

BMR352

2000 W digital quarter brick DC/DC IBC

The BMR352 is new generation of high-power digital DC/DC converter. The impressive performance of this converter includes an efficiency reaching 97.9% at 48V_{in} at 50% load. The BMR352 is a non-isolated quarter brick. The converter delivers a fully regulated 12.2V, with a continuous power level of 2000W and has a peak power capability of up to 3000W for limited time.

This converter is designed for through-hole mounting using wave solder or pin-in-paste production, and incorporates a novel design of baseplate, which optimizes thermal performance while minimizing height.



Key features

- High efficiency with 97.9%
- Non-isolated
- 12.2 V fully regulated
- Peak power capability
- Event data recorder (black-box)
- Parallel Operation with active current share
- Screwed baseplate
- Monotonic start-up
- Output over voltage protection
- Over temperature protection
- Output short-circuit protection
- Remote control
- PMBus configuration

Soldering methods

- Reflow soldering Pin-in-paste
- Wave soldering
- Manual soldering

Key electrical information

Parameter	Values
Input range	40-60 V
Output voltage	12.2 V
Output current	167 A
Output power	2000 W

<u>Mechanical</u>

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

Application areas

• Datacom applications

Product options

The table below describes the different product options.

Example:	BMR352	2	2	00	/031	н	Definitions
Product family	BMR352						
Pin length options		2					0 = 5.33 mm / 0.21 in 2 = 3.69 mm / 0.15 in 3 = 4.57 mm / 0.18 in 4 = 2.79 mm / 0.11 in
Baseplate / HS option			2				 1 = Baseplate closed deck, 14.8 mm / 0.58 in height 2 = Baseplate closed deck, 14.5 mm / 0.57 in height
Other hardware options				00			00 = Vout 12.20V, (40-60Vin) 2000W (Peak 3000W), 7-pin digital interface with Power Good and Active Current Share
Configuration code					/031		/031 = 12.20V _{out} · Active current share configuration for 40-60V _{in}
Packaging options						Н	H = hard tray, dry pack (PIP reflow soldering) blank = foam tray (no dry pack, wave soldering)

For more information, please refer to Part 3 Mechanical information.

If you do not find the variant you are looking for, please contact us at <u>Flex Power Modules</u> .

Order number examples

Part number	Vin	Outputs	Configuration
BMR352 2200/031H	40-60 V	12.2V / 167A/ 2000 W	3.69 mm pins / 7-pin digital header / Baseplate closed deck/ ACS / hard tray

Part 1: Electrical specifications

Absolute maximum ratings

Stress in excess of our defined absolute maximum ratings may cause permanent damage to the converter. Absolute maximum ratings, also referred to as *non-destructive limits*, are normally tested with one parameter at a time exceeding the limits in the electrical specification.

Characteristics	min	typ	max	Unit
Operating temperature (T _{P1})	-40		+125	°C
Storage temperature	-55		+125	°C
Input voltage (Vin)	-0.5		+65	V
Input voltage transient (100 ms)			+80	V
Isolation voltage (input to output)			0	V
Isolation voltage (baseplate to output)			0	V
Remote control pin voltage (*Note 1)	-0.3		5	V

*Note 1: measurement with 20M bandwidth.

Reliability

Failure rate (λ) and mean time between failures (MTBF= 1/ λ) are calculated based on Telcordia SR-332 Issue 4: Method 1, Case 3, (80% of I_{out_TDP}, T_{P1}=40°C, Airflow=200 LFM).

	Mean	90% confidence level	Unit
Steady-state failure rate (λ)	159	173	nfailures/h
Standard deviation (σ)	10.3		nfailures/h
MTBF		5.8	MHr

Typical application diagram

Capacitor values are defined in the Electrical Specification tables. The EMI filter is defined in the EMC Part 2.



Electrical specifications for BMR352 XX00/031

12.20V, 167A (250A) ≤ 2000W (3000W)

Min and Max values are valid for: $T_{P1} = -30$ to $+90^{\circ}$ C, $V_{in} = 40V$ to 60V, unless otherwise specified under conditions. Typical values given at: $T_{P1} = +25^{\circ}$ C, $V_{in} = 54V$, max P_{out_TDP} , unless otherwise specified under conditions, see Note 1.

Additional external C_{in} = 270µF, C_{out} = 4mF

Characteristic	conditions	minimum	typical	maximum	unit
Key features					
	60% of Pout_TDP		97.6		%
	100% of Pout_TDP		97.5		%
Efficiency (ŋ)	50% of P_{out_TDP} V _{in} = 48 V		97.9		%
	100% of P_{out_TDP} V _{in} = 48 V		97.7		%
P_{out_TDP} thermal design power (TDP)	See Note 1			2000	W
P_{out_MAX} peak power (t ≤70ms)	See Note 1			3000	W
Power dissipation	100% of Pout_TDP		51	69	W
Switching frequency (f_{s})	0-100 % of Pout_TDP	170	175	180	kHz
Recommend capacitive load	See Note 2	4000		20000	μF
Input characteristics					
Input voltage range (V _{in})		40		60	V
Input idling power	P _{out} = 0 W		12	15.9	W
Input standby power	(turned off with RC)		600	700	mW
Input OVP			85		V
Internal input capacitance			94.7		μF
Recommended external input capacitance	See Note 3	270			μF

Note 1: Max. output current is rated at 167A. Max continuous power (thermal design power (TDP) is \leq 2000W depending on thermal conditions.

Note 2: Minimum 4*1000uF OS-CON capacitor and 10*10uF MLCC.

Note 3: Recomended to use $2x100\mu$ F electrolyte capacitor + $2x27\mu$ F OS-CON capacitor.

Electrical specifications for BMR352 XX00/031

12.20V, 167A (250A) ≤ 2000W (3000W)

Min and Max values are valid for: $T_{P1} = -30$ to $+90^{\circ}$ C, $V_{in} = 40$ V to 60V, unless otherwise specified under conditions. Typical values given at: $T_{P1} = +25^{\circ}$ C, $V_{in} = 54$ V, max P_{out_TDP} , unless otherwise specified under conditions, see Note 1.

Additional external $C_{in} = 270 \mu F$, $C_{out} = 4mF(2.5\% \text{ MLCC})$

Characteristic	conditions	minimum	typical	maximum	unit	
Output characteristics	Output characteristics					
Output voltage initial set- ting and accuracy	$P_{out} = 0 W$	12.14	12.20	12.33	V	
Output voltage tolerance band	0 – 100% of max P _{out_TDP} V _{in} = 40-60 V	11.8		12.36	V	
Output adjust range	0-100% of max Pout_TDP	8		13.2	V	
Idling voltage	$P_{out} = 0 W, 54 V$	12.04		12.36	V	
Line regulation	V _{in} = 40 - 60 V 0 - 100% of max P _{out_TDP}		5	70	mV	
Load regulation	0 - 100% of max Pout_TDP		200	260	mV	
Output current (Iout)	V _{in} = 40 - 60 V	0		167	A	
Load transient voltage de- viation	Load step 25-75-25% of		±240	±468	mV	
Load transient recovery time	max P _{out_TDP} di/dt = 5 A/µs. See Note 2		100		μs	
Load transient voltage de- viation	Load step 25-75-25% of max P _{out_TDP} di/dt = 1 A/µs. See Note 2		±180	±300	mV	
Load transient recovery time	Load step 25-75-25% of max P _{out_TDP} di/dt = 1 A/µs. See Note 2		100		US	
Output ripple & noise	max P _{out_TDP} See Note 3		70	120	$mV_{\text{p-p}}$	

Note 1: Max. output current is rated at 167A. Max continuous power (thermal design power (TDP) is \leq 2000W depending on thermal conditions.

Note 2: Cout is 4x1mF OS-CON and 10*10uF MLCC

Note 3: See Technical Reference doc: Design considerations

Part 1: Electrical specifications

Electrical specifications for BMR352 XX00/031

12V, 167A (250A) ≤ 2000W (3000W)

Characteristic	conditions	minimum	typical	maximum	unit	
On/off control						
Turn-off input voltage	Decreasing input voltage	34	35	36	V	
Turn-on input voltage	Increasing input voltage	36	37	38	V	
Ramp-up time (from 0–100% of V _{out})		7	10	13	ms	
Start-up time (from V_{in} connection to 90% of $V_{\text{out}})$			38		ms	
RC start-up time			25		ms	
Logic high: trigger level			1.4		V	
Logic low: trigger level			1.3		V	
Logic low: response time		0.1	0.2	0.3	ms	
Sink current		0.4			mA	
Protection features	Protection features					
Current limit threshold (OCP)	T _{P1} < max T _{P1}	254	274	294	А	
Output current limit (OCP) response time and type	Disable and do not retry	20	29	50	μs	
Current limit threshold (Slow OCP)			200		А	
	Load step 167-209A.			200	ms	
Current limit Off Delay	See note 1					
(Slow OCP)	Load step 167-250A. See note 1			70	ms	
Output overvoltage pro- tection (OVP)			14.2		V	
Output overvoltage pro- tection (OVP) response time and type	Disabled until fault cleared		70		μs	
Over temperature protec- tion (OTP)	See note 2		125		°C	
Over temperature protection (OTP) re-start temperature and type	Disabled until fault cleared		90		°C	

Note 1: Off Delay is dependent on averaging power level above TDP, 167A. Product is configured to allow 250A/3000W for max 500ms. High di/dt on load step up to peak power, might cause current overshot resulting in OCP fault.

Note 2: Please attach thermocouple on NTC resistor to test OTP function, the hot spot (P1) temperature is just for reference.

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Electrical specifications for BMR352 XX00/031

12.2V, 167A <u>≤</u>2000W

In the table below all PMBus are written in capital letters.

 $T_{P1} = -30$ to $+90^{\circ}$ C, $V_{in} = 40V$ to 60V, unless otherwise specified under conditions.

Typical values given at: $T_{P1} = +25 \text{ °C}$, $V_{in} = 54V$, max $P_{out_{TDP}}$, unless otherwise specified under conditions

Command	Conditions	minimum	typical	maximum	Unit
Monitoring accuracy					
Input voltage READ_VIN			±125		mV
Output voltage READ_VOUT			±40		mV
Output current	$T_{P1} = 25 \text{ °C}, V_O = 12.2V$		±3.0		А
READ_IOUT	T _{P1} = -20-120 ° C , V _O = 12.2V		±7.0		А
Duty cycle READ_DUTY_CYCLE	No tolerance, Read value is the actual value applied by PWM controller				
Temperature READ_TEMPERATURE_1	Temperature sensor, -20- 120 °C		±5		°C

For more detailed information please refer to Technical Reference Document: PMBus commands.

This product is supported by the <u>Flex Power Designer tool.</u>

Part 1: Electrical specifications

Electrical specifications for BMR352 XX00/031

12.2V, 167A <u>≤</u>2000W

Efficiency



Efficiency vs. output power and input voltage at T_{P1} = +25°

Line regulation



Output voltage vs. input voltage at T_{P1} = +90°C

Power loss at max temperature



Dissipated power vs. output power and input voltage at T_{Pl} = +90°C

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Power dissipation



Dissipated power vs. load power at $T_{P1} = +25^{\circ}C$

Available power



Available output power vs. input voltage , $T_{P1} = +90^{\circ}C$

Output voltage adjust range



Max and min V_{out} trim vs V_{in}

Part 2: EMC EMC specifications

Conducted EMI measured according to EN55022 / EN55032, CISPR 22 / CISPR 32 and FCC part 15J (see test set-up below). The fundamental switching frequency is 175kHz for BMR352. The EMI characteristics below is measured at V_{in} = 54V and max I_{out} .







EMI with filter, EN55032 test methods and limits are the same as EN55022

Optional external filter for Class B

Suggested external input filter in order to meet Class B in EN 55022 / EN 55032, CISPR 22 / CISPR 32 and FCC part 15J.





Test set-up

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.

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Part 3: Mechanical information

BMR352 X1XX/XXX: hole mounted, baseplate version- product height 14.8±0.5

The mechanical information is based on a module which is hole mounted and has a baseplate.



Part 3: Mechanical information

BMR352 X2XX/XXX: hole mounted, baseplate version- product height 14.5±0.5

The mechanical information is based on a module which is hole mounted and has a baseplate.



	Lead length
Standard	5.33 [0.210]
LA	3.69 [0.145]
LB	4.57 [0.180]
LC	2.79 [0.110]
Table 1	



RECOMMENDED FOOTPRINT-TOP VIEW





PIN SPECIFICATIONS: Pin1-3,4-7, Material: Copper alloy Plating: Min Au 0.1 µm over 1-3 µm Ni,

Pin8-14, Material: Brass Plating: Min Au 0.1 μm over 1-3 μm Ni.

CASE: Material: Aluminium For screw attachment apply mounting torque of max 0.44Nm (3.9 lbf in). M3 screws must not protrude more than 3.8mm(0.150inch) into the baseplate.

Recommended hole dimensions are only for reference.It is the end users decision based on different situations like production processes

Weight: Typical 95.8 g All dimensions in mm [inch] Tolerances unless specified: x.x ±0.5 mm [0.02], x.xx±0.25 mm [0.01] (not applied on footprint or typical values)



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Part 3: Mechanical information

BOTTOM VIEW - Recommended footprint all variants showing pin positions



Pin	Desig- nation	Function PCB pins
1	+In	Positive Input
2	RC	Remote Control
3	-In	Negative Input
4	-Out	Negative Output
5	-Out	Negative Output
6	+Out	Positive Output
7	+Out	Positive Output

Pin	Desig- nation	Function 7 pin Connector
8	PG	Power Good
9	NC	No Connection
10	SDA	PMBus Data
11	SALERT	PMBus alert signal
12	SCL	PMBus Clock
13	SA1	PMBus Address 1
14	IMON	Current Share

Part 4: Thermal considerations

Thermal considerations

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

General

For products mounted on a PWB without a heatsink 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 wind speed and temperature are measured in a point upstream the device. The *output current derating graphs* found later in this section for each model provide the available output current vs. ambient air temperature and air velocity at V_{in} = 54 V.

For products using any form of heatsink structure a top spacing board and side airflow guides are used to ensure airflow hitting the module and not diverted away.

Distance between the tested device and the top space board and the side airflow guides are 6.35 mm \pm 1 mm.

The product is tested on a 185 x 185 mm, 105 μ m (3 oz), 6-layer test board mounted vertically in a wind tunnel.

For products with baseplate used in a sealed box/cold wall application, cooling is achieved mainly by conduction through the cold wall. The product is tested in a sealed box test set up with ambient temperatures 85°C. See <u>Design Note 028</u> for further details.





Picture: general test set-up

Picture: cold wall test set-up

Definition of product operating temperature

Proper thermal conditions can be verified by measuring the temperature at position P1 as shown below. The temperature at this position (T_{P1}) 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. See Note 1.

Position	Description	Max. Temp.
Р1	PWB reference point	T _{P1} = 125°C



Note 1: Heat sink needs to be unscrewed in order to attach thermal probe to the component lead.

Thermal graphs

Output power derating - 1.0 inch heatsink



Max ambient temperature (°C)

Available output power vs. ambient air temperature and airflow. Airflow Direction -IN to +IN.

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Part 5: Packaging Packaging information

H option: Select for PIP reflow solder and pick & place - dry packed				
Material	Antistatic Polyphenylene Ester (PPE)			
Surface resistance	\geq 1 x 10 ⁴ to < 1 x 10 ¹¹ ohms			
Bakabilty	Tray can be baked at max. 125 °C for 24 h. Please remove the fitments before baking.			
Tray capacity	14 converters/tray			
Box capacity	42 products (3 full trays/ box)			
Tray weight	Base Plate Version 210 g empty tray, 1600 g full tray			

JEDEC standard tray. 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 <u>mechanical drawing</u> for exact location on product.



Part 5: Packaging

Packaging information

Blank option:	Select for wave or hand					
soldering, NOT dry packed						

Material	Antistatic Polyethylene (PE) foam	
Surface resistance	$\geq 1 \times 10^4$ to < 1 x 10 ¹¹ ohms	
Bakabilty	Tray cannot be baked	
Tray capacity	20 converters / tray	
Box capacity	40 products (2 full trays/ box)	
Weight	Base Plate Version	
	60 g empty tray, 2050 g full tray.	



Example PE foam tray

Part 6: Revision history Revision table

Revision number	revision change	date	revisor
Rev. A	New revision	2025-01-14	jidlsuna
Rev. B	Smaller format updates	2025-01-14	Kartwaer
Rev. C	Add 20M bandwidth as measurment note	2025-06-24	jidmawan
Rev. D	Updated test board info in part 4	2025-07-03	Kartwaer

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