BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

Key Features
- Industry standard low profile Quarter-brick
  58.4 x 36.8 x 12.19 mm (2.30 x 1.45 x 0.48 in)
- High efficiency, typ. 97 % at 53 Vout, half load
- 1500 Vdc input to output isolation
- Baseplate to enhance thermal performance
- Droop load sharing capability
- MTBF over 6 million hours

General Characteristics
- Input voltage range: 45-56 V
- Output voltage: 10.4 V
- Max output current: 96.2 A
- Max output power: 1000 W
- Monotonic start-up
- Output over voltage protection
- Over temperature protection
- Output short-circuit protection
- Remote control
- Highly automated manufacturing ensures quality
- ISO 9001/14001 certified supplier

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BMR480 series DC-DC Converters
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Ordering Information

<table>
<thead>
<tr>
<th>Product program</th>
<th>Vin</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR480 0100 / 001</td>
<td>45 - 56</td>
<td>10.4 V / 96.2 A, 1000 W, baseplate</td>
</tr>
<tr>
<td>BMR480 0100 / 017</td>
<td>45 - 56</td>
<td>10.4 V / 96.2 A, 960 W, baseplate, DLS</td>
</tr>
</tbody>
</table>

Product number and Packaging

<table>
<thead>
<tr>
<th>BMR480</th>
<th>n₁</th>
<th>n₂</th>
<th>n₃</th>
<th>n₄</th>
<th>n₅</th>
<th>n₆</th>
<th>n₇</th>
<th>n₈</th>
<th>n₉</th>
<th>n₁₀</th>
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<tr>
<td>Mechanical option</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Baseplate</td>
<td>x</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Hardware option</td>
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<td>x</td>
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<td>Configuration file</td>
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<td>x</td>
<td>x</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>/</td>
</tr>
</tbody>
</table>

Options

- n₁: 0 = Standard pin length 5.33 mm (0.210 in.) 2 = Lead length 3.69 mm (0.145 in.) (cut) 3 = Lead length 4.57 mm (0.180 in.) (cut)
- n₂: 1 = Baseplate
- n₃, n₄: 00 = 45-56 Vin, 10.4 Vout, with power good pin
- n₅, n₆, n₇: 001 = 10.4 V Standard configuration for 45-56 Vin, n₅n₆ = 00
- 017 = 10.4 V with droop load sharing function configuration for 45-56 Vin, n₅n₆ = 00
- xxx = Application Specific Configuration

Compatibility with RoHS requirements

The products are compatible with the relevant clauses and requirements of the RoHS directive 2011/65/EU and have a maximum concentration value of 0.1% by weight in homogeneous materials for lead, mercury, hexavalent chromium, PBB and PBDE and of 0.01% by weight in homogeneous materials for cadmium.

Exemptions in the RoHS directive utilized in Flex Power Modules products are found in the Statement of Compliance document.

Flex Power Modules fulfills and will continuously fulfill all its obligations under regulation (EC) No 1907/2006 concerning the registration, evaluation, authorization and restriction of chemicals (REACH) as they enter into force and is through product materials declarations preparing for the obligations to communicate information on substances in the products.

Quality Statement

The products are designed and manufactured in an industrial environment where quality systems and methods like ISO 9000, Six Sigma, and SPC are intensively in use to boost the continuous improvements strategy. Infant mortality or early failures in the products are screened out and they are subjected to an ATE-based final test. Conservative design rules, design reviews and product qualifications, plus the high competence of an engaged work force, contribute to the high quality of the products.

Warranty

Warranty period and conditions are defined in Flex Power Modules General Terms and Conditions of Sale.

Limitation of Liability

Flex Power Modules does not make any other warranties, expressed or implied including any warranty of merchantability or fitness for a particular purpose (including, but not limited to, use in life support applications, where malfunctions of product can cause injury to a person’s health or life).

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General Information

Reliability

The failure rate (λ) and mean time between failures (MTBF = 1/λ) is calculated at max output power and an operating ambient temperature (Tₐ) of +40°C. Flex Power Modules uses Telcordia SR-332 Issue 3 Method 1 to calculate the mean steady-state failure rate and standard deviation (σ).

Telcordia SR-332 Issue 3 also provides techniques to estimate the upper confidence levels of failure rates based on the mean and standard deviation.

<table>
<thead>
<tr>
<th>Mean steady-state failure rate, λ</th>
<th>Std. deviation, σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 nFailures/h</td>
<td>8.4 nFailures/h</td>
</tr>
</tbody>
</table>

MTBF (mean value) for the BMR480 series = 6.65 Mh.
MTBF at 90% confidence level = 6.20 Mh
BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

Safety Specification

General information

Flex Power Modules DC/DC converters and DC/DC regulators are designed in accordance with the safety standards IEC 60950-1, EN 60950-1 and UL 60950-1 Safety of Information Technology Equipment.

IEC/EN/UL 60950-1 contains requirements to prevent injury or damage due to the following hazards:

- Electrical shock
- Energy hazards
- Fire
- Mechanical and heat hazards
- Radiation hazards
- Chemical hazards

On-board DC/DC converters and DC/DC regulators are defined as component power supplies. As components they cannot fully comply with the provisions of any safety requirements without “conditions of acceptability”. Clearance between conductors and between conductive parts of the component power supply and conductors on the board in the final product must meet the applicable safety requirements. Certain conditions of acceptability apply for component power supplies with limited stand-off (see Mechanical Information and Safety Certificate for further information). It is the responsibility of the installer to ensure that the final product housing these components complies with the requirements of all applicable safety standards and regulations for the final product.

Component power supplies for general use should comply with the requirements in IEC/EN/UL 60950-1 Safety of Information Technology Equipment. Product related standards, e.g. IEEE 802.3af Power over Ethernet, and ETS-300132-2 Power interface at the input to telecom equipment, operated by direct current (dc) are based on IEC/EN/UL 60950-1 with regards to safety.

Flex Power Modules DC/DC converters, Power interface modules and DC/DC regulators are UL 60950-1 recognized and certified in accordance with EN 60950-1. The flammability rating for all construction parts of the products meet requirements for V-0 class material according to IEC 60695-11-10, Fire hazard testing, test flames – 50 W horizontal and vertical flame test methods.

Isolated DC/DC converters

The product may provide basic or functional insulation between input and output according to IEC/EN/UL 60950-1 (see Safety Certificate), different conditions shall be met if the output of a basic or a functional insulated product shall be considered as safety extra low voltage (SELV).

For basic insulated products (see Safety Certificate) the output is considered as safety extra low voltage (SELV) if one of the following conditions is met:

- The input source provides supplementary or double or reinforced insulation from the AC mains according to IEC/EN/UL 60950-1.
- The input source provides functional or basic insulation from the AC mains and the product’s output is reliably connected to protective earth according to IEC/EN/UL 60950-1.

For functional insulated products (see Safety Certificate) the output is considered as safety extra low voltage (SELV) if one of the following conditions is met:

- The input source provides double or reinforced insulation from the AC mains according to IEC/EN/UL 60950-1.
- The input source provides basic or supplementary insulation from the AC mains and the product’s output is reliably connected to protective earth according to IEC/EN/UL 60950-1.
- The input source is reliably connected to protective earth and provides basic or supplementary insulation according to IEC/EN/UL 60950-1 and the maximum input source voltage is 60 Vdc.

Galvanic isolation between input and output is verified in an electric strength test and the isolation voltage (Viso) meets the voltage strength requirement for basic insulation according to IEC/EN/UL 60950-1.

It is recommended to use a slow blow fuse at the input of each DC/DC converter. If an input filter is used in the circuit the fuse should be placed in front of the input filter. In the rare event of a component problem that imposes a short circuit on the input source, this fuse will provide the following functions:

- Isolate the fault from the input power source so as not to affect the operation of other parts of the system
- Protect the distribution wiring from excessive current and power loss thus preventing hazardous overheating
Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_{P1}$ Operating Temperature (see Thermal Consideration section)</td>
<td>-40</td>
<td>+125</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>$T_S$ Storage temperature</td>
<td>-55</td>
<td>+125</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>$V_I$ Input voltage</td>
<td>-0.5</td>
<td>+125</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{iso}$ Isolation voltage (input to output test voltage)</td>
<td>500</td>
<td>1 500</td>
<td>Vdc</td>
<td></td>
</tr>
<tr>
<td>$V_{iso}$/ Isolation voltage (base plate to output test voltage)</td>
<td>500</td>
<td>1 500</td>
<td>Vdc</td>
<td></td>
</tr>
<tr>
<td>$V_{in}$ Input voltage transient ($t_p 100$ ms)</td>
<td>-0.3</td>
<td>+80</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{HC}$ Remote Control pin voltage</td>
<td>5</td>
<td>5</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

Stress in excess of Absolute Maximum Ratings may cause permanent damage. Absolute Maximum Ratings, sometimes referred to as no destruction limits, are normally tested with one parameter at a time exceeding the limits in the Electrical Specification. If exposed to stress above these limits, function and performance may degrade in an unspecified manner.

Fundamental Circuit Diagram
Common Electrical Specification

This section includes parameter specifications common to all product versions within the product series. Typically, these are parameters defined by the digital controller of the products. In the table below PMBus commands for configurable parameters are written in capital letters.

\[ T_{P1} = -30 \text{ to } +95 \, ^\circ\text{C}, \quad V_I = 40 \text{ to } 60 \, \text{V}, \text{ unless otherwise specified under Conditions.} \]

Typical values given at: \( T_{P1} = +25 \, ^\circ\text{C}, \quad V_I = 53 \, \text{V}, \text{ max } I_O, \text{ unless otherwise specified under Conditions:} \]

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f_{SW} = 1/T_{SW} )</td>
<td>Switching Frequency</td>
<td></td>
<td>230</td>
<td></td>
<td>kHz</td>
</tr>
<tr>
<td></td>
<td>Switching Frequency Range, Note 1</td>
<td>PMBus configurable FREQUENCY_SWITCH</td>
<td>150</td>
<td>250</td>
<td>kHz</td>
</tr>
<tr>
<td></td>
<td>Switching Frequency Set-point Accuracy</td>
<td></td>
<td>-2</td>
<td>2</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>External Sync Pulse Width</td>
<td></td>
<td>150</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>Input Clock Frequency Drift Tolerance</td>
<td>External sync</td>
<td>-4</td>
<td>4</td>
<td>%</td>
</tr>
</tbody>
</table>

| \( T_{INIT} \) | Initialization Time | From \( V_I > -27 \, \text{V} \) to ready to be enabled | 30 | | ms |
| \( T_{ONdel_tot} \) | Total On Delay Time | Enable by input voltage | \( T_{INIT} + T_{ONdel} \) | | |
| | | Enable by RC or CTRL pin | \( T_{ONdel} \) | | |
| \( T_{ONdel} \) | Output voltage On Delay Time | PMBus configurable Turn on delay duration | 0 | | ms |
| | | TON_DELAY | 0 | 655 | ms |
| | Accuracy (actual delay vs set value) | | \( \pm 1 \) | | % |
| \( T_{OFFdel} \) | Output voltage Off Delay Time | PMBus configurable Turn off delay duration, Note 2 | 5 | | ms |
| | | TOFF_DELAY | 0 | 655 | ms |
| | Accuracy (actual delay vs set value), Note 3 | | \( \pm 1 \) | | % |
| \( T_{ONrise}/T_{OFFfall} \) | On/Off Ramp Time (0-100%-0 of \( V_O \)) | Turn on ramp duration -Stand alone -DLS | 10 | 200 | ms |
| | | Turn off ramp duration | Disabled in standard configuration. Turn off immediately upon expiration of Turn off delay. | | ms |
| | | Range TON_RISE/TOFF_FALL | 0 | 655 | ms |
| | | Ramp time accuracy for standalone operation (actual ramp time vs set value) | \( \pm 1 \) | | % |
| \( V_{off} \) | Input turn off range | States the level where the output voltage is disabled, PMBus configurable | 30 | 40 | 60 | V |
| \( V_{on} \) | Input turn on range | States the level where the output voltage is enabled, PMBus configurable | 30 | 42 | 60 | V |
## BMR480 series DC-DC Converters
### Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Good, PG</td>
<td>PG threshold</td>
<td>8</td>
<td>V&lt;sub&gt;o&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PMBus configurable Rising</td>
<td>5</td>
<td>V&lt;sub&gt;o&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PG thresholds range</td>
<td>0</td>
<td>100</td>
<td>% V&lt;sub&gt;o&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>From V&lt;sub&gt;o&lt;/sub&gt; reaching target to PG assertion</td>
<td>1</td>
<td></td>
<td>ms</td>
<td></td>
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### Input Under Voltage Protection, IUVP

<table>
<thead>
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<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>IUVP threshold</td>
<td>0</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IUVP threshold range</td>
<td>0-100</td>
<td>%V&lt;sub&gt;in&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IUVP hysteresis</td>
<td>0</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IUVP hysteresis range</td>
<td>0-100</td>
<td>%V&lt;sub&gt;in&lt;/sub&gt;</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Set point accuracy</td>
<td>±1</td>
<td>%</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>IUVP response delay</td>
<td>100</td>
<td>μs</td>
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<tr>
<td></td>
<td>Fault response</td>
<td>Ignore fault</td>
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### Input Over Voltage Protection, IOVP

<table>
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<th>typ</th>
<th>max</th>
<th>Unit</th>
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<td></td>
<td>IOVP threshold</td>
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<td>V</td>
<td></td>
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<tr>
<td></td>
<td>IOVP threshold range</td>
<td>0-100</td>
<td>%V&lt;sub&gt;in&lt;/sub&gt;</td>
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<td>IOVP hysteresis</td>
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<td>IOVP hysteresis range</td>
<td>0-100</td>
<td>%V&lt;sub&gt;in&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Set point accuracy</td>
<td>±1</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IOVP response delay</td>
<td>100</td>
<td>μs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fault response</td>
<td>Ignore fault</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>IOVP response delay</td>
<td>Disable until Fault Cleared</td>
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### Output Voltage Over/Under Voltage Protection, OVP/UVP

<table>
<thead>
<tr>
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<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UVP threshold</td>
<td>0</td>
<td>V&lt;sub&gt;o&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>UVP threshold range</td>
<td>0-100</td>
<td>%V&lt;sub&gt;o&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OVP threshold</td>
<td>15.6</td>
<td>V&lt;sub&gt;o&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OVP threshold range</td>
<td>0-16</td>
<td>V&lt;sub&gt;o&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>UVP/OVP response time</td>
<td>100/50</td>
<td>μs</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Fault response</td>
<td>Ignore fault</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OCP threshold</td>
<td>110</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OCP threshold range</td>
<td>0-256</td>
<td>A</td>
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<tr>
<td></td>
<td>Protection delay</td>
<td>See Note 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fault response</td>
<td>Ignore fault</td>
<td></td>
<td></td>
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</table>

### Over Current Protection, OCP Note 5

<table>
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<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OT threshold</td>
<td>125</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OT threshold range</td>
<td>-50</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OTP hysteresis</td>
<td>35</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fault response</td>
<td>Stand alone: Conditioned constant current, retry start constantly, 80ms delay between retry start. DLS: Constant current with delay 2ms before shutdown and do not retry start.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Over Temperature Protection, OTP, Note 7

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OT threshold</td>
<td>125</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OT threshold range</td>
<td>-50</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OTP hysteresis</td>
<td>35</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fault response</td>
<td>Shutdown, automatic restart when no fault exists, ~90°C @ the temperature sensor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring Accuracy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input voltage READ_VIN</td>
<td></td>
<td>±125</td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage READ_VOUT</td>
<td></td>
<td>±10</td>
<td>mV</td>
<td></td>
<td></td>
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<tr>
<td>Output current READ_IOUT</td>
<td>T_P1 = 25 °C</td>
<td>±0.25</td>
<td>A</td>
<td></td>
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<tr>
<td></td>
<td>T_P1 = -30 - 125 °C</td>
<td>±2.5</td>
<td>A</td>
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<tr>
<td>Duty cycle READ_DUTY_CYCLE</td>
<td>No tolerance, Read value is the actual value</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>applied by PWM controller</td>
<td></td>
<td></td>
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<tr>
<td>Temperature READ_TEMPERATURE_1</td>
<td>Temperature sensor, -30 - 125 °C</td>
<td>±7</td>
<td>°C</td>
<td></td>
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</table>

- **Current difference between products in a current sharing group, Note 8**: Steady state operation
  - Max 2 x READ_IOUT monitoring accuracy

- **Supported number of products in a current sharing group**: 3

<p>| | | | | | |</p>
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<tr>
<td>V_DL</td>
<td>Logic output low signal level</td>
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<td>0.25</td>
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<td>V_SH</td>
<td>Logic output high signal level</td>
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<td></td>
<td>2.7</td>
<td>V</td>
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<tr>
<td>I_SL</td>
<td>Logic output low sink current</td>
<td></td>
<td>4</td>
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<tr>
<td>I_SH</td>
<td>Logic output high source current</td>
<td></td>
<td>4</td>
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<td>V_L</td>
<td>Logic input low threshold</td>
<td></td>
<td>1.1</td>
<td>V</td>
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<td>V_H</td>
<td>Logic input high threshold</td>
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<td>2.1</td>
<td>V</td>
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<td>C_PIN</td>
<td>Logic pin input capacitance</td>
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<td>10</td>
<td>pF</td>
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<tr>
<td>RG_PU</td>
<td>Secondary Remote-Control logic pin internal</td>
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<td></td>
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<td>pF</td>
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<td></td>
<td>pull-up resistance</td>
<td></td>
<td>internal pull-up</td>
<td>CTRL to +3.3V Note 9</td>
<td>47</td>
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<td>f_SMB</td>
<td>Supported SMBus Operating frequency</td>
<td>100</td>
<td>400</td>
<td>kHz</td>
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<td>T_BUF</td>
<td>SMBus Bus free time</td>
<td></td>
<td>1.3</td>
<td>µs</td>
<td></td>
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<tr>
<td>t_SAD</td>
<td>SMBus SDA setup time from SCL</td>
<td>See section SMBus – Timing</td>
<td>100</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t_SDH</td>
<td>SMBus SDA hold time from SCL</td>
<td>See section SMBus – Timing</td>
<td>0</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>T_START/STOP</td>
<td>SMBus START/STOP condition setup/hold time from</td>
<td></td>
<td>600</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCL</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>T_LOW</td>
<td>SCL low period</td>
<td></td>
<td>1.3</td>
<td>µs</td>
<td></td>
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<tr>
<td>T_HIGH</td>
<td>SCL high period</td>
<td></td>
<td>0.6</td>
<td>50</td>
<td>µs</td>
</tr>
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</table>

Note 1. There are configuration changes to consider when changing the switching frequency, see section Switching Frequency.
Note 2. A default value of 0 ms forces the device to Immediate Off behavior with TOFF_FALL ramp-down setting being ignored.
Note 3. The specified accuracy applies for off delay times larger than 4 ms. When setting 0 ms the actual delay will be 0 ms.
Note 4. According to the combination of command MFR_RESPONSE_Unit_CFG and delay time set in IOU_T_OC_FAULT_RESPONSE, see Appendix – PMBus commands.
Note 5. Note that higher OCP threshold than specified may result in damage of the module at OC fault conditions.
Note 6. For current setting see Appendix – PMBus commands
Note 7. See section Over Temperature Protection (OTP).
Note 8. Only valid for Active Current Share (ACS).
Note 9. If configure the CTRL pin with internal Pull-up with command MFR_MULTI_PIN_CONFIG, see Appendix – PMBus commands.
Electrical Specification
10.4 V, 96.2A / 1000 W

Note 1: The maximum output current is limited to 96.2 A

Note 2: Below HRR (Hybrid Regulated Ratio) set point the output voltage will track the input voltage but include a guard band to ensure enough head room to max duty cycle in order to secure full regulation down to VIN_OFF at maximum output current. Resulting Vout can be derived by using the formula: If Vin < VIN, VIN_WARN, Vout = VoutNom – (VIN_WARN – Vin)(VP/VPnom) else Vout = VoutNom. The available output power will decrease when operating in HRR due to output voltage input voltage dependency, see graph Available Power.

Note 3: Cout = 3.5 mF (7x470 µF + 270 µF; 16SPEPC, Panasonic, low ESR, POLYMER cap.

Note 4: Hiccup short circuit protection; RMS output current is the presented.

Note 5: Filter 10 µF tantalum + 0.1 µF ceramic.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
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</thead>
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<tr>
<td>V&lt;sub&gt;t&lt;/sub&gt;</td>
<td>Input voltage range</td>
<td>45</td>
<td>56</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;in&lt;/sub&gt;</td>
<td>Turn-off input voltage</td>
<td>Decreasing input voltage</td>
<td>39</td>
<td>40</td>
<td>41</td>
</tr>
<tr>
<td>V&lt;sub&gt;in&lt;/sub&gt;</td>
<td>Turn-on input voltage</td>
<td>Increasing input voltage</td>
<td>41</td>
<td>42</td>
<td>43</td>
</tr>
<tr>
<td>C&lt;sub&gt;i&lt;/sub&gt;</td>
<td>Internal input capacitance</td>
<td>V&lt;sub&gt;i&lt;/sub&gt; = 53 V</td>
<td>9.5</td>
<td>µF</td>
<td></td>
</tr>
<tr>
<td>P&lt;sub&gt;O&lt;/sub&gt;</td>
<td>Output power</td>
<td>Note 1, 2</td>
<td>0</td>
<td>1000</td>
<td>W</td>
</tr>
<tr>
<td>η</td>
<td>Efficiency</td>
<td>50% of max I&lt;sub&gt;O&lt;/sub&gt;, V&lt;sub&gt;i&lt;/sub&gt; = 50 V</td>
<td>97.3</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max I&lt;sub&gt;O&lt;/sub&gt;, V&lt;sub&gt;i&lt;/sub&gt; = 50 V</td>
<td>96.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% of max I&lt;sub&gt;O&lt;/sub&gt;, V&lt;sub&gt;i&lt;/sub&gt; = 53 V</td>
<td>97.2</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>max I&lt;sub&gt;O&lt;/sub&gt;, V&lt;sub&gt;i&lt;/sub&gt; = 53 V</td>
<td>96.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P&lt;sub&gt;n&lt;/sub&gt;</td>
<td>Power Dissipation</td>
<td>max I&lt;sub&gt;O&lt;/sub&gt;</td>
<td>34</td>
<td>45</td>
<td>W</td>
</tr>
<tr>
<td>P&lt;sub&gt;i&lt;/sub&gt;</td>
<td>Input idling power</td>
<td>I&lt;sub&gt;s&lt;/sub&gt; = 0 A, V&lt;sub&gt;i&lt;/sub&gt; = 53 V</td>
<td>6.6</td>
<td>W</td>
<td></td>
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<tr>
<td>P&lt;sub&gt;nc&lt;/sub&gt;</td>
<td>Input standby power</td>
<td>V&lt;sub&gt;i&lt;/sub&gt; = 53 V (turned off with RC)</td>
<td>1</td>
<td>W</td>
<td></td>
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<tr>
<td>f&lt;sub&gt;s&lt;/sub&gt;</td>
<td>Switching frequency</td>
<td>0-100% of max P&lt;sub&gt;O&lt;/sub&gt;</td>
<td>220</td>
<td>230</td>
<td>234</td>
</tr>
</tbody>
</table>

V<sub>O</sub> | Output voltage initial setting and accuracy | T<sub>Pf</sub> = +25°C, V<sub>i</sub> = 53 V, P<sub>O</sub> = 0 W | 10.38 | 10.4 | 10.42 | V |
| V<sub>o</sub> | Output adjust range | 0-100% of max P<sub>O</sub>, see Note 2 | 8   | 12  |      | V   |
|      | Output voltage tolerance band | 0-100% of max P<sub>O</sub>, see Note 2 | 10.2 | 10.6 |      | V   |
|      | Idling voltage | P<sub>O</sub> = 0 W | 10.3 | 10.5 |      | V   |
|      | Line regulation | V<sub>i</sub> = 45 - 56 V, 100% of max P<sub>O</sub> | 10  |      |      | mV  |
|      | Load regulation | V<sub>i</sub> = 53 V, 0-100% of max P<sub>O</sub> | 25  |      |      | mV  |
| V<sub>o</sub> | Load transient voltage deviation | V<sub>i</sub> = 53 V, Load step 25-75-25% of max I<sub>O</sub>, di/dt = 2 A/µs. | ±330 |      |      | mV  |
| t<sub>r</sub> | Load transient recovery time | See Note 3 | 200 |      |      | µs  |
| t<sub>r</sub> | Ramp-up time (from 0-100% of V<sub>O</sub>) | 0-100% of max P<sub>O</sub> | 10  |      |      | ms  |
| t<sub>s</sub> | Start-up time (from V<sub>i</sub> connection to 100% of V<sub>O</sub>) | max P<sub>O</sub> | 40  |      |      | ms  |
| t<sub>SC</sub> | RC start-up time | max P<sub>O</sub> | 11  |      |      | ms  |
| RC | Sink current | | 0.3 |      | mA   |
|      | Trigger level | RC-voltage | 1.6 |      | V    |
|      | Response time | | 1   |      | ms   |
| I<sub>o</sub> | Output current | V<sub>i</sub> = 45 – 56 V | 0   | 96.2 | A    |
| I<sub>lim</sub> | Current limit threshold | | 100 | 110 | 120  | A    |
| | Short circuit current | T<sub>Pf</sub> = 25°C, Irms, see Note 4 | 14  |      |      | A    |
| C<sub>out</sub> | Recommended Capacitive Load | T<sub>Pf</sub> = 25°C | 470 | 3500 | 15000 | µF |
| V<sub> EMC</sub> | Output ripple & noise | See ripple & noise section, max P<sub>O</sub>, see Note 5 | 50  |      |      | mVp-p |
| OVP | Output over voltage protection | | 15.6 |      | V    |
Typical Characteristics
10.4 V / 1000 W

**Efficiency**

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>45V</th>
<th>50V</th>
<th>53V</th>
<th>56V</th>
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<tbody>
<tr>
<td>0 A</td>
<td>95%</td>
<td>94%</td>
<td>93%</td>
<td>92%</td>
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<tr>
<td>10 A</td>
<td>96%</td>
<td>95%</td>
<td>94%</td>
<td>93%</td>
</tr>
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<td>20 A</td>
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</tr>
<tr>
<td>40 A</td>
<td>99%</td>
<td>98%</td>
<td>97%</td>
<td>96%</td>
</tr>
<tr>
<td>50 A</td>
<td>99%</td>
<td>98%</td>
<td>97%</td>
<td>96%</td>
</tr>
<tr>
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<td>70 A</td>
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<td>96%</td>
</tr>
<tr>
<td>90 A</td>
<td>99%</td>
<td>98%</td>
<td>97%</td>
<td>96%</td>
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Efficiency vs. load current and input voltage at $T_{PI} = +25°C$

**Power Dissipation**

<table>
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<th>Voltage (V)</th>
<th>45V</th>
<th>50V</th>
<th>53V</th>
<th>56V</th>
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<tr>
<td>0 A</td>
<td>0 W</td>
<td>0 W</td>
<td>0 W</td>
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<tr>
<td>90 A</td>
<td>90 W</td>
<td>90 W</td>
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Dissipated power vs. load current and input voltage at $T_{PI} = +25°C$

**Output Characteristics**

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<th>Voltage (V)</th>
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<th>50V</th>
<th>53V</th>
<th>56V</th>
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<tbody>
<tr>
<td>0 A</td>
<td>9.6</td>
<td>9.8</td>
<td>10.0</td>
<td>10.2</td>
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<tr>
<td>10 A</td>
<td>9.6</td>
<td>9.8</td>
<td>10.0</td>
<td>10.2</td>
</tr>
<tr>
<td>20 A</td>
<td>9.6</td>
<td>9.8</td>
<td>10.0</td>
<td>10.2</td>
</tr>
<tr>
<td>30 A</td>
<td>9.6</td>
<td>9.8</td>
<td>10.0</td>
<td>10.2</td>
</tr>
<tr>
<td>40 A</td>
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<td>9.8</td>
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<tr>
<td>50 A</td>
<td>9.6</td>
<td>9.8</td>
<td>10.0</td>
<td>10.2</td>
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<tr>
<td>60 A</td>
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<tr>
<td>70 A</td>
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<td>10.2</td>
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<tr>
<td>80 A</td>
<td>9.6</td>
<td>9.8</td>
<td>10.0</td>
<td>10.2</td>
</tr>
<tr>
<td>90 A</td>
<td>9.6</td>
<td>9.8</td>
<td>10.0</td>
<td>10.2</td>
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</table>

Output voltage vs. load current at $T_{PI} = +25°C$

**Current Limit Characteristics**

<table>
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<th>Voltage (V)</th>
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<th>53V</th>
<th>56V</th>
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</thead>
<tbody>
<tr>
<td>90 A</td>
<td>9.6</td>
<td>9.6</td>
<td>9.6</td>
<td>9.6</td>
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<tr>
<td>100 A</td>
<td>9.6</td>
<td>9.6</td>
<td>9.6</td>
<td>9.6</td>
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<tr>
<td>110 A</td>
<td>9.6</td>
<td>9.6</td>
<td>9.6</td>
<td>9.6</td>
</tr>
<tr>
<td>120 A</td>
<td>9.6</td>
<td>9.6</td>
<td>9.6</td>
<td>9.6</td>
</tr>
</tbody>
</table>

Output voltage vs. load current at $I_O > max I_O, T_{PI} = +25°C$
**BMR480 series DC-DC Converters**

**Input** 45-56 V, **Output** up to 96.2 A / 1000 W

---

**Typical Characteristics**

**10.4 V / 1000 W**

### Start-up

Start-up enabled by connecting $V_i$ at:
- $T_{PI}=+25^\circ C$, $V_i=53$ V,
- $I_O=96.2$ A resistive load.

Top trace: output voltage 10 V/div.
Bottom trace: input voltage 50 V/div.
Time scale: 10 ms/div.

### Shut-down

Shut-down enabled by disconnecting $V_i$ at:
- $T_{PI}=+25^\circ C$, $V_i=53$ V,
- $I_O=96.2$ A resistive load.

Top trace: output voltage 10 V/div.
Bottom trace: input voltage 20 V/div.
Time scale: 50 ms/div.

### Output Ripple & Noise

Output voltage ripple at:
- $T_{PI}=+25^\circ C$, $V_i=53$ V,
- $I_O=96.2$ A resistive load.

Trace: output voltage 20 mV/div.
Time scale: 2 µs/div.

### Output Load Transient Response

Output voltage response to load current step-change 23.5-73-23.5 A (2 A/µs) at:
- $T_{PI}=+25^\circ C$, $V_i=53$ V.

Top trace: output voltage 500 mV/div.
Bottom trace: load current 50 A/div.
Time scale: 0.5 ms/div.

---

**Input Voltage Transient Response**

Input Voltage transient. Hold-up sequence with PIM4710 at:
- $T_{PI}=+25^\circ C$, $V_i=53$ V,
- $I_O=96.2$ A resistive load.

Top trace: input voltage 20 V/div.
Bottom trace: Output voltage 2 V/div.
Time scale: 2 ms/div.
BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

Typical Characteristics at \( V_I = 54 \) V

Output Power Derating - Base plate

Available output power vs. ambient air temperature and airflow. See Thermal Consideration section.

Output Power Derating - \( \frac{1}{2}'' \) Heat Sink

Available output power vs. ambient air temperature and airflow. See Thermal Consideration section.

Output Current Derating – Cold wall sealed box

Available load current vs. base plate temperature. \( V_I = 53 \) V. See Thermal Consideration section.
**BMR480 series DC-DC Converters**

*Input 45-56 V, Output up to 96.2 A / 1000 W*

---

**Electrical Specification**

**10.4 V, 96.2A / 960 W**

Note 1: The maximum output current is limited to 96.2 A

Note 2: Cout = 3.5 mF (7×470 µF + 270 µF; 16SEPC, Panasonic, low ESR, POLYMER cap.

Note 3: Latching over current protection, unit shutdown during an over current event.

Note 4: Filter 10 µF tantalum + 0.1 µF ceramic.

---

### Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_i$</td>
<td>Input voltage range</td>
<td>45</td>
<td>56</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{off}$</td>
<td>Turn-off input voltage</td>
<td>40</td>
<td>41</td>
<td>42</td>
<td>V</td>
</tr>
<tr>
<td>$V_{on}$</td>
<td>Turn-on input voltage</td>
<td>42</td>
<td>43</td>
<td>45</td>
<td>V</td>
</tr>
<tr>
<td>$C_i$</td>
<td>Internal input capacitance $V_i = 53$ V</td>
<td>9.5</td>
<td></td>
<td></td>
<td>µF</td>
</tr>
<tr>
<td>$P_o$</td>
<td>Output power</td>
<td>See Note 1, 2</td>
<td>0</td>
<td>960</td>
<td>W</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Efficiency</td>
<td>50%</td>
<td>97.3</td>
<td>96.7</td>
<td>%</td>
</tr>
<tr>
<td>$P_s$</td>
<td>Power Dissipation</td>
<td>max $I_o$</td>
<td>33</td>
<td>41</td>
<td>W</td>
</tr>
<tr>
<td>$P_i$</td>
<td>Input idling power</td>
<td>$I_o = 0$ A, $V_i = 53$ V</td>
<td>6.5</td>
<td></td>
<td>W</td>
</tr>
<tr>
<td>$P_{nc}$</td>
<td>Input standby power</td>
<td>$V_i = 53$ V (turned off with RC)</td>
<td>1</td>
<td></td>
<td>W</td>
</tr>
<tr>
<td>$I_s$</td>
<td>Switching frequency</td>
<td>0-100% of max $P_o$</td>
<td>220</td>
<td>230</td>
<td>234</td>
</tr>
</tbody>
</table>

| $V_o$                            | Output voltage initial setting and accuracy      | $T_{PI} = +25°C, V_i = 53$ V, $P_o = 0$ W | 10.5 | 10.53 | 10.56 | V    |
| $V_o$                            | Output adjust range                             | 0-100% of max $P_o$ | 8    | 12    |      | V    |
| $V_o$                            | Output voltage tolerance band                   | 0-100% of max $P_o$ | 9.83 | 10.63 |      | V    |
| $V_o$                            | Idling voltage                                  | $P_o = 0$ W | 10.4 | 10.52 | 10.56 | V    |
| $V_o$                            | Line regulation                                 | $V_i = 45 - 56$ V, 100% of max $P_o$ | 10   |      |      | mV   |
| $V_o$                            | Load regulation                                 | $V_i = 53$ V, 0-100% of max $P_o$ | 525  | 600   |      | mV   |
| $V_o$                            | Load transient voltage deviation                | $V_i = 53$ V, Load step 25-75-25% of max $I_o$, $di/dt = 2$ A/µs. | ±260 |      |      | mV   |
| $I_{tr}$                         | Load transient recovery time                    | See Note 2 | 200  |      |      | µs   |
| $I_r$                            | Ramp-up time                                    | 0-100% of max $P_o$ | 200  |      |      | ms   |
| $I_s$                            | Start-up time                                   | (from $V_o$ connection to 100% of $V_o$) | 230  |      |      | ms   |
| $I_{nc}$                         | RC start-up time                                | (from $V_o$ connection to 100% of $V_o$) | max $P_o$ | 201 |      | ms   |
| $I_o$                            | Sink current                                    | 0.3   |      |      | mA   |
| $I_{nc}$                         | Trigger level                                   | RC-voltage | 1.6  |      |      | V    |
| $I_{tr}$                         | Response time                                   | 1     |      |      | ms   |
| $I_o$                            | Output current                                  | $V_i = 45 - 56$ V | 0    | 96.2  |      | A    |
| $I_{nc}$                         | Current limit threshold                         | $T_{PI} < max T_{PI}$ | 100  | 110   | 120   | A    |
| $I_{nc}$                         | Short circuit current                           | $T_{PI} = 25°C$, see Note 3 |      |      |      | A    |
| $C_{set}$                        | Recommended Capacitive Load                     | $T_{PI} = 25°C$ | 470  | 3500  | 15000 | µF   |
| $V_{out}$                        | Output ripple & noise                            | See ripple & noise section, max $P_o$, see Note 4 | 67   |      |      | mVp-p |
| $OVP$                            | Output over voltage protection                  | 15.6  |      |      | V    |

---

Note 1: The maximum output current is limited to 96.2 A

Note 2: Cout = 3.5 mF (7×470 µF + 270 µF; 16SEPC, Panasonic, low ESR, POLYMER cap.

Note 3: Latching over current protection, unit shutdown during an over current event.

Note 4: Filter 10 µF tantalum + 0.1 µF ceramic.
**BMR480 series DC-DC Converters**

Input 45-56 V, Output up to 96.2 A / 1000 W

### Typical Characteristics

**10.4 V / 960 W**

#### Efficiency

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>97</td>
</tr>
<tr>
<td>50</td>
<td>94</td>
</tr>
<tr>
<td>53</td>
<td>91</td>
</tr>
<tr>
<td>56</td>
<td>88</td>
</tr>
</tbody>
</table>

Efficiency vs. load current and input voltage at $T_{\text{P1}} = +25^\circ\text{C}$

#### Power Dissipation

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Power Dissipation (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td>50</td>
<td>35</td>
</tr>
<tr>
<td>53</td>
<td>30</td>
</tr>
<tr>
<td>56</td>
<td>25</td>
</tr>
</tbody>
</table>

Dissipated power vs. load current and input voltage at $T_{\text{P1}} = +25^\circ\text{C}$

#### Output Characteristics

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Output Current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>9.6</td>
</tr>
<tr>
<td>50</td>
<td>9.8</td>
</tr>
<tr>
<td>53</td>
<td>10.0</td>
</tr>
<tr>
<td>56</td>
<td>10.2</td>
</tr>
</tbody>
</table>

Output voltage vs. load current at $T_{\text{P1}} = +25^\circ\text{C}$

#### Output Characteristics

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>96.2</td>
</tr>
</tbody>
</table>

Output voltage vs. Input voltage and load current at $T_{\text{P1}} = +25^\circ\text{C}$
**BMR480 series** DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

**Typical Characteristics**

10.4 V / 960 W

Start-up

![Start-up](image1)

Start-up enabled by connecting \( V_i \) at:
\[ T_{R1} = +25^\circ C, V_i = 53 \text{ V}, \]
\[ I_o = 96.2 \text{ A resistive load}. \]

Top trace: output voltage 5 V/div.
Bottom trace: input voltage 20 V/div.
Time scale: 100 ms/div.

Shut-down

![Shut-down](image2)

Shut-down enabled by disconnecting \( V_i \) at:
\[ T_{R1} = +25^\circ C, V_i = 53 \text{ V}, \]
\[ I_o = 96.2 \text{ A resistive load}. \]

Top trace: output voltage 5 V/div.
Bottom trace: input voltage 20 V/div.
Time scale: 2 ms/div.

Output Ripple & Noise

![Output Ripple & Noise](image3)

Output voltage ripple at:
\[ T_{R1} = +25^\circ C, V_i = 53 \text{ V}, \]
\[ I_o = 96.2 \text{ A resistive load}. \]

Trace: output voltage 20 mV/div.
Time scale: 2 µs/div.

Output Load Transient Response

![Output Load Transient Response](image4)

Output voltage response to load current step-change 24-72-24 A (2 A/µs) at:
\[ T_{R1} = +25^\circ C, V_i = 53 \text{ V}. \]

Top trace: output voltage 500 mV/div.
Bottom trace: load current 20 A/div.
Time scale: 1 ms/div.
**Typical Characteristics at \( V_I = 54 \text{ V} \)**

**Output Power Derating - Base plate**

![Graph showing output power derating for base plate at different airflow rates and temperatures.](image)

Available output power vs. ambient air temperature and airflow. See Thermal Consideration section.

**Output Power Derating - \( \frac{1}{2}'' \) Heat Sink**

![Graph showing output power derating for \( \frac{1}{2}'' \) heat sink at different airflow rates and temperatures.](image)

Available output power vs. ambient air temperature and airflow. See Thermal Consideration section.

**Output Current Derating – Cold wall sealed box**

![Graph showing output current derating for cold wall sealed box at different base plate temperatures.](image)

Available load current vs. base plate temperature. \( V_I = 53 \text{ V} \). See Thermal Consideration section.
EMC Specification
Conducted EMI measured according to EN55022, CISPR 22 and FCC part 15J (see test set-up). The fundamental switching frequency is 230 kHz for BMR480. The EMI characteristics below is measured at $V_i = 53$ V and max $I_O$.

Optional external filter for class B
Suggested external input filter in order to meet class B in EN 55022, CISPR 22 and FCC part 15J.

Filter components:
- $C1 = 4 \times 4.7 \mu F$
- $C2 = 2 \times 10 \mu F$
- $C3 = 2 \times 10 \mu F$
- $+ 330 \mu F$ (e-lyt)
- $C4 = 4.7 nF$
- $C5 = 4.7 nF$
- $L1 = 2.2 mH$
- $L2 = 2.2 mH$

Layout recommendations
The radiated EMI performance of the product will depend on the PWB layout and ground layer design. It is also important to consider the stand-off of the product. If a ground layer is used, it should be connected to the output of the product and the equipment ground or chassis.

A ground layer will increase the stray capacitance in the PWB and improve the high frequency EMC performance.

Output ripple and noise
Output ripple and noise measured according to figure below. See Design Note 022 for detailed information.
**BMR480 series DC-DC Converters**
Input 45-56 V, Output up to 96.2 A / 1000 W

---

**Power Management Overview**
This product is equipped with a PMBus interface. The product incorporates a wide range of readable and configurable power management features that are simple to implement with a minimum of external components. Additionally, the product includes protection features that continuously safeguard the load from damage due to unexpected system faults. A fault is also shown as an alert on the SALERT pin. The following product parameters can continuously be monitored by a host: Input voltage, output voltage/current, duty cycle and internal temperature.

The product is delivered with a default configuration suitable for a wide range operation in terms of input voltage, output voltage, and load. The configuration is stored in an internal Non-Volatile Memory (NVM). All power management functions can be reconfigured using the PMBus interface.

Throughout this document, different PMBus commands are referenced. A detailed description of each command is provided in the appendix at the end of this specification.

The Flex Power Designer software suite can be used to configure and monitor this product via the PMBus interface. For more information please contact your local Flex sales representative.

**SMBus Interface**
This product provides a PMBus digital interface that enables the user to configure many aspects of the device operation as well as to monitor the input and output voltages, output current and device temperature. The product can be used with any standard two-wire I2C (master must allow for clock stretching) or SMBus host device. In addition, the product is compatible with PMBus version 1.3 and includes an SALERT line to help mitigate bandwidth limitations related to continuous fault monitoring. The product supports 100 kHz and 400 kHz bus clock frequency only. The PMBus signals, SCL, SDA and SALERT require passive pull-up resistors as stated in the SMBus Specification. Pull-up resistors are required to guarantee the rise time as follows:

$$\tau = R_p C_p \leq 1\mu s$$

where $R_p$ is the pull-up resistor value and $C_p$ is the bus load. The maximum allowed bus load is 400 pF. The pull-up resistor should be tied to an external supply between 2.7 to 3.8 V, which should be present prior to or during power-up. If the proper power supply is not available, voltage dividers may be applied. Note that in this case, the resistance in the equation above corresponds to parallel connection of the resistors forming the voltage divider.

It is recommended to always use PEC (Packet Error Check) when communicating via PMBus. There is an optional setting that makes PEC required which further increase communication robustness. This can be configured by setting bit 7 in command MFR_SPECIAL_OPTIONS (0x0E).

---

**PMBus Addressing**
The following figure and table show recommended resistor values with min and max voltage range for hard-wiring PMBus addresses (series E12, 1% tolerance resistors suggested):

**Schematic of connection of address resistors**

![Schematic of connection of address resistors](image)

<table>
<thead>
<tr>
<th>SA0/SA1 Index</th>
<th>$R_{SA0/SA1}$ [kΩ]</th>
<th>Resulting address with MFR_OFFSET_ADDRESS = 40d</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>40d (0x28)</td>
</tr>
<tr>
<td>1</td>
<td>22</td>
<td>49d (0x31)</td>
</tr>
<tr>
<td>2</td>
<td>33</td>
<td>58d (0x3A)</td>
</tr>
<tr>
<td>3</td>
<td>47</td>
<td>67d (0x43)</td>
</tr>
<tr>
<td>4</td>
<td>68</td>
<td>76d (0x4C)</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>85d (0x55)</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>94d (0x5E)</td>
</tr>
<tr>
<td>7</td>
<td>220</td>
<td>103d (0x67)</td>
</tr>
</tbody>
</table>

The SA0 and SA1 pins can be configured with a resistor to GND according to the following equation.

$$\text{PMBus Address(decimal)} = 8 \times \text{SA0 index} + \text{SA1 index} + \text{MFR_OFFSET_ADDRESS}$$

If the calculated PMBus address is 0, 11 or 12, PMBus address 127 is assigned instead. From a system point of view, the user shall also be aware of further limitations of the addresses as stated in the PMBus Specification. It is not recommended to keep the SA0 and SA1 pins left open.

See section MFR_OFFSET_ADDRESS (0xEE) how to set the command to utilize single address pin option. Specific variants may already have a default non-zero value set for MFR_OFFSET_ADDRESS.

---

**I2C/SMBus – Timing**

![Setup and hold times timing diagram](image)
The setup time, \( t_{set} \), is the time data, SDA, must be stable before the rising edge of the clock signal, SCL. The hold time \( t_{hold} \), is the time data, SDA, must be stable after the rising edge of the clock signal, SCL. If these times are violated incorrect data may be captured or meta-stability may occur and the bus communication may fail. All standard SMBus protocols must be followed, including clock stretching. This product supports the BUSY flag in the status commands to indicate product being too busy for SMBus response. A bus-free time delay between every SMBus transmission (between every stop & start condition) must occur. Refer to the SMBus specification, for SMBus electrical and timing requirements. Note that an additional delay of 5 ms has to be inserted in case of storing the RAM content into the internal non-volatile memory.

**Monitoring via PMBus**

It is possible to continuously monitor a wide variety of parameters through the PMBus interface. These include, but are not limited to, the parameters listed in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>PMBus Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>READ_VIN</td>
</tr>
<tr>
<td>Output voltage</td>
<td>READ_VOUT</td>
</tr>
<tr>
<td>Output current</td>
<td>READ_IOUT</td>
</tr>
<tr>
<td>Temperature (^*)</td>
<td>READ_TEMPERATURE_1</td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>READ_FREQUENCY</td>
</tr>
<tr>
<td>Duty cycle</td>
<td>READ_DUTY_CYCLE</td>
</tr>
</tbody>
</table>

\(^*\)Reports the temperature from temperature sensor set in command 0xDC, internal (controller IC)/external (temp sensor).

**Monitoring Faults**

Fault conditions can be detected using the SALERT pin, which will be asserted low when any number of pre-configured fault or warning conditions occurs. The SALERT pin will be held low until faults and/or warnings are cleared by the CLEAR_FAULTS command, or until the output voltage has been re-enabled. It is possible to mask which fault conditions should not assert the SALERT pin by the command SMBALERT MASK. In response to the SALERT signal, the user may read a number of status commands to find out what fault or warning condition occurred, see table below.

<table>
<thead>
<tr>
<th>Fault &amp; Warning Status</th>
<th>PMBus Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview, Power Good</td>
<td>STATUS_BYTE</td>
</tr>
<tr>
<td>Output voltage level</td>
<td>STATUS_VOUT</td>
</tr>
<tr>
<td>Output current level</td>
<td>STATUS_IOUT</td>
</tr>
<tr>
<td>Input voltage level</td>
<td>STATUS_INPUT</td>
</tr>
<tr>
<td>Temperature level</td>
<td>STATUS_TEMPERATURE</td>
</tr>
<tr>
<td>PMBus communication</td>
<td>STATUS_CML</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>STATUS_MFR_SPECIFIC</td>
</tr>
</tbody>
</table>

**Snapshot Parameter Capture**

When input voltage disappears during conversion the Snapshot functionality will automatically store parametric RAM data to NVM. After one successful ramp with Vin still in the operating range, the snap shot data contains only FFh. To be able to retrieve snap shot data from the previous power cycle, it is therefore important to eliminate ramp up e.g by turning RC off or keeping Vin at 30V. The NVM data can be read back using the MFR_GET_SNAPSHOT (0x07) command to provide valuable information for analysis. The snap shot parameters called old are the recorded values at the fault event. All other snap shot parameters are stored to NVM when Vin is at the input voltage level.

**Ramp up data Capture**

The command MFR_GET_RAMP_DATA (0xDB) retrieves 32 bytes of ramp data. 15 pairs of instant values of Vin and Vout are recorded during ramp and the interval is adjusted to the ramp time. Data bytes 1 & 2 is the counter. Instant values of Vin & Vout are recorded as 8-bit integers, data byte 3 is the first Vin sample and data byte 4 is the first Vout sample. Vin & Vout are recorded as pairs until the ramp is finished. The record counter value is recorded just before ramp. The record value is equal to last value of “snap shot cycles” + 1. This way it can be judged whether the ramp data was recorded before or after snap shot data. Only the first ramp in a power cycle will be recorded. If the read out of the 32 bytes are all FFh then it is a successful ramp-up. Only the first ramp in a power cycle will be recorded. Thus, if the ramp fails, consequent ramp attempts will not be recorded and bit 6 in STATUS_MFR_SPECIFIC (0x80) will be set. Read MFR_GET_RAMP_DATA (0xDB) using Flex Power Designer.
Status data Capture
The command MFR_GET_STATUS_DATA (0xDF) retrieves 32 bytes consisting of a power cycle counter and 15 status words. The recording starts just after ramp has finished. Firstly, the power cycle counter is retrieved from the ramp data and stored as the first word. Secondly the status word is stored. The unit then continues to store status words every ~8 sec intervals. Total recording time is ~8 * 15 ~ 120 s.

Non-Volatile Memory (NVM)
The product incorporates two Non-Volatile Memory areas for storage of the PMBus command values; the Default NVM and the User NVM. The Default NVM is pre-loaded with Flex factory default values. The Default NVM is write-protected and can be used to restore the Flex factory default values through the command RESTORE_DEFAULT_ALL (0x12). The User NVM is pre-loaded with Flex factory default values. The User NVM is writable and open for customization. The values in NVM are loaded during initialization according to section Initialization Procedure, where after commands can be changed through the PMBus Interface. The STORE_USER_ALL (0x15) command will store the changed parameters to the User NVM.

Operating Information
Input Voltage
The input voltage range 40 to 60 Vdc meets the requirements for normal input voltage range in –48 Vdc systems, -40.5 to -57.0 V. At input voltages exceeding 60 V, the power loss will be higher than at normal input voltage and T1 must be limited to absolute max +125°C. The absolute maximum continuous input voltage is 65 Vdc.

Short duration transient disturbances can occur on the DC distribution and input of the product when a short circuit fault occurs on the equipment side of a protective device (fuse or circuit breaker). The voltage level, duration and energy of the disturbance are dependent on the particular DC distribution network characteristics and can be sufficient to damage the product unless measures are taken to suppress or absorb this energy. The transient voltage can be limited by capacitors and other energy absorbing devices like zener diodes connected across the positive and negative input conductors at a number of strategic points in the distribution network. The end-user must secure that the transient voltage will not exceed the value stated in the Absolute maximum ratings. ETSI TR 100 283 examines the parameters of DC distribution networks and provides guidelines for controlling the transient and reduce its harmful effect.

Turn-on and -off Input Voltage
The product monitors the input voltage and will turn on and turn off at configured thresholds (see Electrical Specification). The turn-on input voltage voltage threshold is set higher than the corresponding turn-off threshold. Hence, there is a hysteresis between turn-on and turn-off input voltage levels.

Remote Control (RC)
The products are fitted with a remote control function referenced to the primary negative input connection (-In), with negative and positive logic options available. The RC function allows the product to be turned on/off by an external device like a semiconductor or mechanical switch.

The RC pin has an internal pull up resistor.

The external device must provide a minimum required sink current >0.5 mA to guarantee a voltage not higher than maximum voltage on the RC pin (see Electrical characteristics table). To turn off the product the RC pin should be left open for a minimum of time 150 µs, the same time requirement applies when the product shall turn on. When the RC pin is left open, the voltage generated on the RC pin is max 5 V. The standard product is provided with "negative logic” RC and will be off until the RC pin is connected to the –In. To turn off the product the RC pin should be left open. In situations where it is desired to have the product to power up automatically without the need for control signals or a switch, the RC pin shall be wired directly to –In.

Remote Control (secondary side)
The CTRL-pin can be configured as remote control via the PMBus interface. In the default configuration the CTRL-pin is disabled and floating. The output can be configured to internal pull-up to 3.3 V using the MFR_MULTI_PIN_CONFIG (0xF9) command. The logic options for the secondary remote control can be positive or negative logic. The logic option for the secondary remote control is easily configured via ON_OFF_CONFIG (0x02) using Flex Power Designer software command, see also MFR_MULTI_PIN_CONFIG section. When not used it is recommended to connect the CTRL pin to DGND.

Input and Output Impedance
The impedance of both the input source and the load will interact with the impedance of the product. It is important that the minimum source has low characteristic impedance. Minimum recommended external input capacitance is 220 µF. The electrolytic capacitors will be degraded in low temperature. The needed input capacitance in low temperature should be equivalent to 220 µF at 20°C. The performance in some applications can be enhanced by addition of external capacitance as described under External Decoupling Capacitors. If the input voltage source contains significant inductance, the addition of a low ESR ceramic capacitor of 22 – 100 µF capacitor across the input of the product will ensure stable operation. The minimum required capacitance value depends on the output power and the input voltage. The higher output power the higher input capacitance is needed.
**External Decoupling Capacitors**

When powering loads with significant dynamic current requirements, the voltage regulation at the point of load can be improved by addition of decoupling capacitors at the load. The most effective technique is to locate low ESR ceramic and electrolytic capacitors as close to the load as possible, using several parallel capacitors to lower the effective ESR. The ceramic capacitors will handle high-frequency dynamic load changes while the electrolytic capacitors are used to handle low frequency dynamic load changes. It is equally important to use low resistance and low inductance PWB layouts and cabling.

External decoupling capacitors will become part of the product’s control loop. The control loop is optimized for a wide range of external capacitance and the maximum recommended value that could be used without any additional analysis is found in the Electrical specification.

The ESR of the capacitors is a very important parameter. Stable operation is guaranteed with a verified ESR value of >1 mΩ across the output connections.

For further information please contact your local Flex Power Modules representative.

**PMBus configuration and support**

The product provides a PMBus digital interface that enables the user to configure many aspects of the device operation as well as monitor the input and output parameters.

The Flex Power Designer software suite can be used to configure and monitor this product via the PMBus interface. For more information, please contact your local Flex sales representative.

**Feed Forward Capability**

The BMR480 products have a Feed Forward function implemented that can handle sudden input voltage changes. The output voltage will be regulated during an input transient and will typically stay within 10% when an input transient is applied.

When the HRR function is enabled the input voltage transient is recommended to be within the range of VIN_UV_WARN_LIMIT (0x58) threshold and max input voltage. This is due to output voltage will follow the input voltage ratio below VIN_UV_WARN_LIMIT (0x58) level and during an input voltage change the output voltage ΔV/Δt will be higher and there is a risk for entering current limit when charging the output capacitance. The Feed Forward acts on both positive and negative input voltage transients.

**Output Voltage Adjust using PMBus**

The output voltage of the product can be reconfigured via PMBus command VOUT_COMMAND (0x21) or VOUT_TRIM (0x22). This can be used when adjusting the output voltage above or below output voltage initial setting up to a certain level, see Electrical specification for adjustment range.

When increasing the output voltage, the voltage at the output pins must be kept within the plotted area, see graph. Output voltage setting must be kept below the threshold of the over voltage protection, (OVP) to prevent the product from shutting down. At increased output voltages the maximum power rating of the product remains the same, and the max output current must be decreased correspondingly. According to below graph the BMR480 is operating at max duty cycle where the output voltage start to droop.

![Output voltage adjust range](image)

### HRR (Hybrid Regulated Ratio)

The main purpose of introducing HRR function is to support a regulated output which leave a headroom to 100% duty cycle. At a predetermined threshold configured via command VIN_UV_WARN_LIMIT (0x58) the output voltage will follow the ratio of the input voltage. HRR operation is enabled by setting bit 6 in PMBus command MFR_SPECIAL_OPTION (0xE0). It is not recommended to use HRR functionality for devices operating in parallel configuration Droop load share (DLS) or Active Current Share (ACS) where the current share accuracy can’t be fulfilled. The graph below shows one example with VIN_UV_WARN_LIMIT set to 44V and HRR enabled.

The HRR operation is easily configured using Flex Power Designer software, see also Appendix – PMBus commands.

![Line Characteristics](image)

### Margin Up/Down Controls

These controls allow the output voltage to be momentarily adjusted, either up or down, by a nominal 10%. The margin high and margin low shall be limited to max and min output voltage, if the nominal output voltage is changed. This provides a convenient method for dynamically testing the operation of the load circuit over its supply margin or range. It
BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

Technical Specification
28701-BMR480 0100 Rev A March 2019
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can also be used to verify the function of supply voltage supervisors. The margin up and down levels of the product can easily be re-configured using Flex Power Designer software.

**Soft-start Power Up**
The default rise time for a single product is 10 ms. When starting by applying input voltage the control circuit boot-up time adds an additional 25 ms delay. The soft-start and soft-stop control functionality allows the output voltage to ramp-up and ramp-down with defined timing with respect to the control of the output. This can be used to control inrush current and manage supply sequencing of multiple controllers.

The rise time is the time taken for the output to ramp to its target voltage, while the fall time is the time taken for the output to ramp down from its regulation voltage to 0 V. The TOFF_DELAY (0x64) delay time sets a delay from when the output is enabled until the output voltage starts to ramp up. The TON_DELAY (0x60) time sets a delay from when the output is disabled until the output voltage starts to ramp down.

Parallel operation is easily configured using Flex Power Designer software. See application note AN324 for further information.

By default, soft-stop is disabled, and the regulation of output voltage stops immediately when the output is disabled. Soft-stop can be enabled through the PMBus command ON_OFF_CONFIG (0x02). The delay and ramp times can be reconfigured using the PMBus commands TON_DELAY (0x60), TON_RISE (0x61), TOFF_DELAY (0x64) and TOFF_FALL (0x65).

**Pre-bias Start-up**
The product has a Pre-bias start up functionality and will not sink current during start up if a pre-bias source is present at the output terminals. If the Pre-bias voltage is lower than the target value set in VOUT_COMMAND (0x21), the product will ramp up to the target value. If the Pre-bias voltage is higher than the target value set in VOUT_COMMAND (0x21), the product will ramp down to the target voltage and in this case sink current for a time interval set by the command TOFF_MAX_WARN_LIMIT (0x66).

**Parallel Operation DLS (Droop Load Share)**
Two or more products may be paralleled for redundancy if the total power is equal or less than Pout_max. The products provide output voltage droop corresponding to pre-configured artificial resistance in the output circuit to enable direct paralleling. The stated output voltage set point is at no load. The output voltage will decrease when the load current is increased. This feature allows the products to be connected in parallel and share the current with 10% accuracy at max output power. This means that up to 90% of max rated current from each module can be utilized. The product measures reversed current, and will compensate the output voltage in these situations. At reversed current > 35A the product will shut down immediately. Note that continuous restarts after a fault (“hiccup mode”) are not recommended for parallel operation. Droop Load Share variants (DLS) will have a default response from an OCP fault consisting of a response delay of 2ms then immediately shut down. To prevent unnecessary current stress, changes of the output voltage must be done with the output disabled. This must be considered for all commands that affect the output voltage.

Parallel Operation ACS (Active Current Share)
Better current share performance can be achieved on the variants with ACS feature enabled. The advantages of the ACS compared with normal DLS: It utilizes a dedicate current share bus to balance the load between the paralleled modules. Each module in the bus will trim its regulated output up and down continuously to be able to output the same current seen from the current share bus. This feature will cancel out the current share error caused by the modules output voltage deviation, temperature deviation and layout asymmetry. The max load of the paralleled modules equals to (max load of single module-2.5A) * number of paralleled modules. The 2.5A is the maximum error of the output current monitor and current accuracy between products in a current sharing group is 2 x 2.5A. The ACS also provides less droop compared with the DLS, thus push the max power even higher. The modules are adjusting their output continuously according to the ACS algorithm, the output voltage at idle will vary maximum ±100mV due to limitations in idle current measurements. The ACS feature is not activated during start up so the maximum load during ramp up will still be limited to number of modules x max load of single module x 90% (Pout_max x 0.9).
How to setup the ACS: All the precautions mentioned in the DLS section are still valid when use the ACS. All the CTRL pins of the paralleled modules need to be tied together and close to each module a ceramic capacitor shall be connected between CTRL and DGND. A 33nF C0G type is recommended.

**OTP, UTP (Over/Under Temperature Protection)**
The products are protected from thermal overload by an internal over temperature sensor. The product will make continuous attempts to start up (non-latching mode) and resume normal operation automatically when the temperature has dropped below the temperature threshold set in command OT_WARN_LIMIT (0x51).

The OTP and hysteresis of the product can be re-configured using the PMBus interface. The product has also an under-temperature protection. The OTP and UTP fault limit and fault response can be configured via the PMBus. Note: using the fault response “continue without interruption” may cause permanent damage to the product.

**Input Over/Under Voltage Protection**
The product can be protected from high input voltage and low input voltage by a pre-configured value with a response time of 100us. The over/under-voltage fault level and fault response is easily configured using Flex Power Designer software, see also Appendix – PMBus commands.

**OVP (Output Over Voltage Protection)**
The product includes over voltage limiting circuitry for protection of the load. The default OVP limit is 30% above the nominal output voltage. If the output voltage exceeds the OVP limit, the product can respond in different ways. The default response from an over voltage fault is to immediately shut down. The device will continuously check for the presence of the fault condition, and when the fault condition no longer exists the device will be re-enabled. The OVP fault level and fault response can be configured via the PMBus interface, see Appendix – PMBus commands.

**OCP (Over Current Protection)**
The products include current limiting circuitry for protection at continuous overload. For standard configuration the output voltage will decrease towards 8V, set in command IOUT_OC_LV_FAULT_LIMIT (0x48), then shutdown and automatic restart for output currents in excess of max output current (max Io). The product will resume normal operation after removal of the overload. The load distribution should be designed for the maximum output short circuit current specified.

The over current protection of the product can be configured via the PMBus interface, see Appendix – PMBus commands.

**Synchronization**
It is possible to synchronize 2 or more products by connecting pins 6 (PG_SYNC) or 14 (SA1), see Multi Pin Configuration. To utilize the synchronization one product must be configured to sync out. The other products must be configured as sync in.

The function is enabled and configured to be sync out or sync in via MFR_MULTI_PIN_CONFIG (0xF9). The synchronization can be configured to use interleave between the switching phases, see Interleave section. Synchronization can be configured via the PMBus interface, see Appendix – PMBus commands, MFR_MULTI_PIN_CONFIG (0xF9).

**Interleave**
When multiple product share a common DC input supply, spreading of the switching phases between the products can be utilized. This reduces the input capacitance requirements and efficiency losses, since the peak current drawn from the input supply is effectively spread out over the whole switch period. If two or more units have their outputs connected in parallel, interleaving will reduce ripple currents. This requires that the products are synchronized using the SYNC pin. Interleave function can be configured via the PMBus interface, see Appendix – PMBus commands, INTERLEAVE (0x37). The default configuration is set to 0x0021.

\[
Phase_{\text{offset}}(\degree) = 360 \times \frac{\text{Interleave\_order}}{\text{Number\_in\_group}}
\]

For more details about how to setup Interleave, refer to the PMBus specification.

**Switching frequency**
The switching frequency is set to 230kHz as default but this can be reconfigured via the PMBus interface. The product is optimized at this frequency, but can run at lower and higher frequency (180kHz-250kHz). The electrical performance can be affected if the switching frequency is changed.

**Power Good**
The power good pin 6(PG_SYNC) indicates when the product is ready to provide regulated output voltage to the load. During ramp-up and during a fault condition, PG is held high. By default, PG is asserted low after the output has ramped to a voltage above 8V, and de-asserted if the output voltage falls below 5V. These thresholds may be changed using the PMBus commands POWER_GOOD_ON (0x5E) and POWER_GOOD_OFF (0x5F).

By default, the PG pin is configured as Push/pull output, but it is also possible to set the output in open drain mode by the command MFR_MULTI_PIN_CONFIG (0xF9), see Appendix – PMBus commands.

The polarity is by default configured to active low, the polarity of PG can be set to active high in the command MFR_PGOOD_POLARITY (0xD0):

\[
0xD0 = 00 \text{ (active low)}
\]

\[
0xD0 = 01 \text{ (active high)}
\]
The product provides Power Good flag in the Status Word register that indicates the output voltage is within a specified tolerance of its target level and no-fault condition exists.

It is not recommended to use Push-pull when paralleling PG-pins.

**DBV (Dynamic Bus Voltage)**
The MFR_DBV_CONFIG (0xEF) command can be used when the output voltage shall change depending on the output current load, which can improve the energy consumption. In MFR_DBV_CONFIG there are 4 current thresholds, low to mid (I1H), mid to low (I1L), mid to high (I2H) and high to mid (I2L) and 2 voltage levels that can be set, V1 and V2, V3 is the default setting in VOUT_COMMAND (0x21).

The Vout rise time is configured via VOUT_TRANSITION_RATE (0x27), consider that the max output current or power can’t be exceeded when entering different Vout levels.

The MFR_DBV_CONFIG is easily configured using Flex Power Designer software, see also Appendix – PMBus commands.

**ART (Adaptive Ramp-up Time)**
MFR_DLC_CONFIG (0xF7) command combines ART and DLC functions. This section describes the ART function. It can be useful when adaptive rise time is requested, referenced to the output capacitive load.

From start of ramp-up, TON_RISE (0x61) is used. Vend and Vstart state the levels on the ramp where the output capacitance is measured. The values K1, K2 and K3 set the ramp factor multiplied to the default TON_RISE value. The ramp factor is referenced to Limit1, Limit2 and Limit3 stated in MFR_DLC_CONFIG.

The MFR_DLC_CONFIG is easily configured using Flex Power Designer software, see also Appendix – PMBus commands.

---

**DLC (Dynamic Load Compensation)**
MFR_DLC_CONFIG (0xF7) command combines ART and DLC functions. This section describes the DLC function. The DLC function is useful when optimized parameters for the control loop is requested, referenced to the output capacitive load. Only if the output capacitance is larger than Limit3 the control loop will be changed.

Vend and Vstart state the levels on the ramp where the output capacitance is measured. At the end of this measurement the control loop can possibly change depending on the configuration.

The MFR_DLC_CONFIG is easily configured using Flex Power Designer, see also Appendix – PMBus commands.

**Multi pin configuration**
The MFR_MULTI_PIN_CONFIG (0xF9) command can be re-configured using the PMBus interface to enable or disable different functions and set the pin configuration of the digital header (pin 6-15), see Appendix – PMBus commands. Standard configuration for stand-alone product is set to Power Good Push/pull (0x04). Products that are configured for parallel operation have Power Good configured to Open Drain (0x06). The MULTI_PIN_CONFIG is easily configured using Flex Power Designer, see also Appendix – PMBus commands.

**Address Offset**
The command MFR_OFFSET_ADDRESS (0xEE) is used to configure an address offset. The PMBus-address offset’s value increments the address value following the formula in the PMBus Addressing section of documentation. This increase flexibility when configuring pin SA1 to Sync. See Appendix – PMBus commands.
**Thermal Consideration**

**General**

The products are designed to operate in different thermal environments and sufficient cooling must be provided to ensure reliable operation.

For products mounted on a PWB without a heat sink attached, cooling is achieved mainly by conduction, from the pins to the host board, and convection, which is dependent on the airflow across the product. Increased airflow enhances the cooling of the product. The Output Current Derating graph found in the Output section for each model provides the available output current vs. ambient air temperature and air velocity at $V_i = 53$ V.

The product is tested on a 254 x 254 mm, 35 µm (1 oz), 16-layer test board mounted vertically in a wind tunnel with a cross-section of 608 x 203 mm.

For products with base plate used in a sealed box/cold wall application, cooling is achieved mainly by conduction through the cold wall. The Output Current Derating graphs are found in the Output section for each model. The product is tested in a sealed box test set up with ambient temperatures 85°C. See Design Note 028 for further details.

**Definition of product operating temperature**

The product operating temperatures is used to monitor the temperature of the product, and proper thermal conditions can be verified by measuring the temperature at positions P1 and P2. The temperature at these positions ($T_{P1}$, $T_{P2}$) should not exceed the maximum temperatures in the table below. The number of measurement points may vary with different thermal design and topology. Temperatures above maximum $T_{P1}$, measured at the reference point P1 are not allowed and may cause permanent damage.

<table>
<thead>
<tr>
<th>Position</th>
<th>Description</th>
<th>Max Temp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>PWB reference point, base-plate version</td>
<td>$T_{P1} = 125^\circ$ C</td>
</tr>
<tr>
<td>P2</td>
<td>MOSFET case</td>
<td>$T_{P2} = 125^\circ$ C</td>
</tr>
</tbody>
</table>
Ambient Temperature Calculation

For products with base plate the maximum allowed ambient temperature can be calculated by using the thermal resistance.

1. The power loss is calculated by using the formula
   \[ \left( \frac{1}{\eta} - 1 \right) \times \text{output power} = \text{power losses} \ (P_d). \]
   \( \eta \) = efficiency of product. E.g. 96% = 0.96

2. Find the thermal resistance (Rth) in the Thermal Resistance graph found in the Output section for each model. **Note that the thermal resistance can be reduced if a heat sink is mounted on the top of the base plate.**

Calculate the temperature increase (\( \Delta T \)).
\[ \Delta T = R_{th} \times P_d \]

3. Max allowed ambient temperature is:
\[ \text{Max } T_{\text{P1}} - \Delta T. \]

E.g. BMR 480 0100 at 2.0m/s:
1. \( \left( \frac{0.959}{0.96} - 1 \right) \times 1000 \text{ W} = 42 \text{ W} \)
2. \( 42 \text{ W} \times 2.0^\circ \text{C}/\text{W} = 84^\circ \text{C} \)
3. \( 125^\circ \text{C} - 84^\circ \text{C} = \text{max ambient temperature is } 41^\circ \text{C} \)

4. The thermal performance can be improved by mounting a heat sink on top of the base plate.

The actual temperature will be dependent on several factors such as the PWB size, number of layers and direction of airflow.

---

Connections (Bottom view)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Designation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+In</td>
<td>Positive Input</td>
</tr>
<tr>
<td>2</td>
<td>RC</td>
<td>Remote Control</td>
</tr>
<tr>
<td>3</td>
<td>-In</td>
<td>Negative Input</td>
</tr>
<tr>
<td>4</td>
<td>-Out</td>
<td>Negative Output</td>
</tr>
<tr>
<td>5</td>
<td>-Out</td>
<td>Negative Output</td>
</tr>
<tr>
<td>6</td>
<td>PG_Sync</td>
<td>Power Good output OR Sync</td>
</tr>
<tr>
<td>7</td>
<td>+Out</td>
<td>Positive Output</td>
</tr>
<tr>
<td>8</td>
<td>+Out</td>
<td>Positive Output</td>
</tr>
<tr>
<td>9</td>
<td>CTRL</td>
<td>PMBus remote control OR Current Share</td>
</tr>
<tr>
<td>10</td>
<td>DGND</td>
<td>PMBus ground</td>
</tr>
<tr>
<td>11</td>
<td>SDA</td>
<td>PMBus Data</td>
</tr>
<tr>
<td>12</td>
<td>SALERT</td>
<td>PMBus alert signal</td>
</tr>
<tr>
<td>13</td>
<td>SCL</td>
<td>PMBus Clock</td>
</tr>
<tr>
<td>14</td>
<td>SA1</td>
<td>PMBus Address 1</td>
</tr>
<tr>
<td>15</td>
<td>SA0</td>
<td>PMBus Address 0</td>
</tr>
</tbody>
</table>
BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

All component placements – whether shown as physical components or symbolical outline – are for reference only and are subject to change throughout the product's life cycle, unless explicitly described and dimensioned in this drawing.
Soldering Information – Hole Mount through Pin in Paste Assembly

The pin in paste mount product is intended for forced convection or vapor phase reflow soldering in SnPb and Pb-free processes.

The reflow profile should be optimised to avoid excessive heating of the product. It is recommended to have a sufficiently extended preheat time to ensure an even temperature across the host PWB and it is also recommended to minimize the time in reflow.

A no-clean flux is recommended to avoid entrainment of cleaning fluids in cavities inside the product or between the product and the host board, since cleaning residues may affect long time reliability and isolation voltage.

A no-clean flux is recommended to avoid entrainment of cleaning fluids in cavities inside the product or between the product and the host board, since cleaning residues may affect long time reliability and isolation voltage.

General reflow process specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>SnPb eutectic</th>
<th>Pb-free</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average ramp-up (T_{PRODUCT})</td>
<td>3°C/s max</td>
<td>3°C/s max</td>
</tr>
<tr>
<td>Typical solder melting (liquidus) temperature (T_l)</td>
<td>183°C</td>
<td>221°C</td>
</tr>
<tr>
<td>Minimum reflow time above T_l</td>
<td>60 s</td>
<td>60 s</td>
</tr>
<tr>
<td>Minimum pin temperature (T_{PIN})</td>
<td>210°C</td>
<td>235°C</td>
</tr>
<tr>
<td>Peak product temperature (T_{PRODUCT})</td>
<td>225°C</td>
<td>280°C</td>
</tr>
<tr>
<td>Average ramp-down (T_{PRODUCT})</td>
<td>6°C/s max</td>
<td>6°C/s max</td>
</tr>
<tr>
<td>Maximum time 25°C to peak</td>
<td>6 minutes</td>
<td>8 minutes</td>
</tr>
</tbody>
</table>

Product reflow processes

SnPb solder processes

For SnPb solder processes, a pin temperature (T_{PIN}) in excess of the solder melting temperature (T_l, 183°C for Sn63Pb37) for more than 60 seconds and a peak temperature of 220°C is recommended to ensure a reliable solder joint.

For dry packed products only: depending on the type of solder paste and flux system used on the host board, up to a recommended maximum temperature of 245°C could be used, if the products are kept in a controlled environment (dry pack handling and storage) prior to assembly.

Lead-free (Pb-free) solder processes

For Pb-free solder processes, a pin temperature (T_{PIN}) in excess of the solder melting temperature (T_l, 217 to 221°C for SnAgCu solder alloys) for more than 60 seconds and a peak temperature of 245°C on all solder joints is recommended to ensure a reliable solder joint.

Dry Pack Information

Products intended for Pb-free reflow soldering processes are delivered in standard moisture barrier bags according to IPC/JEDEC standard J-STD-033 (Handling, packing, shipping and use of moisture/reflow sensitivity surface mount devices).

Using products in high temperature Pb-free soldering processes requires dry pack storage and handling. In case the products have been stored in an uncontrolled environment and no longer can be considered dry, floor life according to MSL 3, the modules must be baked according to J-STD-033.

Thermocoupler Attachment

T_{PRODUCT} is measured on the base plate top side, since this will likely be the warmest part of the product during the reflow process.

T_{PIN} temperature is measured on the power module pins solder joints at customer board.

Product reflow classification

The product has been tested for the following

Pb-free solder classification

For Pb-free solder processes, the product is qualified for MSL 3 according to IPC/JEDEC standard J-STD-020C.
**Soldering Information - Hole Mounting**

The hole mounted product is intended for plated through hole mounting by wave or manual soldering. The pin temperature is specified to maximum to 270°C for maximum 10 seconds.

A maximum preheat rate of 4°C/s and maximum preheat temperature of 150°C is suggested. When soldering by hand, care should be taken to avoid direct contact between the hot soldering iron tip and the pins for more than a few seconds in order to prevent overheating.

A no-clean flux is recommended to avoid entrapment of cleaning fluids in cavities inside the product or between the product and the host board. The cleaning residues may affect long time reliability and isolation voltage.

**Delivery Package Information**

The products are delivered in antistatic polystyrene trays and in antistatic PE foam trays.

---

### Tray Specifications – Through hole pin in paste & base plate version (both dry pack)

<table>
<thead>
<tr>
<th>Material</th>
<th>Antistatic Polystyrene (black)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface resistance</td>
<td>$10^5 &lt; \text{Ohm/square} &lt; 10^{11}$</td>
</tr>
<tr>
<td>Bakability</td>
<td>The trays cannot be baked</td>
</tr>
<tr>
<td>Tray thickness</td>
<td>25.8 mm 1.02 [inch] (TH PIP version)</td>
</tr>
<tr>
<td></td>
<td>25 mm 0.984 [inch] (Base plate version)</td>
</tr>
<tr>
<td>Box capacity</td>
<td>48 products (4 full trays/box)</td>
</tr>
<tr>
<td>Tray weight</td>
<td>56 g empty, 704 g full tray (TH PIP)</td>
</tr>
<tr>
<td></td>
<td>58 g empty, 898 g full tray (Base plate)</td>
</tr>
</tbody>
</table>

---

JEDEC standard tray for 2x6 = 12 products.  
All dimensions in mm  
Tolerances: X.x ±0.26 [0.01], X.xx ±0.13 [0.005]  
Note: pick up positions refer to center of pocket.  
See mechanical drawing for exact location on product.
### Tray Specifications – Through hole version & BP version without dry pack

<table>
<thead>
<tr>
<th>Material</th>
<th>PE Foam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface resistance</td>
<td>$10^5 &lt; \text{Ohm/square} &lt; 10^{11}$</td>
</tr>
<tr>
<td>Bakability</td>
<td>The trays are not bakeable</td>
</tr>
<tr>
<td>Tray capacity</td>
<td>20 converters/tray</td>
</tr>
<tr>
<td>Box capacity</td>
<td>60 products (3 full trays/box)</td>
</tr>
<tr>
<td>Weight</td>
<td>Product – Open frame 1100 g full tray, 140g empty tray 1480 g full tray, 140 g empty tray</td>
</tr>
</tbody>
</table>

### Tray Specifications – base plate version (dry pack, pick & place) (“H” option)

<table>
<thead>
<tr>
<th>Material</th>
<th>Antistatic PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface resistance</td>
<td>$10^5 &lt; \text{Ohm/square} &lt; 10^{11}$</td>
</tr>
<tr>
<td>Bakability</td>
<td>The trays can be baked at maximum 125°C for 48 hours</td>
</tr>
<tr>
<td>Tray capacity</td>
<td>10 converters/tray</td>
</tr>
<tr>
<td>Box capacity</td>
<td>40 products (4 full trays/box)</td>
</tr>
<tr>
<td>Weight</td>
<td>220 g empty, 1050 g full tray (Base plate)</td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters

**Input**: 45-56 V, **Output up to**: 96.2 A / 1000 W

---

**Product Qualification Specification**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>External visual inspection</td>
<td>IPC-A-610</td>
</tr>
<tr>
<td>Change of temperature (Temperature cycling)</td>
<td>IEC 60068-2-14 Na</td>
</tr>
<tr>
<td>Cold (in operation)</td>
<td>IEC 60068-2-1 Ad</td>
</tr>
<tr>
<td>Damp heat</td>
<td>IEC 60068-2-67 Cy</td>
</tr>
<tr>
<td>Dry heat</td>
<td>IEC 60068-2-2 Bd</td>
</tr>
<tr>
<td>Electrostatic discharge susceptibility</td>
<td>IEC 61340-3-1, JESD 22-A114</td>
</tr>
<tr>
<td>Immersion in cleaning solvents</td>
<td>IEC 60068-2-45 XA, method 2</td>
</tr>
<tr>
<td>Mechanical shock</td>
<td>IEC 60068-2-27 Ea</td>
</tr>
<tr>
<td>Moisture reflow sensitivity</td>
<td>J-STD-020E</td>
</tr>
<tr>
<td>Operational life test</td>
<td>MIL-STD-202G, method 108A</td>
</tr>
<tr>
<td>Resistance to soldering heat</td>
<td>IEC 60068-2-20 Tb, method 1A</td>
</tr>
<tr>
<td>Robustness of terminations</td>
<td>IEC 60068-2-21 Test Ua1</td>
</tr>
<tr>
<td>Solderability</td>
<td>IEC 60068-2-20 test Ta</td>
</tr>
<tr>
<td>Vibration, broad band random</td>
<td>IEC 60068-2-64 Fh, method 1</td>
</tr>
</tbody>
</table>

**Notes**

1. Only for products intended for reflow soldering (surface mount products & pin-in paste\(^3\) products)
2. Only for products intended for wave soldering (plated through hole products)
3. Pin-in paste refers to hole mounted products that utilize reflow soldering

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Technical Specification

BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

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**PMBus Command Appendix**

This appendix contains a detailed reference of the PMBus commands supported by the product.

**Data Formats**
The products make use of a few standardized numerical formats, along with custom data formats. A detailed walkthrough of the above formats is provided in AN304, as well as in sections 7 and 8 of the PMBus Specification Part II. The custom data formats vary depending on the command, and are detailed in the command description.

**Standard Commands**
The functionality of commands with code 0x00 to 0xCF is usually based on the corresponding command specification provided in the PMBus Standard Specification Part II (see Power System Management Bus Protocol Documents below). However there might be different interpretations of the PMBus Standard Specification or only parts of the Standard Specification applied, thus the detailed command description below should always be consulted.

**Forum Websites**
The System Management Interface Forum (SMIF)
http://www.powersig.org/
The System Management Interface Forum (SMIF) supports the rapid advancement of an efficient and compatible technology base that promotes power management and systems technology implementations. The SMIF provides a membership path for any company or individual to be active participants in any or all of the various working groups established by the implementer forums.

Power Management Bus Implementers Forum (PMBUS-IF)
http://pmbus.org/
The PMBUS-IF supports the advancement and early adoption of the PMBus protocol for power management. This website offers recent PMBus specification documents, PMBus articles, as well as upcoming PMBus presentations and seminars, PMBus Document Review Board (DRB) meeting notes, and other PMBus related news.

**PMBus – Power System Management Bus Protocol Documents**
These specification documents may be obtained from the PMBus-IF website described above. These are required reading for complete understanding of the PMBus implementation. This appendix will not re-address all of the details contained within the two PMBus Specification documents.

Specification Part I - General Requirements Transport And Electrical Interface
Includes the general requirements, defines the transport and electrical interface and timing requirements of hard wired signals.

Specification Part II - Command Language
Describes the operation of commands, data formats, fault management and defines the command language used with the PMBus.

**SMBus – System Management Bus Documents**
This specification specifies the version of the SMBus on which Revision 1.2 of the PMBus Specification is based. This specification is freely available from the System Management Interface Forum Web site at:
http://www.smbus.org/specs/
PMBus Command Summary and Factory Default Values of Standard Configuration

The factory default values provided in the table below are valid for the Standard configuration. Factory default values for other configurations can be found using the Ericsson Power Designer tool.

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Data Format</th>
<th>Factory Default Value</th>
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<td>INTERLEAVE</td>
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<td>R/W Word</td>
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## Technical Specification

**BMR480 series DC-DC Converters**  
Input 45-56 V, Output up to 96.2 A / 1000 W

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**BMR480 series DC-DC Converters**  
Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
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<th>Data Format</th>
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### PMBus Command Summary and Factory Default Values of Standard Configuration

The factory default values provided in the table below are valid for the Standard configuration. Factory default values for other configurations can be found using the Ericsson Power Designer tool.

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<tr>
<th>Code</th>
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<th>Data Format</th>
<th>Factory Default Value Standard Configuration BMR 480 XXXX/017 R1</th>
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<td>VOUT_MODE</td>
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<td>VOUT_COMMAND</td>
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<td>0x22</td>
<td>VOUT_TRIM</td>
<td>R/W Word</td>
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<td>VOUT_CAL_OFFSET</td>
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<td>VOUT_MAX</td>
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<td>VOUT_MARGIN_HIGH</td>
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<td>VOUT_MARGIN_LOW</td>
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<td>VOUT_TRANSITION_RATE</td>
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<td>VOUT_DROOP</td>
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<td>VIN_OFF</td>
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<td>IOUT_OC_WARN_LIMIT</td>
<td>R/W Word</td>
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<td>POWER_GOOD_ON</td>
<td>R/W Word</td>
<td>0x4000 8.0 V</td>
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<td>POWER_GOOD_OFF</td>
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<td>0x61</td>
<td>TON_RISE</td>
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<td>0x62</td>
<td>TON_MAX_FAULT_LIMIT</td>
<td>R/W Word</td>
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# Technical Specification

## BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
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<tr>
<th>Code</th>
<th>Name</th>
<th>Data Format</th>
<th>Factory Default Value</th>
<th>Standard Configuration</th>
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<tr>
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<tr>
<td>0xCA</td>
<td>MFR_MIN_DUTY</td>
<td>R/W Word</td>
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<tr>
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<td>MFR_ACTIVE.Clamp</td>
<td>Read Word</td>
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<td>R/W Byte</td>
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# Technical Specification

BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Data Format</th>
<th>Factory Default Value</th>
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<td>0xF1</td>
<td>MFR_SETUP_PASSWORD</td>
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<td>MFR_DISABLE_SECURITY_ONCE</td>
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<td>MFR_SECURITY_BIT_MASK</td>
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<td>MFR_TRANSFORMER_TURN</td>
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<td>MFR_RESTART</td>
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</table>
PMBus Command Details

**OPERATION (0x01)**
Transfer Type: R/W Byte
Description: Sets the desired PMBus enable and margin operations.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
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<tbody>
<tr>
<td>7:6</td>
<td>Enable</td>
<td>Make the device enable or disable.</td>
<td>00</td>
<td>Immediate Off</td>
<td>Disable Immediately without sequencing.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>Soft Off</td>
<td>Disable “Softly” with sequencing.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>Enable</td>
<td>Enable device to the desired margin state.</td>
</tr>
<tr>
<td>5:4</td>
<td>Margin</td>
<td>Select between margin high/low states or nominal output.</td>
<td>00</td>
<td>Nominal</td>
<td>Operate at nominal output voltage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>Margin Low</td>
<td>Operate at margin low voltage set in VOUT_MARGIN_LOW.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>Margin High</td>
<td>Operate at margin high voltage set in VOUT_MARGIN_HIGH.</td>
</tr>
<tr>
<td>3:2</td>
<td>Act on Fault</td>
<td>Set 10b to act on fault or set to 01b to ignore fault.</td>
<td>01</td>
<td>Ignore Faults</td>
<td>Ignore Faults when in a margined state. The device will ignore appropriate overvoltage/undervoltage warnings and faults and respond as programmed by the warning limit or fault response command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>Act on Faults</td>
<td>Act on Faults when in a margined state. The device will handle appropriate overvoltage/undervoltage warnings and faults and respond as programmed by the warning limit or fault response command.</td>
</tr>
</tbody>
</table>

**ON_OFF_CONFIG (0x02)**
Transfer Type: R/W Byte
Description: Configures how the device is controlled by the CONTROL pin and the PMBus.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Powerup Operation</td>
<td>Sets the default to either operate any time power is present or for the on/off to be controlled by CONTROL pin and serial bus commands.</td>
<td>0</td>
<td>Enable Always</td>
<td>Unit powers up any time power is present regardless of state of the CONTROL pin.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Enable pin or PMBus</td>
<td>Unit does not power up until commanded by the CONTROL pin and OPERATION command.</td>
</tr>
<tr>
<td>3</td>
<td>PMBus Enable Mode</td>
<td>Controls how the unit responds to commands received via the serial bus.</td>
<td>0</td>
<td>Ignore PMBus</td>
<td>Unit ignores the on/off portion of the OPERATION command from serial bus.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Use PMBus</td>
<td>To start, the unit requires that the on/off portion of the OPERATION command is instructing the unit to run.</td>
</tr>
<tr>
<td>2</td>
<td>Enable Pin Mode</td>
<td>Controls how the unit responds to the CONTROL pin.</td>
<td>0</td>
<td>Ignore pin</td>
<td>Unit ignores the CONTROL/Enable pin.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Use pin</td>
<td>Unit requires the CONTROL pin to be asserted to start the unit.</td>
</tr>
<tr>
<td>1</td>
<td>Enable Pin Polarity</td>
<td>Polarity of the CONTROL pin.</td>
<td>0</td>
<td>Active Low</td>
<td>Enable pin will cause device to enable when driven low.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Active High</td>
<td>Enable pin will cause device to enable when driven high.</td>
</tr>
</tbody>
</table>
BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Disable Action</td>
<td>CONTROL pin action when commanding the unit to turn off.</td>
<td>0</td>
<td>Soft Off</td>
<td>Use the programmed turn off delay and fall time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Imm. Off</td>
<td>Turn off the output and stop transferring energy to the output as fast as possible. The device’s product literature shall specify whether or not the device sinks current to decrease the output voltage fall time.</td>
</tr>
</tbody>
</table>

CLEAR_FAULTS (0x03)
Transfer Type: Send Byte
Description: Clears all fault status bits

WRITE_PROTECT (0x10)
Transfer Type: R/W Byte
Description: The WRITE_PROTECT command is used to control writing to the PMBus device. The intent of this command is to provide protection against accidental changes. This command is not intended to provide protection against deliberate or malicious changes to a device’s configuration or operation.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>All supported commands may have their parameters read, regardless of the WRITE_PROTECT settings.</td>
<td>0x80</td>
<td>Disable all writes except to the WRITE_PROTECT command.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x40</td>
<td>Enable operation except to the WRITE_PROTECT, OPERATION and PAGE commands.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x20</td>
<td>Enable control and Vout commands except to the WRITE_PROTECT, OPERATION, PAGE, ON_OFF_CONFIG and VOUT_COMMAND commands.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x00</td>
<td>Enable writes to all commands.</td>
<td></td>
</tr>
</tbody>
</table>

STORE_DEFAULT_ALL (0x11)
Transfer Type: Send Byte
Description: Commands the device to store its configuration into the Default Store.

RESTORE_DEFAULT_ALL (0x12)
Transfer Type: Send Byte
Description: Commands the device to restore its configuration from the Default Store.

STORE_USER_ALL (0x15)
Transfer Type: Send Byte
Description: Stores, at the USER level, all PMBus values that were changed since the last restore command.

RESTORE_USER_ALL (0x16)
Transfer Type: Send Byte
Description: Restores PMBus settings that were stored using STORE_USER_ALL. This command is automatically performed at power up.

CAPABILITY (0x19)
Transfer Type: Read Byte
Description: This command provides a way for a host system to determine some key capabilities of a PMBus device.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Packet Error</td>
<td>Packet error checking.</td>
<td>00</td>
<td>Not supported</td>
<td>Packet Error Checking not supported.</td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

#### Bit Function Description Value Function Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:5</td>
<td>Maximum Bus Speed</td>
<td>Maximum bus speed.</td>
<td>00</td>
<td>100kHz</td>
<td>Maximum supported bus speed is 100 kHz.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>400kHz</td>
<td>Maximum supported bus speed is 400 kHz.</td>
</tr>
<tr>
<td>3:0</td>
<td>Smbalert</td>
<td>SMBALERT</td>
<td>00</td>
<td>No Smbalert</td>
<td>The device does not have a SMBALERT# pin and does not support the SMBus Alert Response protocol.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>Have Smbalert</td>
<td>The device does have a SMBALERT# pin and does support the SMBus Alert Response protocol.</td>
</tr>
</tbody>
</table>

### VOUT_MODE (0x20)
Transfer Type: Read Byte
Description: Controls how future VOUT-related commands parameters will be interpreted.

#### Bit Function Description Value Function Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:0</td>
<td>Five bit two's complement EXPONENT for the MANTISSA delivered as the data bytes for VOUT_COMMAND in VOUT_LINEAR Mode, five bit VID code identifier per in VID Mode or always set to 00000b in Direct Mode.</td>
<td>000</td>
<td>Linear</td>
<td>Linear Mode Format.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>001</td>
<td>VID</td>
<td>VID Mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>010</td>
<td>Direct</td>
<td>Direct Mode.</td>
</tr>
</tbody>
</table>

### VOUT_COMMAND (0x21)
Transfer Type: R/W Word
Description: Commands the device to transition to a new output voltage.

<table>
<thead>
<tr>
<th>Bit Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0 Sets the nominal value of the output voltage.</td>
<td>Vout Mode Unsigned</td>
<td>V</td>
</tr>
</tbody>
</table>

### VOUT_TRIM (0x22)
Transfer Type: R/W Word
Description: Configures a fixed offset to be applied to the output voltage when enabled.

<table>
<thead>
<tr>
<th>Bit Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0 Sets VOUT trim value. The two bytes are formatted as a two's complement binary mantissa, used in conjunction with the exponent set in VOUT_MODE.</td>
<td>Vout Mode Signed</td>
<td>V</td>
</tr>
</tbody>
</table>

### VOUT_CAL_OFFSET (0x23)
Transfer Type: R/W Word
Description: Vout calibration value. It is a signed number in Vout linear mode. The setting will be applied output voltage.

<table>
<thead>
<tr>
<th>Bit Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0 Vout calibration value. It is a signed number in Vout linear mode. The setting will be applied output voltage.</td>
<td>Vout Mode Signed</td>
<td>V</td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

#### VOUT_MAX (0x24)
Transfer Type: R/W Word  
Description: Configures the maximum allowed output voltage.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the maximum possible value setting of VOUT. The maximum VOUT_MAX setting is 110% of the pin-strap setting.</td>
<td>Vout Mode</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VOUT_MARGIN_HIGH (0x25)
Transfer Type: R/W Word  
Description: Configures the target for margin-up commands.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the value of the VOUT during a margin high.</td>
<td>Vout Mode</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VOUT_MARGIN_LOW (0x26)
Transfer Type: R/W Word  
Description: Configures the target for margin-down commands.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the value of the VOUT during a margin low.</td>
<td>Vout Mode</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VOUT_TRANSITION_RATE (0x27)
Transfer Type: R/W Word  
Description: Configures the transition time for margins and VCOMMAND output changes.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the transition rate during margin or other change of VOUT.</td>
<td>Linear</td>
<td>V/ms</td>
</tr>
</tbody>
</table>

#### VOUT_DROOP (0x28)
Transfer Type: R/W Word  
Description: Configures the Isense voltage to load current ratio.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the effective load line (V/I slope) for the rail in which the device is used.</td>
<td>Linear</td>
<td>mV/A</td>
</tr>
</tbody>
</table>

#### VOUT_SCALE_LOOP (0x29)
Transfer Type: R/W Word  
Description: Gain of Vout EADC sense.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Gain of Vout EADC sense.</td>
<td>Direct</td>
<td></td>
</tr>
</tbody>
</table>

#### VOUT_SCALE_MONITOR (0x2A)
Transfer Type: R/W Word  
Description: Normally there is a voltage divider in the voltage sense circuit. The scale factor is represented by VOUT_SCALE_MONITOR.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Normally there is a voltage divider in the voltage sense circuit. The scale factor is represented by VOUT_SCALE_MONITOR.</td>
<td>Direct</td>
<td></td>
</tr>
</tbody>
</table>

#### MAX_DUTY (0x32)
Transfer Type: R/W Word  
Description: Configures the maximum allowed duty-cycle.
FREQUENCY_SWITCH (0x33)
Transfer Type: R/W Word
Description: Controls the switching frequency in 1kHz steps.

VIN_ON (0x35)
Transfer Type: R/W Word
Description: The VIN_ON command sets the value of the input voltage, in volts, at which the unit should start power conversion.

VIN_OFF (0x36)
Transfer Type: R/W Word
Description: The VIN_OFF command sets the value of the input voltage, in volts, at which the unit, once operation has started, should stop power conversion.

INTERLEAVE (0x37)
Transfer Type: R/W Word
Description: Configures the phase offset with respect to a common SYNC clock. When multiple product share a common DC input supply, spreading of the switching phases between the products can be utilized. This reduces the input capacitance requirements and efficency losses, since the peak current drawn from the input supply is effectively spread out over the whole switch period. If two or more units have their outputs connected in parallell, interleaving will reduce ripple currents. This requires that the products are synchronized using the SYNC pin.

IOUT_CAL_OFFSET (0x39)
Transfer Type: Read Word
Description: Sets the current-sense offset.

VOUT_OV_FAULT_LIMIT (0x40)
Transfer Type: R/W Word
Description: Output over voltage fault limit.

VOUT_OV_FAULT_RESPONSE (0x41)
Transfer Type: R/W Byte
Description: Output over voltage fault response.
<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>Response</td>
<td>Describes the device interruption operation. 00b - The PMBus device continues operation without interruption. 01b - The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). 10b - The device shuts down (disables the output) and responds according to the Retry Setting in bits [5:3]. 11b - The device’s output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists.</td>
<td>00</td>
<td>Ignore Fault</td>
<td>The PMBus device continues operation without interruption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>Perform Retries</td>
<td>The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>Disable and retry</td>
<td>The device shuts down (disables the output) and responds according to the retry setting in bits [5:3].</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>Disable until Fault Cleared</td>
<td>A fault can be cleared in several ways: The bit is individually cleared, The device receives a CLEAR_FAULTS command, a RESET signal (if one exists) is asserted, the output is commanded through the CTRL pin, the OPERATION command, or the combined action of the CTRL pin and OPERATION command, to turn off and then to turn back on, or Bias power is removed from the PMBus device.</td>
</tr>
<tr>
<td>5:3</td>
<td>Retries</td>
<td>The device attempts to restart the number of times set by these bits. 000b means the device does not attempt a restart. 111b means the device attempts restarting continuously.</td>
<td>00</td>
<td>Do Not Retry</td>
<td>A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>001</td>
<td>Retry Once</td>
<td>The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>010</td>
<td>Retry Twice</td>
<td>The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
</tbody>
</table>
## Bit | Function | Description
--- | --- | ---
011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.

100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.

101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.

110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.

111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down.

### 2:0 Retry Time and Delay Time
Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xD2.

<table>
<thead>
<tr>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
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<tr>
<td>8</td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
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<tr>
<td>12</td>
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<td>32</td>
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<tr>
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</tr>
</tbody>
</table>

VOUT_OV_WARN_LIMIT (0x42)
Transfer Type: R/W Word
Description: Output over voltage warning limit.
### BMR480 series DC-DC Converters

*Input 45-56 V, Output up to 96.2 A / 1000 W*

#### VOUT_UV_WARN_LIMIT (0x43)
Transfer Type: R/W Word  
Description: Output under voltage warning limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Output under voltage warning limit.</td>
<td>Vout Mode</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VOUT_UV_FAULT_LIMIT (0x44)
Transfer Type: R/W Word  
Description: Output under voltage fault limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Output under voltage fault limit.</td>
<td>Vout Mode</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VOUT_UV_FAULT_RESPONSE (0x45)
Transfer Type: R/W Byte  
Description: Output under voltage fault response.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>Response</td>
<td>Describes the device interruption operation. 00b - The PMBus device continues operation without interruption. 01b - The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). 10b - The device shuts down (disables the output) and responds according to the Retry Setting in bits [5:3]. 11b - The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists.</td>
<td></td>
<td>Ignore Fault</td>
<td>The PMBus device continues operation without interruption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Perform Retries while Operating</td>
<td>The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Disable and retry</td>
<td>The device shuts down (disables the output) and responds according to the retry setting in bits [5:3].</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Disable until Fault Cleared</td>
<td>A fault can be cleared in several ways: The bit is individually cleared. The device receives a CLEAR_FAULTS command, a RESET signal (if one exists) is asserted, the output is commanded through the CTRL pin, the OPERATION command, or the combined action of the CTRL pin and OPERATION command, to turn off and turn back on, or Bias power is removed from the PMBus device.</td>
</tr>
<tr>
<td>5:3</td>
<td>Retries</td>
<td></td>
<td>000</td>
<td>Do Not Retry</td>
<td>A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7).</td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>Retry 1</td>
<td>The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>001</td>
<td>Retry Once</td>
<td>The device attempts to restart the number of times set by these bits. 000b means the device does not attempt a restart. 111b means the device attempts restarting continuously.</td>
</tr>
<tr>
<td>010</td>
<td>Retry Twice</td>
<td>The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>011</td>
<td>Retry 3 times</td>
<td>The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>100</td>
<td>Retry 4 times</td>
<td>The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>101</td>
<td>Retry 5 times</td>
<td>The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>110</td>
<td>Retry 6 times</td>
<td>The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
</tbody>
</table>
# BMR480 Series DC-DC Converters

**Input** 45-56 V, **Output** up to 96.2 A / 1000 W

## Technical Specification

### BMR480 Series DC-DC Converters

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>Retry</td>
<td>The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down.</td>
</tr>
</tbody>
</table>

#### Bit 2:0 Retry Time and Delay Time

| Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xD2. |

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
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<tr>
<td>2</td>
<td>4</td>
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<tr>
<td>3</td>
<td>8</td>
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<tr>
<td>4</td>
<td>16</td>
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<tr>
<td>5</td>
<td>32</td>
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<tr>
<td>6</td>
<td>64</td>
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<tr>
<td>7</td>
<td>128</td>
</tr>
</tbody>
</table>

### IOUT_OC_FAULT_LIMIT (0x46)

**Transfer Type:** R/W Word  
**Description:** Output over current limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Output over current fault limit.</td>
<td>Linear</td>
<td>A</td>
</tr>
</tbody>
</table>

### IOUT_OC_FAULT_RESPONSE (0x47)

**Transfer Type:** R/W Byte  
**Description:** Output over current fault response.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>Response</td>
<td>For all values of bits [7:6], the device: Sets the corresponding fault bit in the status registers and if the device supports notifying the host, it does so.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>00</td>
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<tr>
<td></td>
<td></td>
<td>01</td>
</tr>
</tbody>
</table>
## BMR480 series DC-DC Converters

**Input**: 45-56 V, **Output**: up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Delay w/ Const. Current &amp; Retry</td>
<td>The PMBus device continues to operate, maintaining the output current at the value set by <code>IOUT_OC_FAULT_LIMIT</code> without regard to the output voltage, for the delay time set by bits [2:0] and the delay time units for specified in the <code>IOUT_OC_FAULT_RESPONSE</code>. If the device is still operating in current limiting at the end of the delay time, the device responds as programmed by the Retry Setting in bits [5:3].</td>
<td></td>
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</tr>
<tr>
<td>11</td>
<td>Disable and Retry</td>
<td>The PMBus device shuts down and responds as programmed by the Retry Setting in bits [5:3].</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5:3</td>
<td>Retries</td>
<td>The device attempts to restart the number of times set by these bits. 000b means the device does not attempt a restart. 111b means the device attempts restarting continuously.</td>
<td>000</td>
<td>Do Not Retry</td>
<td>A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>001</td>
<td>Retry Once</td>
<td>The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>010</td>
<td>Retry Twice</td>
<td>The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>011</td>
<td>Retry 3 times</td>
<td>The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>Retry 4 times</td>
<td>The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

#### Technical Specification

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Retry</td>
<td>The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>110</td>
<td>Retry</td>
<td>The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>111</td>
<td>Retry</td>
<td>The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down.</td>
</tr>
</tbody>
</table>

#### 2:0 Retry Time and Delay Time

Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xD2.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>7</td>
<td>128</td>
<td>128</td>
</tr>
</tbody>
</table>

#### IOUT_OC_LV_FAULT_LIMIT (0x48)

Transfer Type: R/W Word
Description: Set the output over-current low-voltage fault threshold.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Set the output over-current low-voltage fault threshold.</td>
<td>Vout Mode Unsigned</td>
<td>V</td>
</tr>
</tbody>
</table>

#### IOUT_OC_WARN_LIMIT (0x4A)

Transfer Type: R/W Word
Description: Output over current warning limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Output over current warning limit.</td>
<td>Linear</td>
<td>A</td>
</tr>
</tbody>
</table>

#### OT_FAULT_LIMIT (0x4F)

Transfer Type: R/W Word
Description: Over temperature fault limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Over temperature fault limit.</td>
<td>Linear</td>
<td>°C</td>
</tr>
</tbody>
</table>
OT_FAULT_RESPONSE (0x50)
Transfer Type: R/W Byte
Description: Over temperature fault response.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>Response</td>
<td>00  Ignore Fault The PMBus device continues operation without interruption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>01  Perform Retries while Operating The PMBus device continues operation for</td>
</tr>
<tr>
<td></td>
<td></td>
<td>delay time specified by bits [2:0] and the delay time unit specified for that</td>
</tr>
<tr>
<td></td>
<td></td>
<td>particular fault. If the fault condition is still present at the end of the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>delay time, the unit responds as programmed in the Retry Setting (bits [5:3])</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10  Disable and retry The device shuts down (disables the output) and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>responds according to the retry setting in bits [5:3].</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11  Disable until Fault Cleared A fault can cleared in several ways: The bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>is individually cleared, The device receives a CLEAR_FAULTS command, a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RESET signal (if one exists) is asserted, the output is commanded through</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the CTRL pin, the OPERATION command, or the combined action of the CTRL pin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and OPERATION command, to turn off and then to turn back on, or Bias power</td>
</tr>
<tr>
<td></td>
<td></td>
<td>is removed from the PMBus device.</td>
</tr>
</tbody>
</table>

| 5:3  | Retries        | 000  Do Not Retry A zero value for the Retry Setting means that the unit     |
|      |                | does not attempt to restart. The output remains disabled until the fault is   |
|      |                | cleared (Section 10.7).                                                     |
|      |                | 001  Retry Once The PMBus device attempts to restart 1 time. If the device   |
|      |                | fails to restart, it disables the output and remains off until the fault is   |
|      |                | cleared as described in Section 10.7. The time between the start of each     |
|      |                | attempt to restart is set by the value in bits [2:] along with the delay     |
|      |                | time unit specified for that particular fault.                              |
|      |                | 010  Retry Twice The PMBus device attempts to restart 2 times. If the device  |
|      |                | fails to restart, it disables the output and remains off until the fault is   |
|      |                | cleared as described in Section 10.7. The time between the start of each     |
|      |                | attempt to restart is set by the value in bits [2:] along with the delay     |
|      |                | time unit specified for that particular fault.                              |
## BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function and Delay Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xD2.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>011</td>
<td>Retry 3 times</td>
<td>The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>100</td>
<td>Retry 4 times</td>
<td>The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>101</td>
<td>Retry 5 times</td>
<td>The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>110</td>
<td>Retry 6 times</td>
<td>The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>111</td>
<td>Retry Continuously</td>
<td>The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2:0</th>
<th>Retry Time and Delay Time</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td></td>
</tr>
</tbody>
</table>

**OT_WARN_LIMIT (0x51)**

Transfer Type: R/W Word

Description: Over temperature warning limit.
# Technical Specification

## BMR480 series DC-DC Converters

**Input**: 45-56 V, **Output**: up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Over temperature warning limit.</td>
<td>Linear</td>
<td>°C</td>
</tr>
</tbody>
</table>

**UT_WARN_LIMIT (0x52)**

Transfer Type: R/W Word

Description: Under temperature warning limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Under temperature warning limit.</td>
<td>Linear</td>
<td>°C</td>
</tr>
</tbody>
</table>

**UT_FAULT_LIMIT (0x53)**

Transfer Type: R/W Word

Description: Under temperature fault limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Under temperature fault limit.</td>
<td>Linear</td>
<td>°C</td>
</tr>
</tbody>
</table>

**UT_FAULT_RESPONSE (0x54)**

Transfer Type: R/W Byte

Description: Under temperature fault response.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>Response</td>
<td>Ignore Fault</td>
<td>00</td>
<td>Ignore Fault</td>
<td>The PMBus device continues operation without interruption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perform Retries while Operating</td>
<td>01</td>
<td>Perform Retries</td>
<td>The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disable and retry</td>
<td>10</td>
<td>Disable and retry</td>
<td>The device shuts down (disables the output) and responds according to the retry setting in bits [5:3].</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disable until Fault Cleared</td>
<td>11</td>
<td>Disable until Fault Cleared</td>
<td>A fault can cleared in several ways: The bit is individually cleared, The device receives a CLEAR_FAULTS command, a RESET signal (if one exists) is asserted, the output is commanded through the CTRL pin, the OPERATION command, or the combined action of the CTRL pin and OPERATION command, to turn off and then to turn back on, or Bias power is removed from the PMBus device.</td>
</tr>
<tr>
<td>5:3</td>
<td>Retries</td>
<td>Do Not Retry</td>
<td>000</td>
<td>Do Not Retry</td>
<td>A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7).</td>
</tr>
</tbody>
</table>
## BMR480 series DC-DC Converters

**Input**: 45-56 V, **Output**: up to 96.2 A / 1000 W

### Technical Specification

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Retry Once</td>
<td>The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>010</td>
<td>Retry Twice</td>
<td>The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>011</td>
<td>Retry 3 times</td>
<td>The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>100</td>
<td>Retry 4 times</td>
<td>The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>101</td>
<td>Retry 5 times</td>
<td>The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>110</td>
<td>Retry 6 times</td>
<td>The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
</tbody>
</table>
## BMR480 series DC-DC Converters

**Input:** 45-56 V, **Output:** up to 96.2 A / 1000 W

### Technical Specification

28701-BMR480 0100 Rev A March 2019

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### Bit Function Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>Retry Continuously</td>
<td>The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down.</td>
</tr>
</tbody>
</table>

### 2:0 Retry Time and Delay Time

Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xD2.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
</tr>
</tbody>
</table>

### VIN_OV_FAULT_LIMIT (0x55)

Transfer Type: R/W Word

Description: Input over voltage fault limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Input over voltage fault limit.</td>
</tr>
</tbody>
</table>

### Format | Unit
---|---
Linear | V

### VIN_OV_FAULT_RESPONSE (0x56)

Transfer Type: R/W Byte

Description: Input over voltage fault response.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Ignore Fault</td>
<td>The PMBus device continues operation without interruption.</td>
</tr>
<tr>
<td>01</td>
<td>Perform Retries while Operating</td>
<td>The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]).</td>
</tr>
<tr>
<td>10</td>
<td>Disable and retry</td>
<td>The device shuts down (disables the output) and responds according to the retry setting in bits [5:3].</td>
</tr>
<tr>
<td>11</td>
<td>Disable until Fault Cleared</td>
<td>A fault can cleared in several ways: The bit is individually cleared, The device receives a CLEAR_FAULTS command, a RESET signal (if one exists) is asserted, the output is commanded through the CTRL pin, the OPERATION command, or the combined action of the CTRL pin and OPERATION command, to turn off and then to turn back on, or Bias power is removed from the PMBus device.</td>
</tr>
</tbody>
</table>
## BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5:3</td>
<td>Retries</td>
<td></td>
<td>000</td>
<td>Do Not Retry</td>
<td>A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>001</td>
<td>Retry Once</td>
<td>The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>010</td>
<td>Retry Twice</td>
<td>The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>011</td>
<td>Retry 3 times</td>
<td>The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>Retry 4 times</td>
<td>The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>101</td>
<td>Retry 5 times</td>
<td>The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>Retry 6 times</td>
<td>The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>Retry Continuously</td>
<td>The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2:0 Retry Time and Delay Time

Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xD2.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Linear</td>
<td>V</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Linear</td>
<td>V</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Linear</td>
<td>V</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Linear</td>
<td>V</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Linear</td>
<td>V</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Linear</td>
<td>V</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>Linear</td>
<td>V</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Linear</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VIN_OV_WARN_LIMIT (0x57)

Transfer Type: R/W Word
Description: Input over voltage warning limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Input over voltage warning limit.</td>
<td>Linear</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VIN_UV_WARN_LIMIT (0x58)

Transfer Type: R/W Word
Description: Input under voltage warning limit. This command set also the input voltage threshold for the HRR function (Hybrid Ratio Regulation). The HRR function is enabled with command MFR_SPECIAL_OPTIONS (0xE0).

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Input under voltage warning limit and/or HRR threshold.</td>
<td>Linear</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VIN_UV_FAULT_LIMIT (0x59)

Transfer Type: R/W Word
Description: Input under voltage fault limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Input under voltage fault limit.</td>
<td>Linear</td>
<td>V</td>
</tr>
</tbody>
</table>

#### VIN_UV_FAULT_RESPONSE (0x5A)

Transfer Type: R/W Byte
Description: Input under voltage fault response.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>Response</td>
<td></td>
<td>00</td>
<td>Ignore Fault</td>
<td>The PMBus device continues operation without interruption.</td>
</tr>
</tbody>
</table>
# BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Perform Retries while Operating</td>
<td>The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]).</td>
</tr>
<tr>
<td>10</td>
<td>Disable and retry</td>
<td>The device shuts down (disables the output) and responds according to the retry setting in bits [5:3].</td>
</tr>
<tr>
<td>11</td>
<td>Disable until Fault Cleared</td>
<td>A fault can cleared in several ways: The bit is individually cleared. The device receives a CLEAR_FAULTS command, a RESET signal (if one exists) is asserted, the output is commanded through the CTRL pin, the OPERATION command, or the combined action of the CTRL pin and OPERATION command, to turn off and then to turn back on, or Bias power is removed from the PMBus device.</td>
</tr>
</tbody>
</table>

5:3 Retries

<table>
<thead>
<tr>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>Do Not Retry</td>
<td>A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7).</td>
</tr>
<tr>
<td>001</td>
<td>Retry Once</td>
<td>The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>010</td>
<td>Retry Twice</td>
<td>The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>011</td>
<td>Retry 3 times</td>
<td>The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
</tbody>
</table>
### BMR480 Series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Retry 4 times</td>
<td>The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>101</td>
<td>Retry 5 times</td>
<td>The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>110</td>
<td>Retry 6 times</td>
<td>The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>111</td>
<td>Retry Continuously</td>
<td>The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down.</td>
</tr>
</tbody>
</table>

**2:0 Retry Time and Delay Time**

Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xD2.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
</tr>
</tbody>
</table>

**POWER_GOOD_ON (0x5E)**

Transfer Type: R/W Word

Description: Sets the output voltage threshold for asserting PG (Power Good).

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>The POWER_GOOD_ON command sets the output voltage at which an optional POWER_GOOD signal should be asserted.</td>
</tr>
</tbody>
</table>

**Format** | **Unit** |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vout Mode</td>
<td>V</td>
</tr>
</tbody>
</table>

**POWER_GOOD_OFF (0x5F)**

Transfer Type: R/W Word

Description: If the output voltage is lower than this one, negate power good if power good is enabled through MFR_MULTI_PIN_CONFIG and set the power good bit to 1 in PMBUS status.
## Technical Specification

### BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

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### Bit Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>If the output voltage is lower than this one, negate power good if power good is enabled through MFR_MULTI_PIN_CONFIG and set the power good bit to 1 in PMBUS status.</td>
<td>Vout Mode</td>
<td>V</td>
</tr>
</tbody>
</table>

### TON_DELAY (0x60)

Transfer Type: R/W Word

Description: Sets the turn-on delay time

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the delay time from ENABLE to start of VOUT rise.</td>
<td>Direct</td>
<td>ms</td>
</tr>
</tbody>
</table>

### TON_RISE (0x61)

Transfer Type: R/W Word

Description: Sets the turn-on transition time.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the rise time of VOUT after ENABLE and TON_DELAY.</td>
<td>Direct</td>
<td>ms</td>
</tr>
</tbody>
</table>

### TON_MAX_FAULT_LIMIT (0x62)

Transfer Type: R/W Word

Description: Sets an upper limit, in milliseconds, on how long the unit can attempt to power up the output without reaching the output undervoltage fault limit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>A value of 0 milliseconds means that there is no limit and that the unit can attempt to bring up the output voltage indefinitely.</td>
<td>Direct</td>
<td>ms</td>
</tr>
</tbody>
</table>

### TON_MAX_FAULT_RESPONSE (0x63)

Transfer Type: R/W Byte

Description: Only some of the response types are supported.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>Response</td>
<td></td>
<td>00</td>
<td>Ignore Fault</td>
<td>The PMBus device continues operation without interruption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>Perform Retries</td>
<td>The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>Disable and retry</td>
<td>The device shuts down (disables the output) and responds according to the retry setting in bits [5:3].</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>Disable until Fault Cleared</td>
<td>A fault can cleared in several ways: The bit is individually cleared, The device receives a CLEAR_FAULTS command, a RESET signal (if one exists) is asserted, the output is commanded through the CTRL pin, the OPERATION command, or the combined action of the CTRL pin and OPERATION command, to turn off and then to turn back on, or Bias power is removed from the PMBus device.</td>
</tr>
</tbody>
</table>
### Bit 5:3 Retries

<table>
<thead>
<tr>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>Do Not Retry</td>
<td>A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7).</td>
</tr>
<tr>
<td>001</td>
<td>Retry Once</td>
<td>The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>010</td>
<td>Retry Twice</td>
<td>The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>011</td>
<td>Retry 3 times</td>
<td>The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>100</td>
<td>Retry 4 times</td>
<td>The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>101</td>
<td>Retry 5 times</td>
<td>The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
</tbody>
</table>
# BMR480 series DC-DC Converters

**Input**: 45-56 V, **Output up to**: 96.2 A / 1000 W

## Bit Function Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>Retry 6 times</td>
<td>The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
</tr>
<tr>
<td>111</td>
<td>Retry Continuously</td>
<td>The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down.</td>
</tr>
</tbody>
</table>

### 2:0 Retry Time and Delay Time

Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0x02. TON_MAX_FAULT_RESPONSE time unit is referenced to VOUT_FAULT time unit.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
</tr>
</tbody>
</table>

### TOFF_DELAY (0x64)

**Transfer Type**: R/W Word  
**Description**: Sets the turn-off delay.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the delay time from DISABLE to start of VOUT fall.</td>
</tr>
</tbody>
</table>

### TOFF_FALL (0x65)

**Transfer Type**: R/W Word  
**Description**: Sets the turn-off transition time.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets the fall time for VOUT after DISABLE and TOFF_DELAY.</td>
</tr>
</tbody>
</table>

### TOFF_MAX_WARN_LIMIT (0x66)

**Transfer Type**: R/W Word  
**Description**: Sets an upper limit, in milliseconds, on how long the unit can attempt to power down the output without reaching 12.5% of the output voltage programmed at the time the unit is turned off.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>直接</td>
</tr>
</tbody>
</table>

### STATUS_BYTE (0x78)

**Transfer Type**: Read Byte  
**Description**: Returns a brief fault/warning status byte.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Off</td>
<td>This bit is asserted if the unit is not providing power to the output, regardless of the reason, including simply not being enabled.</td>
</tr>
<tr>
<td>5</td>
<td>An output overvoltage fault has occurred.</td>
<td></td>
</tr>
</tbody>
</table>

[Value] 0: No fault  
[Value] 1: Fault
### STATUS_WORD (0x79)
Transfer Type: Read Word
Description: Returns an extended fault/warning status byte.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Vout</td>
<td>An output voltage fault or warning has occurred.</td>
<td>0</td>
<td>No fault</td>
</tr>
<tr>
<td>14</td>
<td>Iout/Pout</td>
<td>An output current or output power fault or warning has occurred.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>13</td>
<td>Input</td>
<td>An input voltage, input current, or input power fault or warning has occurred.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>11</td>
<td>Power-Good</td>
<td>The Power-Good signal, if present, is negated.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>6</td>
<td>Off</td>
<td>This bit is asserted if the unit is not providing power to the output, regardless of the reason, including simply not being enabled.</td>
<td>0</td>
<td>No fault</td>
</tr>
<tr>
<td>5</td>
<td>Vout Overvoltage Fault</td>
<td>An output overvoltage fault has occurred.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>4</td>
<td>Iout Overcurrent Fault</td>
<td>An output overcurrent fault has occurred.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>3</td>
<td>Vin Undervoltage Fault</td>
<td>An input undervoltage fault has occurred.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>2</td>
<td>Temperature</td>
<td>A temperature fault or warning has occurred.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>1</td>
<td>Communication/Logic</td>
<td>A communications, memory or logic fault has occurred.</td>
<td>0</td>
<td>No fault</td>
</tr>
<tr>
<td>0</td>
<td>None of the Above</td>
<td>A fault or warning not listed in bits [7:1] has occurred.</td>
<td>0</td>
<td>No fault</td>
</tr>
</tbody>
</table>

### STATUS_VOUT (0x7A)
Transfer Type: Read Byte
Description: Returns Vout-related fault/warning status bits.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Vout Overvoltage Fault</td>
<td>Vout Overvoltage Fault.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>6</td>
<td>Vout Overvoltage Warning</td>
<td>Vout Overvoltage Warning.</td>
<td>0</td>
<td>No Warning</td>
</tr>
<tr>
<td>5</td>
<td>Vout Undervoltage Warning</td>
<td>Vout Undervoltage Warning.</td>
<td>0</td>
<td>No Warning</td>
</tr>
<tr>
<td>4</td>
<td>Vout Undervoltage Fault</td>
<td>Vout Undervoltage Fault.</td>
<td>0</td>
<td>No Fault</td>
</tr>
<tr>
<td>3</td>
<td>Vout Max Warning</td>
<td>Vout Max Warning (An attempt has been made to set the output voltage to value higher than allowed by the Vout Max command (Section 13.5).</td>
<td>0</td>
<td>No Warning</td>
</tr>
<tr>
<td>2</td>
<td>Ton Max Fault</td>
<td>Ton-Max Fault.</td>
<td>0</td>
<td>No Fault</td>
</tr>
</tbody>
</table>
# Technical Specification

## BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W 

### STATUS_IOUT (0x7B)
Transfer Type: Read Byte  
Description: Returns Iout-related fault/warning status bits.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function Description</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Iout Overcurrent Fault</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td>Iout Overcurrent Fault</td>
<td>1</td>
<td>Fault.</td>
</tr>
<tr>
<td>6</td>
<td>Iout Overcurrent and Low Voltage Fault</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td>Iout Overcurrent and low voltage fault.</td>
<td>1</td>
<td>Fault.</td>
</tr>
<tr>
<td>5</td>
<td>Iout Over Current Warning</td>
<td>0</td>
<td>No Warning.</td>
</tr>
<tr>
<td></td>
<td>Iout Overcurrent Warning.</td>
<td>1</td>
<td>Warning.</td>
</tr>
<tr>
<td>4</td>
<td>Iout Undercurrent Fault</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td>Iout Undercurrent Fault.</td>
<td>1</td>
<td>Fault.</td>
</tr>
</tbody>
</table>

### STATUS_INPUT (0x7C)
Transfer Type: Read Byte  
Description: Returns VIN/IIN-related fault/warning status bits.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function Description</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Vin Overvoltage Fault</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td>Vin Overvoltage Fault.</td>
<td>1</td>
<td>Fault.</td>
</tr>
<tr>
<td>6</td>
<td>Vin Overvoltage Warning</td>
<td>0</td>
<td>No Warning.</td>
</tr>
<tr>
<td></td>
<td>VIN Overvoltage Warning.</td>
<td>1</td>
<td>Warning.</td>
</tr>
<tr>
<td>5</td>
<td>Vin Undervoltage Warning</td>
<td>0</td>
<td>No Warning.</td>
</tr>
<tr>
<td></td>
<td>Vin Undervoltage Warning.</td>
<td>1</td>
<td>Warning.</td>
</tr>
<tr>
<td>4</td>
<td>Vin Undervoltage Fault</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td>Vin Undervoltage Fault.</td>
<td>1</td>
<td>Fault.</td>
</tr>
<tr>
<td>3</td>
<td>Insufficient Vin</td>
<td>0</td>
<td>No Insufficient VIN encountered yet.</td>
</tr>
<tr>
<td></td>
<td>Asserted when either the input voltage has never exceeded the input turn-on threshold Vin-On, or if the unit did start, the input voltage decreased below the turn-off threshold.</td>
<td>1</td>
<td>Insufficient Unit is off.</td>
</tr>
</tbody>
</table>

### STATUS_TEMPERATURE (0x7D)
Transfer Type: Read Byte  
Description: Returns the temperature-related fault/warning status bits.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function Description</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Overtemperature Fault</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td>Overtemperature Fault.</td>
<td>1</td>
<td>Fault.</td>
</tr>
<tr>
<td>6</td>
<td>Overtemperature Warning</td>
<td>0</td>
<td>No Warning.</td>
</tr>
<tr>
<td></td>
<td>Overtemperature Warning.</td>
<td>1</td>
<td>Warning.</td>
</tr>
<tr>
<td>5</td>
<td>Undertemperature Warning</td>
<td>0</td>
<td>No Warning.</td>
</tr>
<tr>
<td></td>
<td>Undertemperature Warning.</td>
<td>1</td>
<td>Warning.</td>
</tr>
<tr>
<td>4</td>
<td>Undertemperature Fault</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td>Undertemperature Fault.</td>
<td>1</td>
<td>Fault.</td>
</tr>
</tbody>
</table>

### STATUS_CML (0x7E)
Transfer Type: Read Byte  
Description: Returns Communication/Logic/Memory-related fault/warning status bits.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function Description</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Invalid Or Unsupported Command Received</td>
<td>0</td>
<td>No Invalid Command Received.</td>
</tr>
<tr>
<td></td>
<td>Invalid Or Unsupported Command Received.</td>
<td>1</td>
<td>Invalid Command Received.</td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Invalid Or Unsupported Data Received</td>
<td>Invalid Or Unsupported Data Received.</td>
<td>0</td>
<td>No Invalid Data Received.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Invalid Data Received.</td>
</tr>
<tr>
<td>5</td>
<td>Packet Error Check Failed</td>
<td>Packet Error Check Failed.</td>
<td>0</td>
<td>No Failure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Failure.</td>
</tr>
<tr>
<td>4</td>
<td>Memory Fault Detected</td>
<td>Memory Fault Detected.</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Fault.</td>
</tr>
<tr>
<td>1</td>
<td>Other Communication Fault</td>
<td>A communication fault other than the ones listed in this table has occurred.</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Fault.</td>
</tr>
<tr>
<td>0</td>
<td>Memory Or Logic Fault</td>
<td>Other Memory Or Logic Fault has occurred.</td>
<td>0</td>
<td>No Fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Fault.</td>
</tr>
</tbody>
</table>

#### READ_VIN (0x88)
Transfer Type: Read Word
Description: Returns the measured input voltage.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Returns the input voltage reading.</td>
<td>Linear</td>
<td>V</td>
</tr>
</tbody>
</table>

#### READ_VOUT (0x8B)
Transfer Type: Read Word
Description: Returns the measured output voltage.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Returns the measured output voltage.</td>
<td>Vout Mode Unsigned</td>
<td>V</td>
</tr>
</tbody>
</table>

#### READ_IOUT (0x8C)
Transfer Type: Read Word
Description: Returns the measured output current.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>The device will NACK this command when not enabled and not in the USER_CONFIG monitor mode.</td>
<td>Linear</td>
<td>A</td>
</tr>
</tbody>
</table>

#### READ_TEMPERATURE_1 (0x8D)
Transfer Type: Read Word
Description: Returns the measured temperature (internal).

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td></td>
<td>Linear</td>
<td>°C</td>
</tr>
</tbody>
</table>

#### READ_TEMPERATURE_2 (0x8E)
Transfer Type: Read Word
Description: Returns the measured temperature (internal).

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td></td>
<td>Linear</td>
<td>°C</td>
</tr>
</tbody>
</table>

#### READ_DUTY_CYCLE (0x94)
Transfer Type: Read Word
Description: Returns the measured duty cycle in percent.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Returns the target duty cycle during the ENABLE state. The device will NACK this command when not enabled and not in the USER_CONFIG monitor mode.</td>
<td>Linear</td>
<td>%</td>
</tr>
</tbody>
</table>
BMR480 series DC-DC Converters
Input 45-56 V, Output up to 96.2 A / 1000 W

READ_FREQUENCY (0x95)
Transfer Type: Read Word
Description: Returns the measured SYNC frequency.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Returns the measured operating switch frequency. The device will NACK this command when not enabled and not in the USER_CONFIG monitor mode.</td>
<td>Direct</td>
<td>kHz</td>
</tr>
</tbody>
</table>

PMBUS_REVISION (0x98)
Transfer Type: Read Byte
Description: Returns the PMBus revision number for this device.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:4</td>
<td>Part I Revision</td>
<td>Part I Revision.</td>
<td>0x0</td>
<td>1.0</td>
<td>Part I Revision 1.0.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x1</td>
<td>1.1</td>
<td>Part I Revision 1.1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x2</td>
<td>1.2</td>
<td>Part I Revision 1.2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x3</td>
<td>1.3</td>
<td>Part I Revision 1.3.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:0</td>
<td>Part II Revision</td>
<td>Part II Revision.</td>
<td>0x0</td>
<td>1.0</td>
<td>Part II Revision 1.0.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x1</td>
<td>1.1</td>
<td>Part II Revision 1.1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x2</td>
<td>1.2</td>
<td>Part II Revision 1.2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x3</td>
<td>1.3</td>
<td>Part II Revision 1.3.</td>
</tr>
</tbody>
</table>

MFR_ID (0x99)
Transfer Type: R/W Block (12 bytes)
Description: Sets the Manufacturers ID

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>95:0</td>
<td>Maximum of 12 characters.</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

MFR_MODEL (0x9A)
Transfer Type: R/W Block (20 bytes)
Description: Sets the MFR MODEL string.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>159:0</td>
<td>Maximum of 20 characters.</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

MFR_REVISION (0x9B)
Transfer Type: R/W Block (12 bytes)
Description: Sets the MFR revision string.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>95:0</td>
<td>Maximum of 12 characters.</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

MFR_LOCATION (0x9C)
Transfer Type: R/W Block (12 bytes)
Description: Sets the MFR location string.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>95:0</td>
<td>Maximum of 12 characters.</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

MFR_DATE (0x9D)
Transfer Type: R/W Block (12 bytes)
Description: This command returns the date the regulator was manufactured.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>95:0</td>
<td>Maximum of 12 characters.</td>
<td>ASCII</td>
</tr>
</tbody>
</table>
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**Technical Specification**

MFR_SERIAL (0x9E)
Transfer Type: R/W Block (20 bytes)
Description: This command returns a string of 13 characters and numbers that provides a unique identification of the regulator.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>159:0</td>
<td>Maximum of 20 characters.</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

USER_DATA_00 (0xB0)
Transfer Type: R/W Block (16 bytes)
Description: User data

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>127:0</td>
<td>16 bytes of user data.</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

MFR_VIN_OV_WARN_RESPONSE (0xC4)
Transfer Type: R/W Byte
Description: Input over voltage Warn response.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>Response</td>
<td></td>
<td>00</td>
<td>Ignore Fault</td>
<td>The PMBus device continues operation without interruption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>Perform Retries while Operating</td>
<td>The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]).</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Disable and retry</td>
<td>00</td>
<td>Do Not Retry</td>
<td>A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7).</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Disable until Fault Cleared</td>
<td>00</td>
<td>Do Not Retry</td>
<td>A fault can cleared in several ways: The bit is individually cleared, The device receives a CLEAR_FAULTS command, a RESET signal (if one exists) is asserted, the output is commanded through the CTRL pin, the OPERATION command, or the combined action of the CTRL pin and OPERATION command, to turn off and then to turn back on, or Bias power is removed from the PMBus device.</td>
</tr>
<tr>
<td>5:3</td>
<td>Retries</td>
<td></td>
<td>000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Bit Function Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Retry Once</td>
<td>The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
<td></td>
</tr>
<tr>
<td>010</td>
<td>Retry Twice</td>
<td>The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
<td></td>
</tr>
<tr>
<td>011</td>
<td>Retry 3 times</td>
<td>The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Retry 4 times</td>
<td>The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>Retry 5 times</td>
<td>The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>Retry 6 times</td>
<td>The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault.</td>
<td></td>
</tr>
</tbody>
</table>
### Bit 2:0 Retry Time and Delay Time

| Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xD2. |
|---|---|---|
| 0 | 1 |
| 1 | 2 |
| 2 | 4 |
| 3 | 8 |
| 4 | 16 |
| 5 | 32 |
| 6 | 64 |
| 7 | 128 |

### MFR_CONFIG_UNUSED_PINS (0xC5)

Transfer Type: R/W Word

Description: Define if pins are used (0) or unused (1). MSB defines if unused pins should be configured as input (0) or output low (1). If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low (mainly for backward compatibility).

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Mfr. FAULT2_CONFIG</td>
<td>If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low.</td>
<td>0</td>
<td>INPUT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>OUTPUT LOW</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Mfr. TMS_CONFIG</td>
<td>If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low.</td>
<td>0</td>
<td>INPUT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>OUTPUT LOW</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Mfr. TDI_CONFIG</td>
<td>If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low.</td>
<td>0</td>
<td>INPUT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>OUTPUT LOW</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Mfr. TDO_CONFIG</td>
<td>If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low.</td>
<td>0</td>
<td>INPUT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>OUTPUT LOW</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Mfr. DPWM3B_CONFIG</td>
<td>If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low.</td>
<td>0</td>
<td>INPUT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>OUTPUT LOW</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Mfr. DPWM3A_CONFIG</td>
<td>If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low.</td>
<td>0</td>
<td>INPUT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>OUTPUT LOW</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Mfr. DPWM2B_CONFIG</td>
<td>If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low.</td>
<td>0</td>
<td>INPUT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>OUTPUT LOW</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Mfr. ADC_EXT_TRIGGER_CONFIG</td>
<td>If an unused pin is defined as input the pin must be grounded. If an unused pin is not grounded it should be defined as output low.</td>
<td>0</td>
<td>INPUT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>OUTPUT LOW</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Mfr. Mfr. FAULT2_UTILIZATION</td>
<td>Define if pin is used or unused. Setting a pin to unused with this command overrides other configurations.</td>
<td>0</td>
<td>USED</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Unused</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>0</td>
<td>USED</td>
<td></td>
</tr>
</tbody>
</table>
## Technical Specification

**BMR480 series DC-DC Converters**  
Input 45-56 V, Output up to 96.2 A / 1000 W

### Bit Function Description | Value | Function Description |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mfr. Mfr. TMS UTILIZATION</td>
<td>Define if pin is used or unused. Setting a pin to unused with this command overrides other configurations.</td>
<td>1</td>
</tr>
<tr>
<td>Mfr. Mfr. TDI UTILIZATION</td>
<td>Define if pin is used or unused. Setting a pin to unused with this command overrides other configurations.</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>UNUSED</td>
</tr>
<tr>
<td>Mfr. Mfr. TDO UTILIZATION</td>
<td>Define if pin is used or unused. Setting a pin to unused with this command overrides other configurations.</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>USED</td>
</tr>
<tr>
<td>Mfr. Mfr. DPWM3B UTILIZATION</td>
<td>Define if pin is used or unused. Setting a pin to unused with this command overrides other configurations.</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>UNUSED</td>
</tr>
<tr>
<td>Mfr. Mfr. DPWM3A UTILIZATION</td>
<td>Define if pin is used or unused. Setting a pin to unused with this command overrides other configurations.</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>UNUSED</td>
</tr>
<tr>
<td>Mfr. Mfr. DPWM2B UTILIZATION</td>
<td>Define if pin is used or unused. Setting a pin to unused with this command overrides other configurations.</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>UNUSED</td>
</tr>
<tr>
<td>Mfr. Mfr. ADC_EXT_TRIG UTILIZATION</td>
<td>Define if pin is used or unused. Setting a pin to unused with this command overrides other configurations.</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>UNUSED</td>
</tr>
</tbody>
</table>

### MFR_RC_LEVEL (0xC6)
Transfer Type: R/W Byte  
Description: Set the Remote control threshold when connected to AD03

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>Sets the level for triggering the Remote control.</td>
<td>Fixed Point</td>
<td>V</td>
</tr>
</tbody>
</table>

### MFR_KS_PRETRIG (0xC7)
Transfer Type: R/W Byte  
Description: Value sets the time for pre-trigger a kickstart pulse. Value=0 equals approximately 20us, each unit adds 450ns to this value

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>Sets the time for pre-trigger a kickstart pulse. Value=0 equals approximately 20us, each unit adds 450ns to this value</td>
<td>Fixed Point</td>
<td>us</td>
</tr>
</tbody>
</table>

### MFR_FAST_VIN_OFF_OFFSET (0xC8)
Transfer Type: R/W Byte  
Description: Adds an offset to the fast VinOff criteria. The offset value is referenced to VinOff value. This is to shutdown the unit in a controlled fashion when Vin is falling fast.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>Adds an offset to the fast VinOff criteria.</td>
<td>Fixed Point</td>
<td>V</td>
</tr>
</tbody>
</table>

### MFR_PGOOD_POLARITY (0xD0)
Transfer Type: R/W Byte  
Description: Power good polarity (1:active high; 0: active low).
### BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

#### MFR_FAST_OCP_CFG (0xD1)
Transfer Type: R/W Word
Description: Set the fast OCP threshold

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>Power good polarity (1: active high; 0: active low).</td>
<td></td>
<td>0x00</td>
<td>Active Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x01</td>
<td>Active High</td>
<td></td>
</tr>
</tbody>
</table>

#### MFR_RESPONSE_UNIT_CFG (0xD2)
Transfer Type: R/W Byte
Description: Defines the basic units 1ms, 10ms, 100ms or 1 sec for each of the four basic responses Vout, Vin, Iout and Temperature. The Configured time is calculated as: Configured time = (Retry Time and Delay Time value in specific Fault response) x (unit in 0xD2)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:6</td>
<td>VOUT response delay unit</td>
<td>Set the fault response delay unit according to configured delay time for VOUT_OV_FAULT_RESPONSE and VOUT_UV_FAULT_RESPONSE.</td>
<td>0</td>
<td>1 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>10 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>100 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1 s/unit</td>
<td></td>
</tr>
<tr>
<td>5:4</td>
<td>Vin response delay unit</td>
<td>Set the fault response delay unit according to configured delay time for VIN_OV_FAULT_RESPONSE and VIN_UV_FAULT_RESPONSE.</td>
<td>0</td>
<td>1 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>10 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>100 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1 s/unit</td>
<td></td>
</tr>
<tr>
<td>3:2</td>
<td>IOUT response delay unit</td>
<td>Set the fault response delay unit according to configured delay time for IOUT_OC_FAULT_RESPONSE and IOUT_OC_FAULT_RESPONSE.</td>
<td>0</td>
<td>1 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>10 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>100 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1 s/unit</td>
<td></td>
</tr>
<tr>
<td>1:0</td>
<td>Temperature response delay unit</td>
<td>Set the fault response delay unit according to configured delay time for OT_FAULT_RESPONSE and UT_FAULT_RESPONSE.</td>
<td>0</td>
<td>1 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>10 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>100 ms/unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1 s/unit</td>
<td></td>
</tr>
</tbody>
</table>

#### MFR_VIN_SCALE_MONITOR (0xD3)
Transfer Type: Read Block (4 bytes)
Description: Vin Scale Monitor at ON and OFF.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>31:16</td>
<td>Mfr. Vin Scale Monitor on</td>
<td>Trimmed offset at ON</td>
<td>Byte Array</td>
</tr>
<tr>
<td>15:0</td>
<td>Mfr. Vin Scale Monitor Off</td>
<td>Trimmed Vin Scale at OFF</td>
<td>Byte Array</td>
</tr>
</tbody>
</table>

#### MFR_PREBIAS_DVDT_CFG (0xD4)
Transfer Type: R/W Block (8 bytes)
Description: Mfr. prebias dV/dt configuration
## BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

### Technical Specification

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>63:48</td>
<td>Mfr. Maximum allowable positive dVin/dt</td>
<td>This value state the max positive Vin change limit to execute a pre-bias start.</td>
<td>Fixed Point Signed</td>
<td>V/ms</td>
</tr>
<tr>
<td>47:32</td>
<td>Mfr. Maximum allowable negative dVin/dt</td>
<td>This value state the max negative Vin change limit to execute a pre-bias start.</td>
<td>Fixed Point Signed</td>
<td>V/ms</td>
</tr>
<tr>
<td>31:16</td>
<td>Mfr. Maximum allowable positive dVout/dt</td>
<td>This value state the max positive Vout change limit to execute a pre-bias start.</td>
<td>Fixed Point Signed</td>
<td>V/ms</td>
</tr>
<tr>
<td>15:0</td>
<td>Mfr. Maximum allowable negative dVout/dt</td>
<td>This value state the max negative Vout change limit to execute a pre-bias start.</td>
<td>Fixed Point Signed</td>
<td>V/ms</td>
</tr>
</tbody>
</table>

### MFR_FILTER_SELECT (0xD5)

Transfer Type: R/W Byte
Description: Filter coefficient selection

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>Filter coefficient selection with byte 1: 0 = Vout, 1 = Iout, VFF = 2</td>
<td>Integer Unsigned</td>
</tr>
</tbody>
</table>

### MFR_GET_SNAPSHOT (0xD7)

Transfer Type: Read Block (32 bytes)
Description: The MFR_GET_SNAPSHOT command is a 32-byte read-back of snapshot data values. When input voltage disappears during conversion the Snapshot functionality will automatically store this parametric data to NVM. If the snapshot data contains only FFh except for the counter, it means that the unit ramped up and then was commanded off before input voltage was removed.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>255:2</td>
<td>40</td>
<td>Snapshot Cycles</td>
<td>Integer Unsigned</td>
<td>Times</td>
</tr>
<tr>
<td>239:2</td>
<td>32</td>
<td>Manufacturer Specific Status Byte</td>
<td>Array</td>
<td></td>
</tr>
<tr>
<td>231:2</td>
<td>24</td>
<td>Status Other</td>
<td>Byte Array</td>
<td></td>
</tr>
<tr>
<td>223:2</td>
<td>16</td>
<td>Status CML</td>
<td>Byte Array</td>
<td></td>
</tr>
<tr>
<td>215:2</td>
<td>08</td>
<td>Status Temperature</td>
<td>Byte Array</td>
<td></td>
</tr>
<tr>
<td>207:2</td>
<td>00</td>
<td>Status Vin</td>
<td>Byte Array</td>
<td></td>
</tr>
<tr>
<td>199:1</td>
<td>92</td>
<td>Status Iout</td>
<td>Byte Array</td>
<td></td>
</tr>
<tr>
<td>191:1</td>
<td>84</td>
<td>Status Vout</td>
<td>Byte Array</td>
<td></td>
</tr>
<tr>
<td>183:1</td>
<td>76</td>
<td>Status Byte</td>
<td>Byte Array</td>
<td></td>
</tr>
<tr>
<td>175:1</td>
<td>60</td>
<td>Status Word</td>
<td>Byte Array</td>
<td></td>
</tr>
<tr>
<td>159:1</td>
<td>44</td>
<td>Time in operation</td>
<td>Integer Unsigned</td>
<td>seconds</td>
</tr>
<tr>
<td>143:1</td>
<td>28</td>
<td>Temperature 2</td>
<td>Linear</td>
<td>°C</td>
</tr>
<tr>
<td>127:1</td>
<td>12</td>
<td>Temperature 1</td>
<td>Linear</td>
<td>°C</td>
</tr>
<tr>
<td>111:9</td>
<td>6</td>
<td>Load Current</td>
<td>Linear</td>
<td>A</td>
</tr>
<tr>
<td>Bit</td>
<td>Function</td>
<td>Description</td>
<td>Format</td>
<td>Unit</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>95:80</td>
<td>Output Voltage</td>
<td>Output voltage.</td>
<td>Vout Mode</td>
<td>V</td>
</tr>
<tr>
<td>79:64</td>
<td>Input Voltage</td>
<td>Input voltage.</td>
<td>Linear</td>
<td>V</td>
</tr>
<tr>
<td>63:48</td>
<td>Duty Cycle Old</td>
<td>Duty cycle recorded during normal operation.</td>
<td>Linear</td>
<td>%</td>
</tr>
<tr>
<td>47:32</td>
<td>Load Current Old</td>
<td>Load current recorded during normal operation.</td>
<td>Linear</td>
<td>A</td>
</tr>
<tr>
<td>31:16</td>
<td>Output Voltage Old</td>
<td>Output voltage recorded during normal operation.</td>
<td>Vout Mode</td>
<td>V</td>
</tr>
<tr>
<td>15:0</td>
<td>Input Voltage Old</td>
<td>Input voltage recorded during normal operation.</td>
<td>Linear</td>
<td>V</td>
</tr>
</tbody>
</table>

**MFR_TEMP_COMPENSATION (0xD8)**

Transfer Type: Read Block (8 bytes)

Description: Mfr. temperature compensation parameter

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>63:56</td>
<td>Mfr. Temperature compensation</td>
<td>MFR_TEMP_COMPENSATION_DT_ADD_2 defines the additional dead time used at</td>
<td>Byte Array</td>
</tr>
<tr>
<td></td>
<td>deadtime added 2</td>
<td>temperature levels below temperature threshold 2. Unit is nano seconds. It’s</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>an unsigned byte, meaning the value can be 0-255.</td>
<td></td>
</tr>
<tr>
<td>55:48</td>
<td>Mfr. Temperature compensation</td>
<td>MFR_TEMP_COMPENSATION_DT_HYS_2 defines a level for hysteresis i.e. temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>deadtime hysteresis 2</td>
<td>rise over this level again before dead times are changed.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>47:40</td>
<td>Mfr. Temperature compensation</td>
<td>It is a signed byte with the temperature as an integer (°C). This defines a</td>
<td>Byte Array</td>
</tr>
<tr>
<td></td>
<td>deadtime threshold 2</td>
<td>second temperature level for temperature compensation of dead times.</td>
<td></td>
</tr>
<tr>
<td>39:32</td>
<td>Mfr. Temperature compensation</td>
<td>MFR_TEMP_COMPENSATION_DT_ADD_1 defines the additional dead time used at</td>
<td>Byte Array</td>
</tr>
<tr>
<td></td>
<td>deadtime added 1</td>
<td>temperature levels below temperature threshold 1. Unit is nano seconds. It’s</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>an unsigned byte, meaning the value can be 0-255.</td>
<td></td>
</tr>
<tr>
<td>31:24</td>
<td>Mfr. Temperature compensation</td>
<td>MFR_TEMP_COMPENSATION_DT_HYS_1 defines a level for hysteresis i.e. temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>deadtime hysteresis 1</td>
<td>rise over this level again before dead times are changed.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>23:16</td>
<td>Mfr. Temperature compensation</td>
<td>It is a signed byte with the temperature as an integer (°C). This defines the</td>
<td>Byte Array</td>
</tr>
<tr>
<td></td>
<td>deadtime threshold 1</td>
<td>first temperature level for temperature compensation of dead times.</td>
<td></td>
</tr>
<tr>
<td>15:8</td>
<td>Mfr. Temperature compensation</td>
<td>The second byte, TEMPERATURE_COMPENSATION_EDAC_SLOPE, sets the slope of the</td>
<td>Byte Array</td>
</tr>
<tr>
<td></td>
<td>EDAC slope</td>
<td>temperature compensation taking place above the EDAC_TEMP_COMP_TRESHOLD level.</td>
<td></td>
</tr>
</tbody>
</table>

Example: First byte represent 40°C so EDAC_TEMP_COMP_TRESHOLD = 40. Compensate EDAC with 25mV from 40°C to 120°C. The resolution is 1.6V/1024 = 1.56mV / LSB. To compensate for the 25mV droop over 80°C we need to add 25/80 = 0.3125mV/°C = 0.3125/1.56 LSB/°C = 0.2 LSB/°C to the reference DAC. 0.2*256 = 51 so EDAC_TEMP_COMP_SLOPE = 51
## BMR480 series DC-DC Converters

**Input:** 45-56 V, **Output:** up to 96.2 A / 1000 W

### Technical Specification

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>Mfr. Temperature compensation EDAC threshold</td>
<td>The first byte in the block is EDAC_TEMP_COMP_TRESHOLD. This defines the level where the temperature compensation shall begin. It is a signed byte with the temperature as an integer (°C). Example: First byte represent 40°C so EDAC_TEMP_COMP_TRESHOLD = 40. Compensate EDAC with 25mV from 40°C to 120°C. The resolution is 1.6V/1024 = 1.56mV/LSB. To compensate for the 25mV droop over 80°C we need to add 25/80 = 0.3125mV = 0.3125/1.56 LSB/°C to the reference DAC. 0.2*256 = 51 so EDAC_TEMP_COMP_SLOPE = 51</td>
<td>Byte Array</td>
</tr>
</tbody>
</table>

**MFR_SET_ROM_MODE (0xD9)**

Transfer Type: Write Block (4 bytes)

Description: Sends Block system into ROM mode. Issue this command before attempting to download new firmware to the controller.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>31:0</td>
<td>Sends system into ROM mode. Issue this command before attempting to download new firmware to the controller.</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

**MFR_ISHARE_THRESHOLD (0xDA)**

Transfer Type: R/W Block (8 bytes)

Description: Mfr. current sharing threshold level

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>31:24</td>
<td>Trim limit</td>
<td>Set the trim limit for output voltage. This limit the output voltage to be trimmed to a certain level to prevent max-trim if the controller sense erroneous current.</td>
<td>Integer</td>
<td>Unsigned</td>
</tr>
<tr>
<td>15:8</td>
<td>Positive threshold level</td>
<td>Set the threshold level where the output voltage is incremental trimmed to achieve current balance between paralleled device. The threshold level represent at what current level the output voltage start increasing. The hysteresis where no current balancing through CTRL pin is done is between the positive and negative threshold levels.</td>
<td>Integer</td>
<td>Unsigned</td>
</tr>
<tr>
<td>7:0</td>
<td>Negative threshold level</td>
<td>Set the threshold level where the output voltage is decremental trimmed to achieve current balance between paralleled device. The threshold level represent at what current level the output voltage start decreasing. The hysteresis where no current balancing through CTRL pin is done is between the positive and negative threshold levels.</td>
<td>Integer</td>
<td>Unsigned</td>
</tr>
</tbody>
</table>

**MFR_GET_RAMP_DATA (0xDB)**

Transfer Type: Read Block (32 bytes)

Description: The command MFR_GET_RAMP_DATA 0xDB retrieves 32 bytes of ramp data. 15 pairs of instant values of Vin and Vout are recorded during ramp and the interval is adjusted to the ramp time. The record counter value is recorded just before ramp. The record value is equal to last value of "snap shot cycles" + 1. This way it can be judged whether the ramp data was recorded before or after snap shot data. Only the first ramp in a power cycle will be recorded. Data is reset after a successful ramp up.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>Enable/Disable</td>
<td>Enable or disable Active Current share</td>
<td>0</td>
<td>Disable</td>
<td>Disables active current share</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Enable</td>
<td>Enables active current share</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>255:248</td>
<td>Vout 14</td>
<td></td>
<td>Integer Unsigned</td>
<td>V</td>
</tr>
<tr>
<td>247:240</td>
<td>Vin 14</td>
<td></td>
<td>Integer Unsigned</td>
<td>V</td>
</tr>
<tr>
<td>239:232</td>
<td>Vout 13</td>
<td></td>
<td>Integer Unsigned</td>
<td>V</td>
</tr>
<tr>
<td>231:224</td>
<td>Vin 13</td>
<td></td>
<td>Integer Unsigned</td>
<td>V</td>
</tr>
<tr>
<td>223:216</td>
<td>Vout 12</td>
<td></td>
<td>Integer Unsigned</td>
<td>V</td>
</tr>
</tbody>
</table>
## BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>215:2</td>
<td>Vin 12</td>
<td>Internal IC Sensor selected.</td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>207:2</td>
<td>Vout 11</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>199:1</td>
<td>Vin 11</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>191:1</td>
<td>Vout 10</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>183:1</td>
<td>Vin 10</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>175:1</td>
<td>Vout 9</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>167:1</td>
<td>Vin 9</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>159:1</td>
<td>Vout 8</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>151:1</td>
<td>Vin 8</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>143:1</td>
<td>Vout 7</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>135:1</td>
<td>Vin 7</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>127:1</td>
<td>Vout 6</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>119:1</td>
<td>Vin 6</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>111:1</td>
<td>Vout 5</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>103:9</td>
<td>Vin 5</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>95:88</td>
<td>Vout 4</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>87:80</td>
<td>Vin 4</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>79:72</td>
<td>Vout 3</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>71:64</td>
<td>Vin 3</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>63:56</td>
<td>Vout 2</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>55:48</td>
<td>Vin 2</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>47:40</td>
<td>Vout 1</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>39:32</td>
<td>Vin 1</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>31:24</td>
<td>Vout 0</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>23:16</td>
<td>Vin 0</td>
<td></td>
<td>Integer</td>
<td>V</td>
</tr>
<tr>
<td>15:0</td>
<td>Counter</td>
<td></td>
<td>Integer</td>
<td>Times</td>
</tr>
</tbody>
</table>

### MFR_SELECT_TEMPERATURE_SENSOR (0xDC)

**Transfer Type:** R/W Byte  
**Description:** Select which temperature sensor, internal one or external remote temperature sensor, is used.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Select which temperature sensor, internal one or external remote sensor</td>
<td>0</td>
<td>Internal IC Sensor</td>
<td>Internal IC temperature sensor selected.</td>
</tr>
</tbody>
</table>
### Technical Specification

#### BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

---

**MFR_VIN_OFFSET (0xDD)**

Transfer Type: Read Block (4 bytes)
Description: Vin offset at ON and OFF.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>31:16</td>
<td>Mfr. Vin Offset on</td>
<td>Trimmed offset at ON</td>
<td>Byte Array</td>
</tr>
<tr>
<td>15:0</td>
<td>Mfr. Vin Offset off</td>
<td>Trimmed offset at OFF</td>
<td>Byte Array</td>
</tr>
</tbody>
</table>

**MFR_VOUT_OFFSET_MONITOR (0xDE)**

Transfer Type: Read Word
Description: Output voltage trim

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Output voltage trim</td>
<td>Vout Mode</td>
<td>Signed</td>
</tr>
</tbody>
</table>

**MFR_GET_STATUS_DATA (0xDF)**

Transfer Type: Read Block (32 bytes)
Description: The command MFR_GET_STATUS_DATA 0xDF retrieves 32 bytes consisting of status words. The recording starts just after ramp has finished and continues during the first 128s after start up (16status word, 8s interval).

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>255:2</td>
<td>Status Word</td>
<td>Status word 15.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>40</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>239:2</td>
<td>Status Word</td>
<td>Status word 14.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>24</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>223:2</td>
<td>Status Word</td>
<td>Status word 13.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>08</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>207:1</td>
<td>Status Word</td>
<td>Status word 12.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>92</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>191:1</td>
<td>Status Word</td>
<td>Status word 11.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>76</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>175:1</td>
<td>Status Word</td>
<td>Status word 10.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>60</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>159:1</td>
<td>Status Word</td>
<td>Status word 9.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>44</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>143:1</td>
<td>Status Word</td>
<td>Status word 8.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>28</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>127:1</td>
<td>Status Word</td>
<td>Status word 7.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>12</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>111:9</td>
<td>Status Word</td>
<td>Status word 6.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95:80</td>
<td>Status Word</td>
<td>Status word 5.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>79:64</td>
<td>Status Word</td>
<td>Status word 4.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>63:48</td>
<td>Status Word</td>
<td>Status word 3.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>47:32</td>
<td>Status Word</td>
<td>Status word 2.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>31:16</td>
<td>Status Word</td>
<td>Status word 1.</td>
<td>Byte Array</td>
</tr>
<tr>
<td>15:0</td>
<td>Status Word</td>
<td>Status word 0.</td>
<td>Byte Array</td>
</tr>
</tbody>
</table>

**MFR_SPECIAL_OPTIONS (0xE0)**

Transfer Type: R/W Byte
Description: Special option configuration. Bit 0 - Reserved Bit 1 - Reserved Bit 2 - DBV: 0:Disabled 1:Enabled Bit 3 - ART/DLC: 0:Disabled 1:Enabled Bit 5 - DLS: 0:Linear droop 1:Non-linear droop Bit 6 - HRR: 0:Disabled 1:Enabled Bit 7 - Require PEC

---

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Technical Specification
# BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

## Technical Specification

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Require Packet Error Check</td>
<td>Enables/Disables Packet Error Check.</td>
<td>0</td>
<td>Disabled</td>
<td>1 Enabled</td>
</tr>
<tr>
<td>6</td>
<td>Enable HRR, (Hybrid Regulated Ratio)</td>
<td>Enables the HRR, Hybrid Regulation Ratio. This enables the unit to have a duty cycle head room where max duty cycle is avoided. The output voltage will follow the input voltage ratio, below the HRR threshold set in command VIN_UV_WARN_LIMIT (0x58).</td>
<td>0</td>
<td>Disabled</td>
<td>1 Enabled</td>
</tr>
<tr>
<td>5</td>
<td>DLS slope configuration</td>
<td>Setup how the slope of the Vout droop is configured, with linear or non-linear droop.</td>
<td>0</td>
<td>Linear droop</td>
<td>Configured with linear droop</td>
</tr>
<tr>
<td>4</td>
<td>Enable DBV, (Dynamic Bus Voltage)</td>
<td>Enables/Disables DBV.</td>
<td>0</td>
<td>Disabled</td>
<td>1 Enabled</td>
</tr>
<tr>
<td>3</td>
<td>Enable ART/DLC, (Adaptive Ramp-up Time, Dynamic Loop Compensation)</td>
<td>Enables/Disables ART/DLC.</td>
<td>0</td>
<td>Disabled</td>
<td>1 Enabled</td>
</tr>
<tr>
<td>2</td>
<td>Remote CTRL pin Enabled</td>
<td>PriRC Pin Enable: 0:Disabled 1:Enabled</td>
<td>0</td>
<td>Disabled</td>
<td>1 Enabled</td>
</tr>
<tr>
<td>1</td>
<td>Remote CTRL pin Polarity</td>
<td>PriRC Polarity: 0:Active Low 1:Active High</td>
<td>0</td>
<td>Active Low</td>
<td>1 Active High</td>
</tr>
<tr>
<td>0</td>
<td>Remote Ctrl On/Off</td>
<td>Primary Remote Control (RC Pin) configuration. Bit 0 - PriRC Disable Mode: 0:Soft-Stop 1:Quick Off</td>
<td>0</td>
<td>Soft Stop</td>
<td>Pre-configured ramp down time set TOFF_FALL.</td>
</tr>
</tbody>
</table>

### MFR_TEMP_OFFSET_INT (0xE1)
Transfer Type: Read Word
Description: Internal temperature offset.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Integer [0.1 °C]</td>
<td>Direct</td>
<td>°C</td>
</tr>
</tbody>
</table>

### MFR_REMOTE_TEMP_CAL (0xE2)
Transfer Type: Read Block (4 bytes)
Description: External temperature offset and slope.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>31:0</td>
<td>T(C) = slope x ADC(v) + offset, Byte 0 byte 1: offset, Byte 2 byte 3: slope.</td>
<td>Byte Array</td>
</tr>
</tbody>
</table>

### MFR_REMOTE_CTRL (0xE3)
Transfer Type: R/W Byte
Description: Primary Remote Control (RC pin) configuration.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>CTRL pin Interaction</td>
<td>PriRC is OR:ed with OPERATION and CTRL pin.</td>
<td>0</td>
<td>OR’ed w/ CTRL pin</td>
<td>1 PriRC is AND:ed with OPERATION and CTRL pin.</td>
</tr>
<tr>
<td>2</td>
<td>Remote CTRL pin Enabled</td>
<td>PriRC Pin Enable: 0:Disabled 1:Enabled</td>
<td>0</td>
<td>Disabled</td>
<td>1 Enabled</td>
</tr>
<tr>
<td>1</td>
<td>Remote CTRL pin Polarity</td>
<td>PriRC Polarity: 0:Active Low 1:Active High</td>
<td>0</td>
<td>Active Low</td>
<td>1 Active High</td>
</tr>
<tr>
<td>0</td>
<td>Remote Ctrl On/Off</td>
<td>PriRC Disable Mode: 0:Soft-Stop 1:Quick Off</td>
<td>0</td>
<td>Soft Stop</td>
<td>Pre-configured ramp down time set TOFF_FALL.</td>
</tr>
</tbody>
</table>
MFR_VFF_PARAMS (0xE6)
Transfer Type: R/W Block (4 bytes)
Description: This function is dependent of voltage levels internal to the control IC. It is not recommended to change the parameters Extra compensation, Vin stable threshold and Reference DAC threshold.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>31:24</td>
<td>Extra compensation threshold</td>
<td>Set a threshold where extra compensation of the VFF response is needed. The extra compensation cut the duty cycle with 50% during one period. Too low threshold creates false triggering with noisy output voltage.</td>
<td>Integer Unsigned</td>
</tr>
<tr>
<td>23:16</td>
<td>Vin stable threshold</td>
<td>Set a threshold where the input voltage is considered stable and a ready for new VFF response</td>
<td>Integer Unsigned</td>
</tr>
<tr>
<td>15:8</td>
<td>Reference DAC fast recover threshold</td>
<td>Below this threshold the reference DAC is adjusted one LSB each interrupt (~27us) otherwise it is adjusted 3 LSB.</td>
<td>Integer Unsigned</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Enable VFF, (Voltage Feed Forward)</td>
<td></td>
<td>0</td>
<td>Disabled</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

MFR_TEMP_COEFF (0xE7)
Transfer Type: Read Block (6 bytes)
Description: Temperature coefficient

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>47:40</td>
<td>Mfr. Temp level 2 Comp Factor</td>
<td>The temperature compensation factor for current sense above temperature level 2, used to compensate IOUT_READ value.</td>
<td>Integer Unsigned</td>
<td>°C</td>
</tr>
<tr>
<td>39:32</td>
<td>Mfr. Temp level 2 Comp</td>
<td>The second temperature level used to compensate IOUT_READ.</td>
<td>Integer Unsigned</td>
<td></td>
</tr>
<tr>
<td>31:24</td>
<td>Mfr. Temp level 1 Comp Factor</td>
<td>The temperature compensation factor for current sense above temperature level 1, used to compensate IOUT_READ value.</td>
<td>Integer Unsigned</td>
<td>°C</td>
</tr>
<tr>
<td>23:16</td>
<td>Mfr. Temp level 1 Comp</td>
<td>The first temperature level used to compensate IOUT_READ.</td>
<td>Integer Unsigned</td>
<td>°C</td>
</tr>
<tr>
<td>15:0</td>
<td>Mfr. Temp Coef Cu</td>
<td>The temperature coefficient for copper.</td>
<td>Direct</td>
<td></td>
</tr>
</tbody>
</table>

MFR_FILTER_COEFF (0xE8)
Transfer Type: R/W Block (27 bytes)
Description: Mfr. filter coefficients

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>215:2</td>
<td>CLA scale</td>
<td>Filter Misc Gain Coefficient: CLA SCALE</td>
<td>Integer Unsigned</td>
</tr>
<tr>
<td>210:2</td>
<td>yscale</td>
<td>Filter Misc Gain Coefficient: YN SCALE</td>
<td>Integer Unsigned</td>
</tr>
<tr>
<td>207:1</td>
<td>kcomp</td>
<td>Filter Misc Gain Coefficient: KCOMP</td>
<td>Integer Unsigned</td>
</tr>
<tr>
<td>175:1</td>
<td>KD alpha [0]</td>
<td>Filter Coefficient: KD alpha [0]</td>
<td>Integer Unsigned</td>
</tr>
<tr>
<td>127:1</td>
<td>KD coef [0]</td>
<td>Filter Coefficient: KD coef [0]</td>
<td>Integer Unsigned</td>
</tr>
</tbody>
</table>
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#### Bit Function Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>63:48</td>
<td>Kl coef [0]</td>
<td>Filter Coefficient: Kl coef [0]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:0</td>
<td>KP coef [0]</td>
<td>Filter Coefficient: KP coef [0]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### MFR_FILTER_NLR_GAIN (0xE9)

Transfer Type: R/W Block (16 bytes)

Description: Mfr. filter nlr gains

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>121:1</td>
<td>AFE Gain</td>
<td>AFE gain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95:80</td>
<td>limit5</td>
<td>Filter Coefficient: LIMIT 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79:64</td>
<td>limit4</td>
<td>Filter Coefficient: LIMIT 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63:48</td>
<td>limit3</td>
<td>Filter Coefficient: LIMIT 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47:32</td>
<td>limit2</td>
<td>Filter Coefficient: LIMIT 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31:16</td>
<td>limit1</td>
<td>Filter Coefficient: LIMIT 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:0</td>
<td>limit0</td>
<td>Filter Coefficient: LIMIT 0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Bit Function Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>127:1</td>
<td>Bin Configuration (6)</td>
<td>Bin Configuration (6)</td>
<td>0</td>
<td>Coef [0]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Coef [1]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Coef [2]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Coef [3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Coef [4]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Coef [5]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>Coef [6]</td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>Bin Alpha (6)</td>
<td>Bin Alpha (6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>NL Mode</td>
<td>NL Mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>Auto Gear Shift</td>
<td>Auto Gear Shift</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>119:1</td>
<td>Bin Configuration (4)</td>
<td>Bin Configuration (4)</td>
<td>0</td>
<td>Coef [0]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Coef [1]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Coef [2]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Coef [3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Coef [4]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Coef [5]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>Coef [6]</td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>Bin Alpha (4)</td>
<td>Bin Alpha (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115:1</td>
<td>Bin Configuration (5)</td>
<td>Bin Configuration (5)</td>
<td>0</td>
<td>Coef [0]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Coef [1]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Coef [2]</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Coef [3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Coef [4]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Coef [5]</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td>6</td>
<td>Coef [6]</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>Bin Alpha (5)</td>
<td>Bin Alpha (5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111:1</td>
<td>Bin Configuration (2)</td>
<td>Bin Configuration (2)</td>
<td>0</td>
<td>Coef [0]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Coef [1]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Coef [2]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Coef [3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Coef [4]</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Coef [5]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>Coef [6]</td>
<td></td>
</tr>
<tr>
<td>108</td>
<td>Bin Alpha (2)</td>
<td>Bin Alpha (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>107:1</td>
<td>Bin Configuration (3)</td>
<td>Bin Configuration (3)</td>
<td>0</td>
<td>Coef [0]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Coef [1]</td>
<td></td>
</tr>
</tbody>
</table>
## BMR480 series DC-DC Converters

Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>104</td>
<td>Bin Alpha (3)</td>
<td>Bin Alpha (3)</td>
<td>2</td>
<td>Coef [2]</td>
<td></td>
</tr>
<tr>
<td>103:1</td>
<td>Bin Configuration (0)</td>
<td>Bin Configuration (0)</td>
<td>3</td>
<td>Coef [3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Coef [4]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Coef [5]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>Coef [6]</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Bin Alpha (0)</td>
<td>Bin Alpha (0)</td>
<td>0</td>
<td>Coef [0]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Coef [1]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Coef [2]</td>
<td></td>
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<td></td>
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<td></td>
<td>3</td>
<td>Coef [3]</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Coef [4]</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Coef [5]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>Coef [6]</td>
<td></td>
</tr>
</tbody>
</table>

### MFR_MIN_DUTY (0xEB)

Transfer Type: R/W Word
Description: Set the minimum duty cycle and minimum deadtime at min duty.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:8</td>
<td>Mfr. Min duty</td>
<td></td>
<td>Integer</td>
<td>ns</td>
</tr>
<tr>
<td>7:0</td>
<td>Mfr. Minimum deadtime</td>
<td></td>
<td>Integer</td>
<td>ns</td>
</tr>
</tbody>
</table>

### MFR_ACTIVE_CLAMP (0xEC)

Transfer Type: Read Word
Description: Active clamp

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:8</td>
<td>Mfr. pulse delay</td>
<td>Set the delay of the pulse to the active clamp.</td>
<td>Integer</td>
<td>x4 ns</td>
</tr>
<tr>
<td>7:0</td>
<td>Mfr. pulse width</td>
<td>Set the pulse width to the active clamp.</td>
<td>Integer</td>
<td>x4 ns</td>
</tr>
</tbody>
</table>

### MFR_OFFSET_ADDRESS (0xEE)

Transfer Type: R/W Byte
Description: Value (n) add an offset to the address on SA0 pin when SA1 pin on the digital connector is used for synchronisation.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td></td>
<td>Integer</td>
<td>n + SA0</td>
</tr>
</tbody>
</table>
MFR_DBV_CONFIG (0xEF)
Transfer Type: R/W Block (6 bytes)
Description: Configuration of Dynamic Bus Voltage.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>47:40</td>
<td>Iout Level mid to high</td>
<td>Iout level mid to high transition.</td>
<td>Fixed Point Signed</td>
<td>A</td>
</tr>
<tr>
<td>39:32</td>
<td>Iout Level high to mid</td>
<td>Iout level high to mid transition.</td>
<td>Fixed Point Signed</td>
<td>A</td>
</tr>
<tr>
<td>31:24</td>
<td>Output Voltage Mid</td>
<td>Output Voltage Mid.</td>
<td>Fixed Point Signed</td>
<td>V</td>
</tr>
<tr>
<td>23:16</td>
<td>Iout Level low to mid</td>
<td>Iout level low to mid transition.</td>
<td>Fixed Point Signed</td>
<td>A</td>
</tr>
<tr>
<td>15:8</td>
<td>Iout Level mid to low</td>
<td>Iout level mid to low transition.</td>
<td>Fixed Point Signed</td>
<td>A</td>
</tr>
<tr>
<td>7:0</td>
<td>Output Voltage Low</td>
<td>Output Voltage Low.</td>
<td>Fixed Point Signed</td>
<td>V</td>
</tr>
</tbody>
</table>

MFR_DEBUG_BUFF (0xF0)
Transfer Type: R/W Block (8 bytes)
Description: Output contents in debug_buf.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>63:0</td>
<td>Output contents in debug_buf.</td>
<td>Byte Array</td>
</tr>
</tbody>
</table>

MFR_SETUP_PASSWORD (0xF1)
Transfer Type: R/W Block (12 bytes)
Description: Once a valid new password is sent, the security is turned on.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>95:0</td>
<td>A write is current password (6 bytes, default &quot;000000000000&quot;) + new password (6 bytes) A read returns: 0x00000000000000000000000000000000 if security is off 0x000000000000000000000000000000001 if security is on 0x000000000000000000000000000000002 if security setup is locked up due to incorrect password entry</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

MFR_DISABLE_SECURITY_ONCE (0xF2)
Transfer Type: R/W Block (6 bytes)
Description: When security is on, this command is used to temporarily disable the security before the next power reset of the digital PWM controller so that a host can send any command that is either write-protected or sendbyte-protected based on a security bit mask. When security is off, this command will be NACKed.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>47:0</td>
<td>A write is current password (after it was set up with MFR_SETUP_PASSWORD).</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

MFR_SECURITY_BIT_MASK (0xF4)
Transfer Type: Read Block (32 bytes)
Description: This command is used to individually enable or disable security feature for a write-protectable or sendbyte- protectable PMBUS command.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>255:0</td>
<td>When protection is enabled for a PMBUS command and when security is on, the PMBUS command is write-protected or send-byte-protected.</td>
<td>Byte Array</td>
</tr>
</tbody>
</table>

MFR_TRANSFORMER_TURN (0xF5)
Transfer Type: Read Byte
Description: Transformer turn ratio.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:4</td>
<td>Mfr. Primary Turn</td>
<td>Number of turn on the primary side of transformer.</td>
<td>Integer Unsigned</td>
</tr>
</tbody>
</table>
## Technical Specification

**BMR480 series DC-DC Converters**  
Input 45-56 V, Output up to 96.2 A / 1000 W

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:0</td>
<td>Mfr. secondary Turn</td>
<td>Number of turn on the secondary side of transformer.</td>
<td>Integer Unsigned</td>
</tr>
</tbody>
</table>

### MFR_OSC_TRIM (0xF6)
Transfer Type: Read Byte  
Description: Internal clock frequency trim value

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>Internal clock frequency trim value.</td>
<td>Integer Unsigned</td>
</tr>
</tbody>
</table>

### MFR_DLC_CONFIG (0xF7)
Transfer Type: R/W Block (8 bytes)  
Description: Configuration of Dynamic Loop Compensation at start up.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>63:56</td>
<td>Ramp Factor 3, (K3)</td>
<td>Ramp factor for third limit. The value in Ramp Factor 3 is multiplied with the TON_RISE value, to calculate a new TON_RISE slope. The new calculated slope will immediately act as TON_RISE</td>
<td>Fixed Point</td>
<td>Signed</td>
</tr>
<tr>
<td>55:48</td>
<td>Third Limit</td>
<td>Third limit for adjustment. When the capacitance estimation reaches over the third limit RAMP_FACTOR_3 is used and the PID setting in Bank 3 is chosen. To change PID settings in Bank 3, 0x0D must be set to 0x03 after that 0xE8 and 0xE9 can be adjusted.</td>
<td>Fixed Point</td>
<td>Signed</td>
</tr>
<tr>
<td>47:40</td>
<td>Ramp Factor 2, (K2)</td>
<td>Ramp factor for second limit. The value in Ramp Factor 2 is multiplied with the TON_RISE value, to calculate a new TON_RISE slope. The new calculated slope will immediately act as TON_RISE</td>
<td>Fixed Point</td>
<td>Signed</td>
</tr>
<tr>
<td>39:32</td>
<td>Second Limit</td>
<td>Second limit for adjustment. When the capacitance estimation reach over the second limit RAMP_FACTOR_2 is used.</td>
<td>Fixed Point</td>
<td>Signed</td>
</tr>
<tr>
<td>31:24</td>
<td>Ramp Factor 1, (K1)</td>
<td>Ramp factor for first limit. The value in Ramp Factor 1 is multiplied with the TON_RISE value, to calculate a new TON_RISE slope. The new calculated slope will immediately act as TON_RISE</td>
<td>Fixed Point</td>
<td>Signed</td>
</tr>
<tr>
<td>23:16</td>
<td>First Limit</td>
<td>First limit for adjustment. When the capacitance estimation reach over the first limit RAMP_FACTOR_1 is used.</td>
<td>Fixed Point</td>
<td>Signed</td>
</tr>
<tr>
<td>15:8</td>
<td>Voltage End</td>
<td>Set the end level on the Vout ramp ON for the output cap estimation measurement.</td>
<td>Fixed Point</td>
<td>Signed</td>
</tr>
<tr>
<td>7:0</td>
<td>Voltage Start</td>
<td>Set the start and end levels on the Vout ramp ON for the output cap estimation measurement.</td>
<td>Fixed Point</td>
<td>Signed</td>
</tr>
</tbody>
</table>

### MFR_ILIM_SOFTSTART (0xF8)
Transfer Type: R/W Byte  
Description: During soft start ILIM is more than the user setting. The value set in this command is in % added ILIM.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td></td>
<td>Integer Unsigned</td>
<td>%</td>
</tr>
</tbody>
</table>

### MFR_MULTI_PIN_CONFIG (0xF9)
Transfer Type: R/W Byte  
Description: The MFR_MULTI_PIN_CONFIG command can be re-configured to enable or disable different functions and set the pin configuration of the digital header (K400) (pin 6-15).

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:5</td>
<td>Sync Mode</td>
<td>These bits enables or disables the SYNC function. When enabling choose between SYNC OUT or SYNC IN.</td>
<td>00</td>
<td>Disabled</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>Sync in</td>
<td>When the product is configured to SYNC in it will synchronize its switching frequency to the product configured as SYNC out. The switching phases can be spread individually using the INTERLEAVE command 0x37</td>
</tr>
</tbody>
</table>
### BMR480 series DC-DC Converters

*Input 45-56 V, Output up to 96.2 A / 1000 W*

#### Technical Specification

© Flex

#### Bit Function Description

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function Description</th>
<th>Value</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Sync out</td>
<td></td>
<td></td>
<td>When the product is configured to SYNC out it will send out a SYNC signal that BMR458 products can connect its SYNC in pin. Only 1 product in a group can be configured to SYNC out.</td>
</tr>
<tr>
<td>3</td>
<td>SA1 as Sync</td>
<td></td>
<td></td>
<td>Change function of Pin 9 on the digital header (K400). This pin can be used as SA1 or SYNC in/out</td>
</tr>
<tr>
<td>2</td>
<td>Power Good Enable</td>
<td></td>
<td></td>
<td>This bit enable or disable the Power Good function</td>
</tr>
<tr>
<td>1</td>
<td>Power Good Output</td>
<td></td>
<td></td>
<td>Two output options is available for Power Good output, it is Push/Pull or Open Drain</td>
</tr>
<tr>
<td>0</td>
<td>CTRL Internal Resistor</td>
<td></td>
<td></td>
<td>Using CTRL internal resistor can be useful if no external pull up or pull down resistor exist or no Digital header (K400) is mounted.</td>
</tr>
</tbody>
</table>

#### MFR_ADDED_DROOP_DURING_RAMP (0xFC)

Transfer Type: R/W Word

Description: Set an added droop during ramp.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:0</td>
<td>Sets an added effective load line (V/I slope) for the rail in which the device is used, during ramp up.</td>
<td>Linear</td>
<td>mV/A</td>
</tr>
</tbody>
</table>

#### MFR_FIRMWARE_DATA (0xFD)

Transfer Type: Read Block (20 bytes)

Description: This is a 20-byte block that contains device ID and versions of the firmware.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>159:0</td>
<td>This is a 20-byte block that contains device ID and versions of the firmware.</td>
</tr>
</tbody>
</table>

#### MFR_RESTART (0xFE)

Transfer Type: Write Block (4 bytes)

Description: Writing the string "ERIC" to this command code forces the unit to restart.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>31:0</td>
<td></td>
<td>ASCII</td>
</tr>
</tbody>
</table>