</td>
<td>7.5-14</td>
<td>0.6-1.8</td>
<td>90</td>
<td></td>
<td>TH/SMD/SIP</td>
</tr>
<tr>
<td>BMR467</td>
<td>7.5-14</td>
<td>0.6-1.8</td>
<td>120</td>
<td></td>
<td>TH/SMD/SIP</td>
</tr>
<tr>
<td>BMR469</td>
<td>7.5-14</td>
<td>0.6-5</td>
<td>2x40A/2x25A</td>
<td></td>
<td>SMD</td>
</tr>
</tbody>
</table>

**PMU8318**

*Analog Point of Load*

- Ultra small form factor: 7.5 x 7.5 x 5.4 mm
- Low weight: 0.92 g
- Available as 4A / 6A / 8A and 22W / 33W / 44W
- Loop optimization
- Soft start & tracking/sequencing features
- Applicable for all markets: Telecom, Datacom, Industrial & Transportation

Bottom side mounting compatibility

V_in: 4.5-17 V

V_out: 0.6-5 V
Flex Power Modules, a division of Flex (NASDAQ: FLEX), designs and manufactures scalable power supply solutions that improve the operational efficiencies of advanced data center, IT information and communication networks. Flex Power Modules’ products provide a complete on-board system solution for cloud, storage and server applications and address customer challenges while delivering superior quality, cost and performance scale. Learn more at flex.com. Twitter: @Flexintl. Live Smarter™

For more information, please visit www.flexpowermodules.com or mail us to pm.info@flex.com.