ERICSSON

Technical Specification

BMR454 series Fully regulated Intermediate Bus Converters Input 36-75 V, Output up to 40 A / 240 W	EN/LZT 146 404 R4A February 2011

Key Features

- Industry standard five pin Eighth-brick
  58.4 x 22.7 x 10.2 mm (2.30 x 0.89 x 0.40 in.)
- Optional digital PMBus interface
- Fully regulated intermediate bus converter
- High efficiency, typ. 95.5% at 12 Vout half load
- +/- 2% output voltage tolerance band
- 1500 Vdc input to output isolation
- 3 million hours MTBF
- Optional baseplate
- ISO 9001/14001 certified supplier
- PMBus Revision 1.1 compliant

Power Management

- Configurable soft start/stop
- Precision delay and ramp-up
- Voltage sequencing and margining
- Voltage/current/temperature monitoring
- Wide output voltage range
- Configurable protection features
- Synchronization

Safety Approvals

113613 903075

RECOGNIZED COMPONENT
Conforms to ANSI/UL 60950-1
Certified to CAN/CSA-C22.2
No.60950-1

Design for Environment

Meets requirements in high-temperature lead-free soldering processes

Contents

Ordering Information

Product program	Output
BMR4540002/003	3.3 V / 40 A, 132 W
BMR4540002/004	5 V / 38 A, 190 W
BMR4540000/002	9 V / 20 A, 180 W
BMR4540000/001	12 V / 20 A, 240 W (Vin 40-75V)
BMR4540004/005	12 V / 20 A, 240 W (Vin 36-75V)

Product Number and Packaging

BMR454 $n_1n_2n_3n_4$ /$n_5n_6n_7$								
Options	n_1	n_2	n_3	n_4	/	n_5	n_6	n_7
Mechanical pin option	x				/			
Mechanical option		x			/			
Hardware option			x	x	/			
Configuration file					/	x	x	x

Optional designation	Description
n_1	0 = Standard pin length 5.33 mm 2 = Lead length 3.69 mm (cut) 3 = Lead length 4.57 mm (cut) 4 = Lead length 2.79 mm (cut)
n_2	0 = Open frame 1 = Baseplate
n_3 n_4	00 = 8.1-13.2Vout with digital interface 01 = 8.1-13.2Vout without digital interface 02 = 3-6.7Vout with digital interface 03 = 3-6.7Vout without digital interface 04 = 12Vout with digital interface 05 = 12Vout without digital interface
n_5 n_6 n_7	001 = 12 V Standard configuration (Vin 40-75V, available only for n3 n4 = 00 or 01) 002 = 9 V Standard configuration 003 = 3.3 V Standard configuration 004 = 5 V Standard configuration 005 = 12 V Standard configuration (Vin 36-75V, available only for n3 n4 = 04 or 05) 007 = 9V with positive RC logic configuration 008 = 12V with positive RC logic configuration (Vin 40-75V, available only for n3 n4 = 00 or 01) 009 = 3.3V with positive RC logic configuration 010 = 5V with positive RC logic configuration 011 = 12V with positive RC logic configuration (Vin 36-75V, available only for n3 n4 = 04 or 05) xxx = Application Specific Configuration
Packaging	25 converters/tray, three (3) trays/box, PE foam dissipative

Example: Product number BMR4542000/002 equals an Through hole mount lead length 3.69 mm (cut), open frame, digital interface with 9 V standard configuration variant.

For application specific configurations contact your local Ericsson Power Modules sales representative.

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 (T_A) of +40°C. Ericsson Power Modules uses Telcordia SR-332 Issue 2 Method 1 to calculate the mean steady-state failure rate and standard deviation (σ).

Telcordia SR-332 Issue 2 also provides techniques to estimate the upper confidence levels of failure rates based on the mean and standard deviation.

Mean steady-state failure rate, λ	Std. deviation, σ
394 nFailures/h	61 nFailures/h

MTBF (mean value) for the BMR453 series = 3 Mh.
MTBF at 90% confidence level = 2.1 Mh

Compatibility with RoHS requirements

The products are compatible with the relevant clauses and requirements of the RoHS directive 2002/95/EC 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 Ericsson Power Modules products are found in the Statement of Compliance document.

Ericsson 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 Ericsson Power Modules General Terms and Conditions of Sale.

Limitation of Liability

Ericsson 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).

Safety Specification

General information

Ericsson Power Modules DC/DC converters and DC/DC regulators are designed in accordance with safety standards IEC/EN/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 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 60950-1, EN 60950-1 and UL 60950-1 *Safety of Information Technology Equipment.* There are other more product related standards, e.g. IEEE 802.3 *CSMA/CD (Ethernet) Access Method*, and ETS-300132-2 *Power supply interface at the input to telecommunications equipment, operated by direct current (dc)*, but all of these standards are based on IEC/EN/UL 60950-1 with regards to safety.

Ericsson Power Modules DC/DC converters 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.

The products should be installed in the end-use equipment, in accordance with the requirements of the ultimate application. Normally the output of the DC/DC converter is considered as SELV (Safety Extra Low Voltage) and the input source must be isolated by minimum Double or Reinforced Insulation from the primary circuit (AC mains) in accordance with IEC/EN/UL 60950-1.

Isolated DC/DC converters

It is recommended that a slow blow fuse is to be used 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.

The galvanic isolation is verified in an electric strength test. The test voltage (V_{iso}) between input and output is 1500 Vdc or 2250 Vdc (refer to product specification).

24 V DC systems

The input voltage to the DC/DC converter is SELV (Safety Extra Low Voltage) and the output remains SELV under normal and abnormal operating conditions.

48 and 60 V DC systems

If the input voltage to the DC/DC converter is 75 Vdc or less, then the output remains SELV (Safety Extra Low Voltage) under normal and abnormal operating conditions.

Single fault testing in the input power supply circuit should be performed with the DC/DC converter connected to demonstrate that the input voltage does not exceed 75 Vdc.

If the input power source circuit is a DC power system, the source may be treated as a TNV-2 circuit and testing has demonstrated compliance with SELV limits in accordance with IEC/EN/UL60950-1.

Non-isolated DC/DC regulators

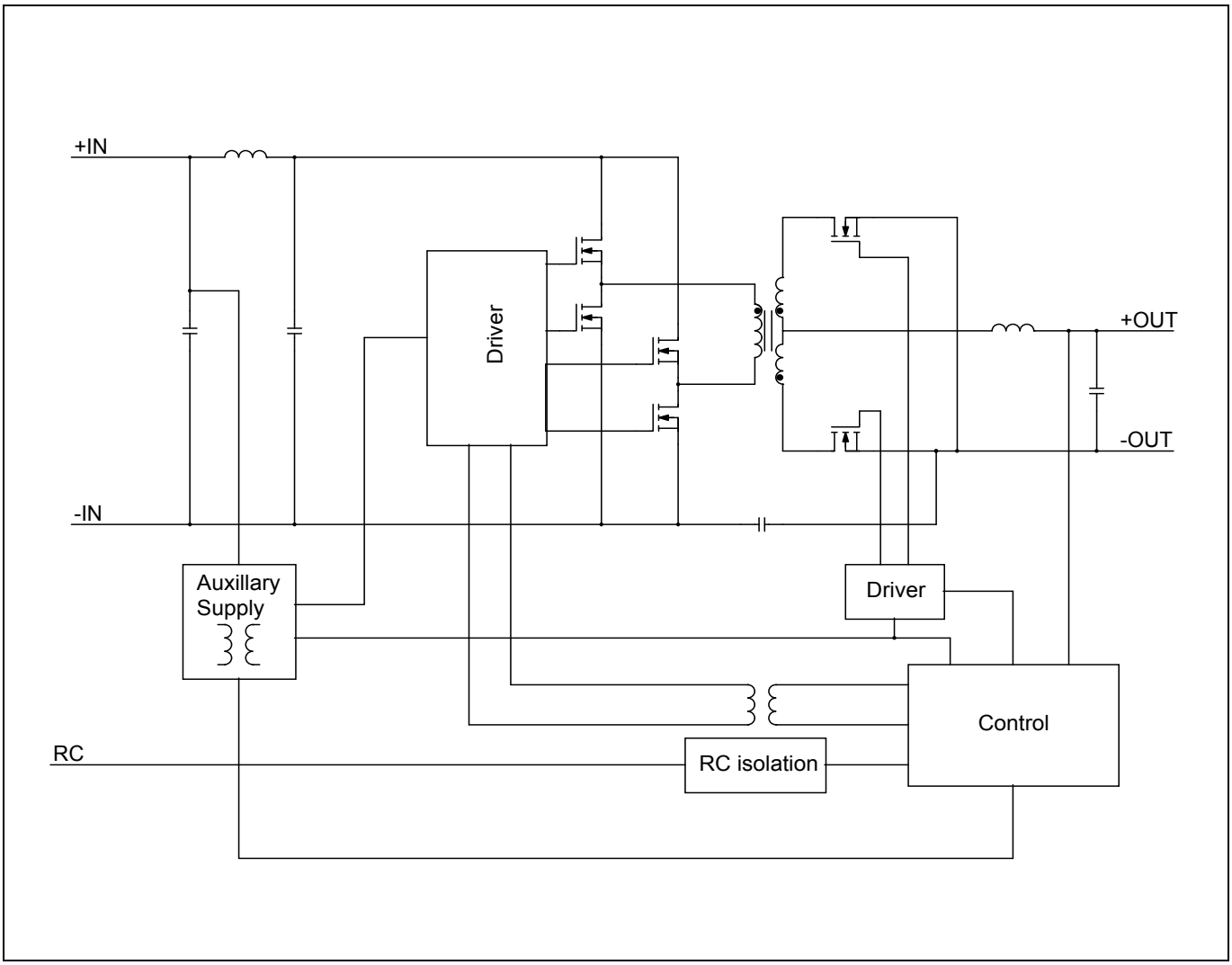
The input voltage to the DC/DC regulator is SELV (Safety Extra Low Voltage) and the output remains SELV under normal and abnormal operating conditions.

Absolute Maximum Ratings

Characteristics		min	typ	max	Unit
T_{P1}	Operating Temperature (see Thermal Consideration section)	-40		+125	°C
T_S	Storage temperature	-55		+125	°C
V_I	Input voltage	-0.5		80	V
V_{iso}	Isolation voltage (input to output test voltage), see note 1			1500	Vdc
V_{tr}	Input voltage transient (Tp 100 ms)			100	V
V_{RC}	Remote Control pin voltage	-0.3		18	V
V Logic I/O	SALERT, CTRL, SYNC, SCL, SDA, SA(0,1)	-0.3		3.6	V

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 of Output data or Electrical Characteristics. If exposed to stress above these limits, function and performance may degrade in an unspecified manner.
Note 1: Isolation voltage (input/output to base-plate) max 750Vdc.

Fundamental Circuit Diagram



Functional Description

T_{P1} = -40 to +90ºC, V_I = 36 to 75 V, sense pins connected to output pins unless otherwise specified under Conditions.
Typical values given at: T_{P1} = +25°C, V_I= 53 V, max I_O , unless otherwise specified under Conditions
Configuration File: 190 10-CDA 102 1900/001 rev A

Characteristics		Conditions	min	typ	max	Unit
PMBus monitoring accuracy						
VIN_READ	Input voltage		-3	+0.4	3	%
VOUT_READ	Output voltage	V_I = 53 V	-1.0	-0.3	1.0	%
IOUT_READ	Output current	V_I = 53 V, 50-100% of max I_O	-6	-1.0	6	%
IOUT_READ	Output current	V_I = 53 V, 10% of max I_O	-0.7	-	0.7	A
TEMP_READ	Temperature		-5	-	5	ºC
Fault Protection Characteristics						
Input Under Voltage Lockout, UVLO	Factory default		-	33	-	V
	Setpoint accuracy		-3	-	3	%
	Hysteresis	Factory default	-	1.8	-	V
		Configurable via PMBus of threshold range, Note 1	0	-	-	V
	Delay		-	200	-	µs
(Output voltage) Over/Under Voltage Protection, OVP/UVP	VOUT_UV_FAULT_LIMIT	Factory default	-	0	-	V
		Configurable via PMBus, Note 1	0	-	16	V
	VOUT_OV_FAULT_LIMIT	Factory default	-	15.6	-	V
		Configurable via PMBus, Note 1	V_{OUT}	-	16	V
	fault response time		-	200	-	µs
Over Current Protection, OCP	Setpoint accuracy	Io	-6		6	%
	IOUT_OC_FAULT_LIMIT	Factory default	-	25	-	A
		Configurable via PMBus, Note 1	0	-	100	
	fault response time		-	200	-	µs
Over Temperature Protection, OTP	OTP_FAULT_LIMIT	Factory default	-	125	-	°C
		Configurable via PMBus, Note 1	-50		125	
	OTP hysteresis	Factory default		10		
		Configurable via PMBus, Note 1	0		165	
	fault response time		-	200	-	µs
Logic Input/Output Characteristics						
Logic input low (V_{IL})		CTRL_CS, SA0, SA1, PG_SYNC, SCL, SDA,	-	-	0.8	V
Logic input high (V_{IH})			2.0	-	-	V
Logic output low (V_{OL})		CTRL_CS, PG_SYNC, SALERT, SCL, SDA I_{OL} = 5 mA	-	-	0.4	V
Logic output high (V_{OH})		CTRL_CS, PG_SYNC, SALERT, SCL, SDA I_{OH} = -5 mA	2.8	-	-	V
Setup time, SMBus			100	-		ns
Hold time, SMBus			300	-		ns

Note 1: See Operating Information section.

3.3 V, 40 A / 132 W Electrical Specification — BMR 454 0002/003

T_{P1} = -40 to +90ºC, V_I = 36 to 75 V, sense pins connected to output pins unless otherwise specified under Conditions.
Typical values given at: T_{P1} = +25°C, V_I= 53 V_I max I_O, unless otherwise specified under Conditions.
Additional C_{out} = 0.1 mF, Configuration File: 190 10-CDA 102 1900/003 rev A

Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range		36		75	V
V_{Ioff}	Turn-off input voltage	Decreasing input voltage	32	33	34	V
V_{Ion}	Turn-on input voltage	Increasing input voltage	34	35	36	V
C_I	Internal input capacitance			11		µF
P_O	Output power		0		132	W
η	Efficiency	50 % of max I_O		93		%
		max I_O		91.2		
		50 % of max I_O, V_I = 48 V		93.2		
		max I_O, V_I = 48 V		91.2		
P_d	Power Dissipation	max I_O		12.8	17.5	W
P_{li}	Input idling power	I_O = 0 A, V_I = 53 V		2.0		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		127		mW
f_s	Switching frequency	0-100 % of max I_O see Note 1	171	180	189	kHz

V_{Oi}	Output voltage initial setting and accuracy	T_{P1} = +25°C, V_I = 53 V, I_O = 40 A	3.26	3.3	3.34	V
V_O	Output adjust range	See operating information	3.0		6.7	V
	Output voltage tolerance band	0-100 % of max I_O	3.22		3.38	V
	Line regulation	max I_O		5	20	mV
	Load regulation	V_I = 53 V, 0-100 % of max I_O		6	16	mV
V_{tr}	Load transient voltage deviation	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/µs see Note 2		±0.2		V
t_{tr}	Load transient recovery time			214		µs
t_r	Ramp-up time (from 10−90 % of V_{Oi})	10-100% of max I_O, T_{P1} = 25ºC, V_I = 53 V see Note 3		8		ms
t_s	Start-up time (from V_I connection to 90 % of V_{Oi})			140		ms
t_f	V_I shut-down fall time (from V_I off to 10 % of V_O)	max I_O		0.33		ms
		I_O = 0 A		3.8		s
t_{RC}	RC start-up time	max I_O		54		ms
	RC shut-down fall time (from RC off to 10 % of V_O)	max I_O		2		ms
		I_O = 0 A		3.8		s
I_O	Output current		0		40	A
I_{lim}	Current limit threshold	V_O = 3.0V, T_{P1} < max T_{ref}	41	45	49	A
I_{sc}	Short circuit current	T_{P1} = 25ºC, V_O < 0.2V, see Note 4		7	8	A
C_{out}	Recommended Capacitive Load	T_{P1} = 25ºC, see Note 5	0.1	4	6	mF
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O, V_{Oi}		25	50	mVp-p
OVP	Over voltage protection	T_{P1} = +25°C, V_I = 53 V, 10-100 % of max I_O, see Note 6		4.6		V

Note 1: Frequency may be adjusted via PMBus, see Operating Information section.

Note 2: Cout = 4mF used at load transient test.

Note 3: Start-up and Ramp-up time can be increased via PMBus, see Operation Information section.

Note 4: RMS current in hiccup mode.

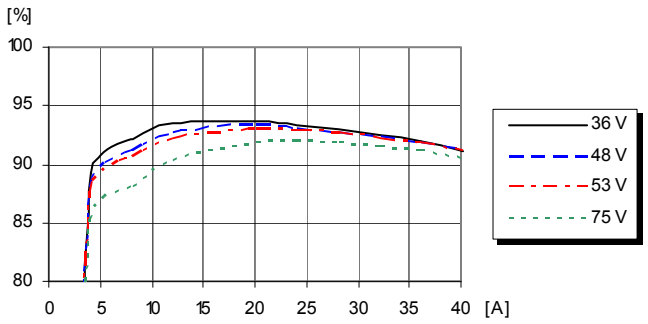
Note 5: Low ESR-value.

Note 6: OVP-level can be adjusted via PMBus, see Operation Information.

3.3 V, 40 A / 132 W Electrical Specification

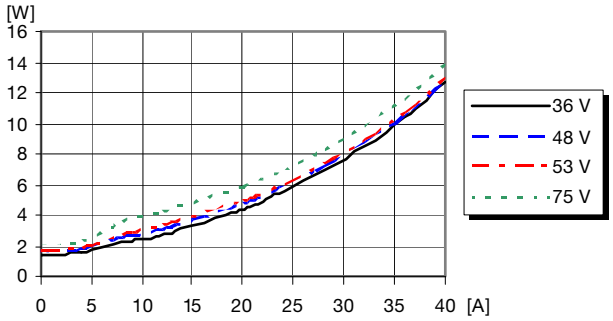
BMR 454 0002/003

Efficiency



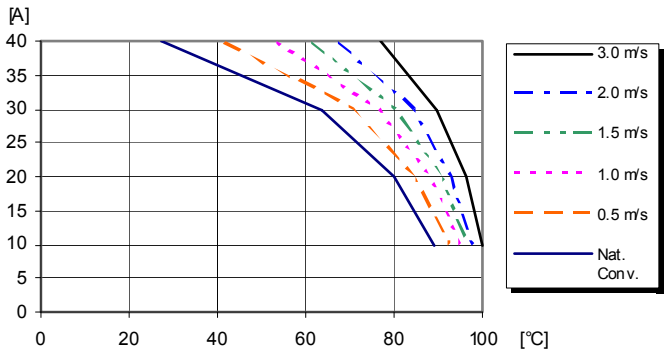
Efficiency vs. load current and input voltage at T_{ref} = +25°C

Power Dissipation



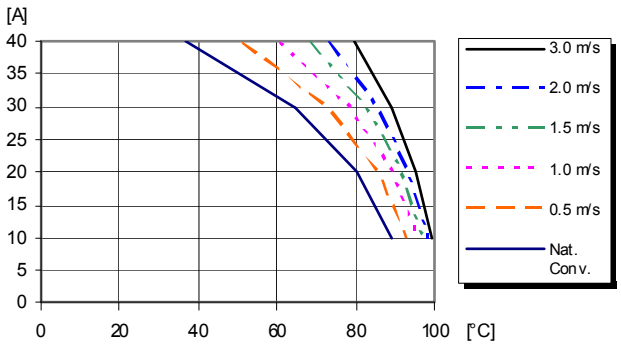
Dissipated power vs. load current and input voltage at T_{ref} = +25°C

Output Current Derating, open frame



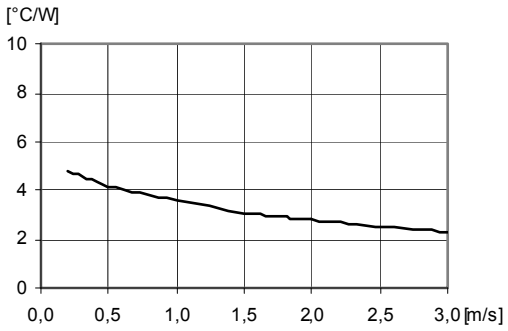
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Output Current Derating, base plate option



Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Thermal Resistance, base plate option

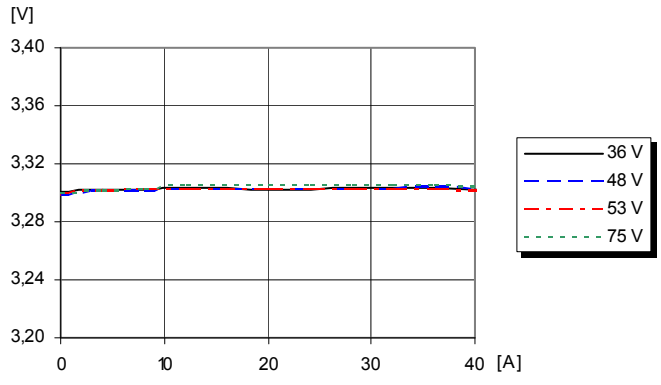


Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section. V_I = 53 V

3.3 V, 40 A / 132 W Electrical Specification

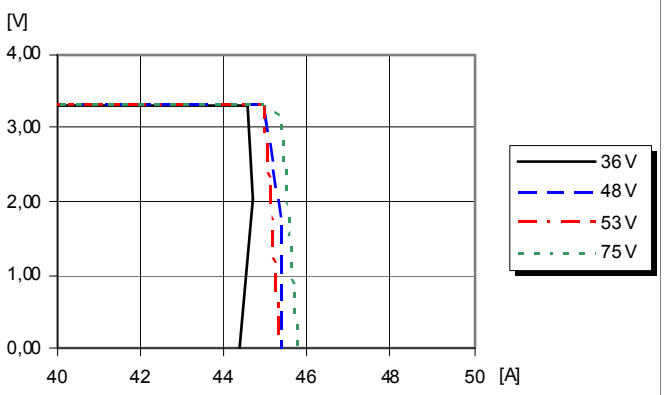
BMR 454 0002/003

Output Characteristics



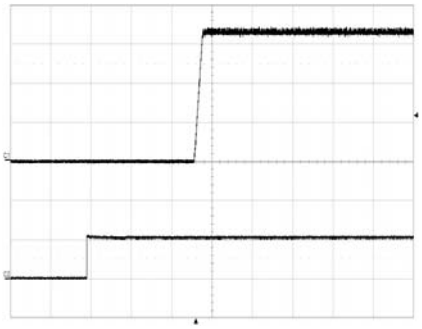
Output voltage vs. load current at T_{ref} = +25°C

Current Limit Characteristics



Output voltage vs. load current at I_O > max I_O , T_{ref} = +25°C

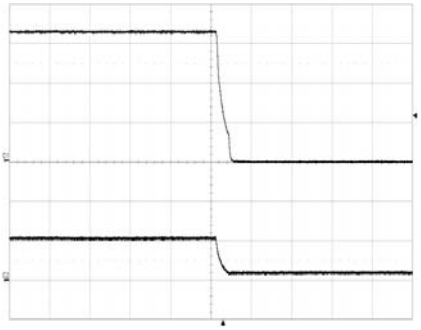
Start-up



Start-up enabled by connecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 40 A resistive load.

Top trace: output voltage (1 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (50 ms/div.).

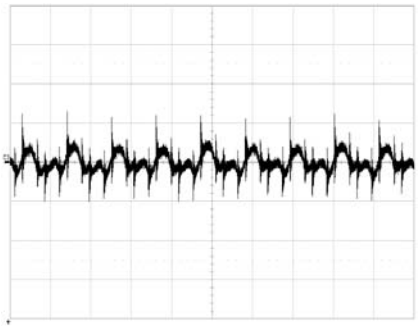
Shut-down



Shut-down enabled by disconnecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O =40 A resistive load.

Top trace: output voltage (2 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (0.5 ms/div.).

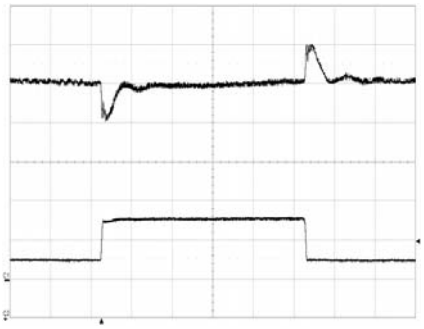
Output Ripple & Noise



Output voltage ripple at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 40 A resistive load.

Trace: output voltage (10mV/div.).
Time scale: (5 µs/div.).

Output Load Transient Response



Output voltage response to load current step-change (10 - 30 - 10 A) at:
T_{ref} =+25°C, V_I = 53 V. Co = 4mF

Top trace: output voltage (0.2 V/div.).
Bottom trace: output current (20A/div.).
Time scale: (0.5 ms/div.).

5 V, 38 A / 190 W Electrical Specification — BMR 454 0002/004

T_{P1} = -40 to +90ºC, V_I = 36 to 75 V, sense pins connected to output pins unless otherwise specified under Conditions.
Typical values given at: T_{P1} = +25°C, V_I= 53 V_I max I_O, unless otherwise specified under Conditions.
Additional C_{out} = 0.1 mF, Configuration File: 190 10-CDA 102 1900/004 rev A

Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range		36		75	V
V_{Ioff}	Turn-off input voltage	Decreasing input voltage	32	33	34	V
V_{Ion}	Turn-on input voltage	Increasing input voltage	34	35	36	V
C_I	Internal input capacitance			11		µF
P_O	Output power		0		190	W
η	Efficiency	50 % of max I_O		94.3		%
		max I_O		93.3		
		50 % of max I_O, V_I = 48 V		94.5		
		max I_O, V_I = 48 V		93.3		
P_d	Power Dissipation	max I_O		13.7	19.1	W
P_{li}	Input idling power	I_O = 0 A, V_I = 53 V		2.6		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		123		mW
f_s	Switching frequency	0-100 % of max I_O see Note 1	171	180	189	kHz

V_{Oi}	Output voltage initial setting and accuracy	T_{P1} = +25°C, V_I = 53 V, I_O = 38 A	4.95	5.0	5.05	V
V_O	Output adjust range	See operating information	3.0		6.7	V
	Output voltage tolerance band	0-100 % of max I_O	4.9		5.1	V
	Line regulation	max I_O		5	21	mV
	Load regulation	V_I = 53 V, 0-100 % of max I_O		5	18	mV
V_{tr}	Load transient voltage deviation	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/µs see Note 2		±0.2		V
t_{tr}	Load transient recovery time			250		µs
t_r	Ramp-up time (from 10−90 % of V_{Oi})	10-100% of max I_O, T_{P1} = 25ºC, V_I = 53 V see Note 3		8		ms
t_s	Start-up time (from V_I connection to 90 % of V_{Oi})			140		ms
t_f	V_I shut-down fall time (from V_I off to 10 % of V_O)	max I_O		0.4		ms
		I_O = 0 A		3.7		s
t_{RC}	RC start-up time	max I_O		55		ms
	RC shut-down fall time (from RC off to 10 % of V_O)	max I_O		3		ms
		I_O = 0 A		3.7		s
I_O	Output current		0		38	A
I_{lim}	Current limit threshold	V_O = 4.5V, T_{P1} < max T_{ref}	41	45	49	A
I_{sc}	Short circuit current	T_{P1} = 25ºC, V_O < 0.2V, see Note 4		7	8	A
C_{out}	Recommended Capacitive Load	T_{P1} = 25ºC, see Note 5	0.1	3.8	6	mF
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O, V_{Oi}		35	75	mVp-p
OVP	Over voltage protection	T_{P1} = +25°C, V_I = 53 V, 10-100 % of max I_O, see Note 6		6.8		V

Note 1: Frequency may be adjusted via PMBus, see Operating Information section.

Note 2: Cout = 3.8mF used at load transient test.

Note 3: Start-up and Ramp-up time can be increased via PMBus, see Operation Information section.

Note 4: RMS current in hiccup mode.

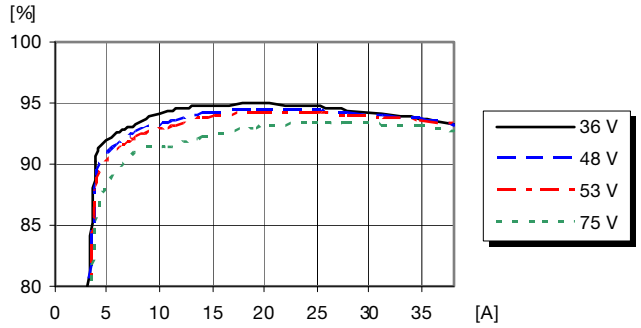
Note 5: Low ESR-value.

Note 6: OVP-level can be adjusted via PMBus, see Operation Information.

5 V, 38 A / 190 W Electrical Specification

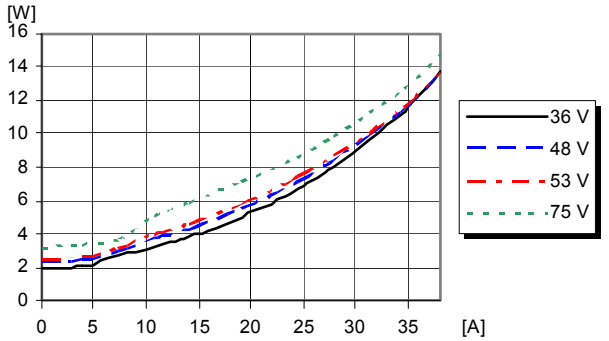
BMR 454 0002/004

Efficiency



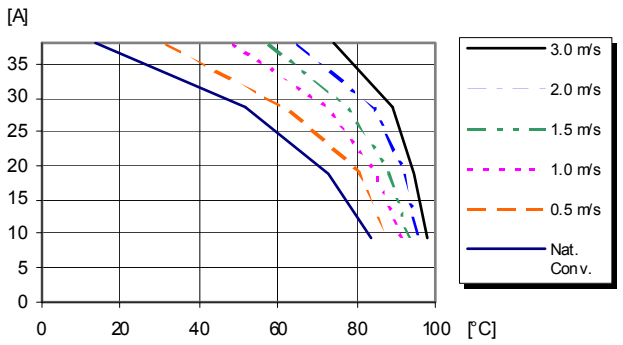
Efficiency vs. load current and input voltage at T_{P1} = +25°C

Power Dissipation



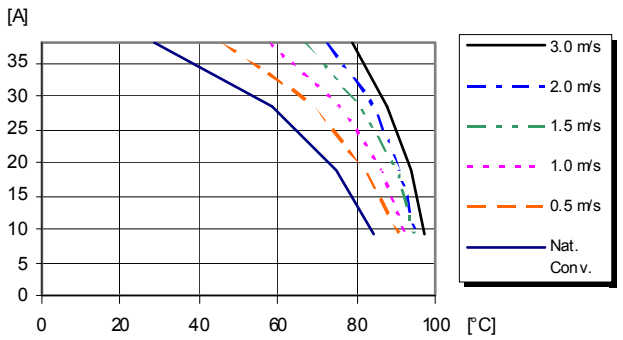
Dissipated power vs. load current and input voltage at T_{P1} = +25°C

Output Current Derating, open frame



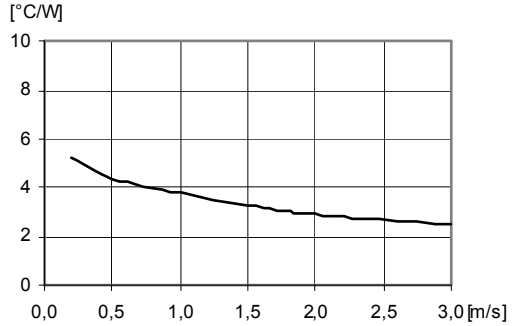
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Output Current Derating, base plate option



Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Thermal Resistance, base plate option

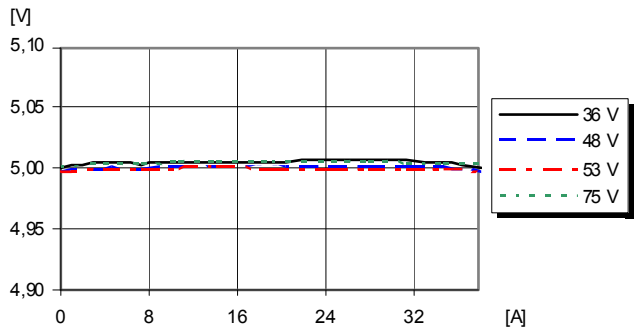


Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section. V_I = 53 V

5 V, 38 A / 190 W Electrical Specification

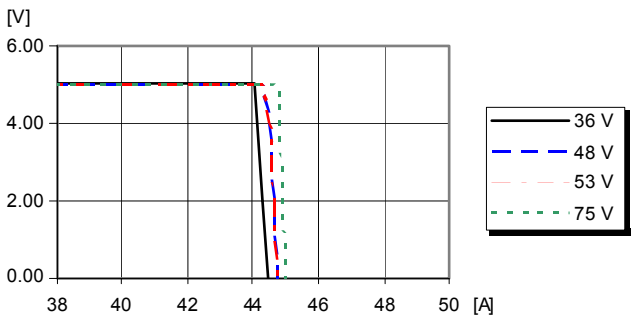
BMR 454 0002/004

Output Characteristics



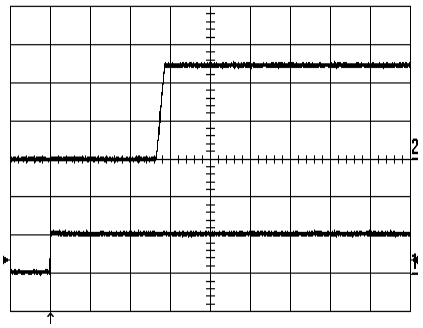
Output voltage vs. load current at T_{ref} = +25°C

Current Limit Characteristics



Output voltage vs. load current at I_O > max I_O , T_{ref} = +25°C

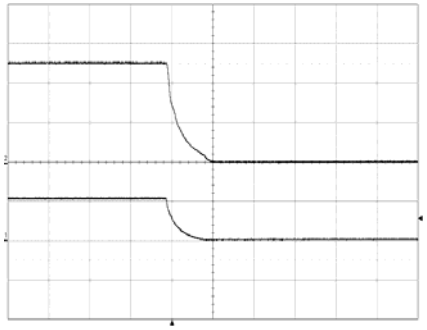
Start-up



Start-up enabled by connecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 38 A resistive load.

Top trace: output voltage (2 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (20 ms/div.).

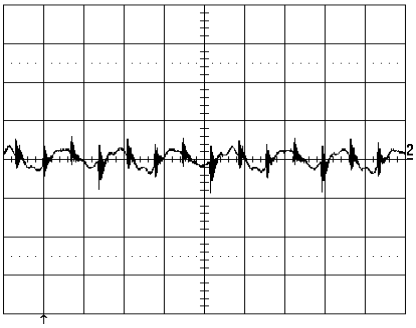
Shut-down



Shut-down enabled by disconnecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O =38 A resistive load.

Top trace: output voltage (2 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (0.2 ms/div.).

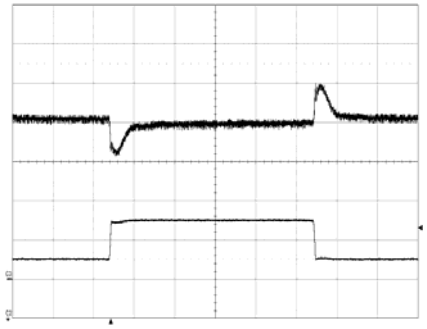
Output Ripple & Noise



Output voltage ripple at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 38 A resistive load.

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

Output Load Transient Response



Output voltage response to load current step-change (9.5 – 28.5 – 9.5 A) at:
T_{ref} =+25°C, V_I = 53 V. Co = 3.8mF

Top trace: output voltage (0.2 V/div.).
Bottom trace: output current (20A/div.).
Time scale: (0.5 ms/div.).

9 V, 20 A / 180 W Electrical Specification — BMR 454 0000/002

T_{P1} = -40 to +90ºC, V_I = 36 to 75 V, sense pins connected to output pins unless otherwise specified under Conditions.
Typical values given at: T_{P1} = +25°C, V_I= 53 V_I max I_O, unless otherwise specified under Conditions.
Additional C_{out} = 0.1 mF, Configuration File: 190 10-CDA 102 1900/002 rev A

Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range		36		75	V
V_{Ioff}	Turn-off input voltage	Decreasing input voltage	32	33	34	V
V_{Ion}	Turn-on input voltage	Increasing input voltage	34	35	36	V
C_I	Internal input capacitance			11		µF
P_O	Output power		0		180	W
η	Efficiency	50 % of max I_O		95		%
		max I_O		94		
		50 % of max I_O, V_I = 48 V		95		
		max I_O, V_I = 48 V		94		
P_d	Power Dissipation	max I_O		11.1	14.7	W
P_{li}	Input idling power	I_O = 0 A, V_I = 53 V		2.2		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		182		mW
f_s	Switching frequency	0-100 % of max I_O see Note 1	171	180	189	kHz

V_{Oi}	Output voltage initial setting and accuracy	T_{P1} = +25°C, V_I = 53 V, I_O = 20 A	8.90	9.0	9.10	V
V_O	Output adjust range	See operating information	8.1		13.2	V
	Output voltage tolerance band	0-100 % of max I_O	8.82		9.18	V
	Line regulation	max I_O		8	45	mV
	Load regulation	V_I = 53 V, 0-100 % of max I_O		8	30	mV
V_{tr}	Load transient voltage deviation	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/µs see Note 2		±0.3		V
t_{tr}	Load transient recovery time			250		µs
t_r	Ramp-up time (from 10−90 % of V_{Oi})	10-100% of max I_O, T_{P1} = 25ºC, V_I = 53 V see Note 3		10		ms
t_s	Start-up time (from V_I connection to 90 % of V_{Oi})			140		ms
t_f	V_I shut-down fall time (from V_I off to 10 % of V_O)	max I_O		0.4		ms
		I_O = 0 A		5		s
t_{RC}	RC start-up time	max I_O		54		ms
	RC shut-down fall time (from RC off to 10 % of V_O)	max I_O		3		ms
		I_O = 0 A		5		s
I_O	Output current		0		20	A
I_{lim}	Current limit threshold	V_O = 8.1V, T_{P1} < max T_{ref}	21	25	28	A
I_{sc}	Short circuit current	T_{P1} = 25ºC, V_O < 0.2V, see Note 4		4	5	A
C_{out}	Recommended Capacitive Load	T_{P1} = 25ºC, see Note 5	0.1	2.2	6	mF
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O, V_{Oi}		60	120	mVp-p
OVP	Over voltage protection	T_{P1} = +25°C, V_I = 53 V, 10-100 % of max I_O, see Note 6		15.6		V

Note 1: Frequency may be adjusted via PMBus, see Operating Information section.

Note 2: Cout = 3.3mF used at load transient test.

Note 3: Start-up and Ramp-up time can be increased via PMBus, see Operation Information section.

Note 4: RMS current in hiccup mode.

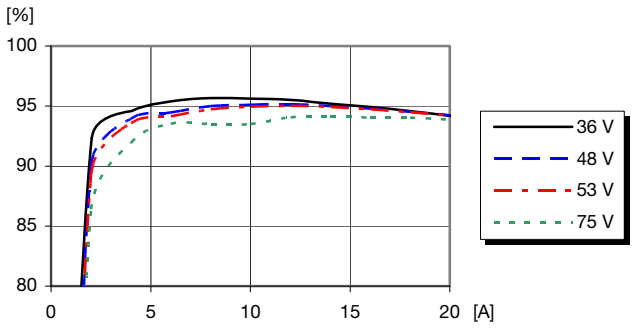
Note 5: Low ESR-value.

Note 6: OVP-level can be adjusted via PMBus, see Operation Information.

9 V, 20 A / 180 W Electrical Specification

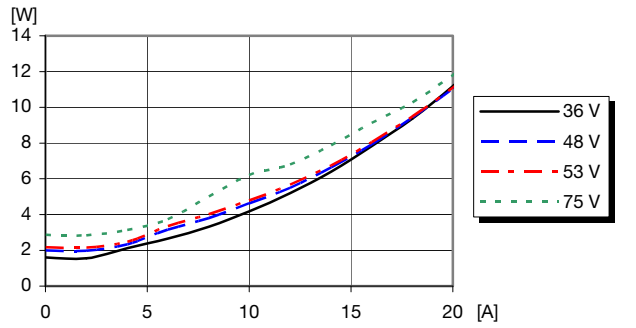
BMR 454 0000/002

Efficiency



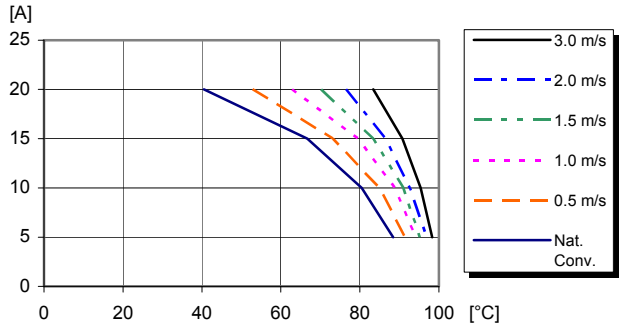
Efficiency vs. load current and input voltage at T_{ref} = +25°C

Power Dissipation



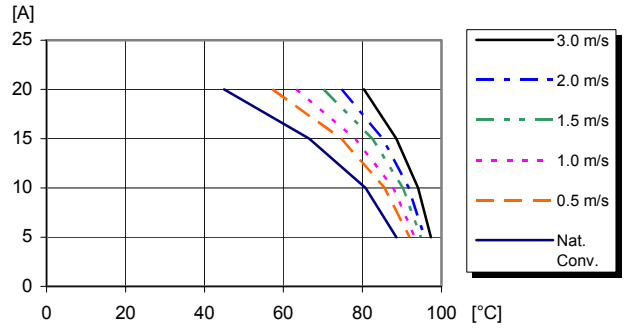
Dissipated power vs. load current and input voltage at T_{ref} = +25°C

Output Current Derating, open frame



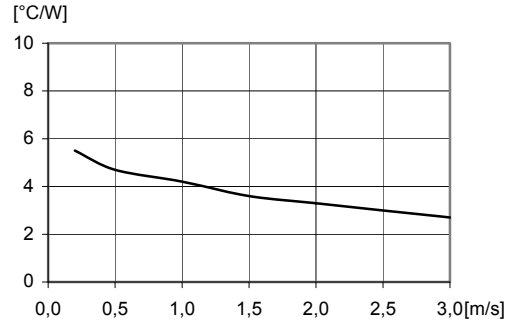
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Output Current Derating, base plate option



Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Thermal Resistance, base plate option

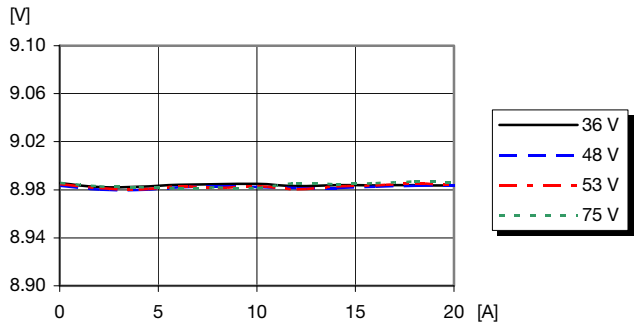


Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section. V_I = 53 V

9 V, 20 A / 180 W Electrical Specification

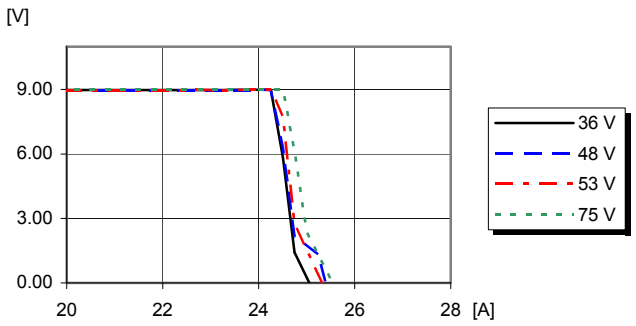
BMR 454 0000/002

Output Characteristics



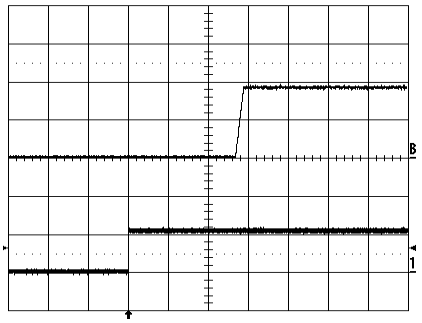
Output voltage vs. load current at T_{ref} = +25°C

Current Limit Characteristics



Output voltage vs. load current at I_O > max I_O , T_{ref} = +25°C

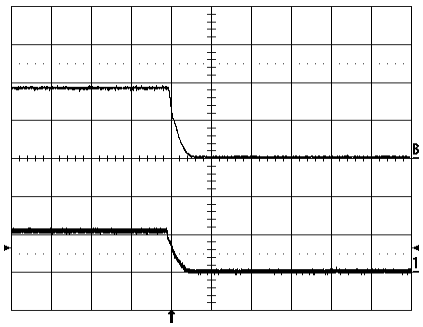
Start-up



Start-up enabled by connecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 20 A resistive load.

Top trace: output voltage (5 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (50 ms/div.).

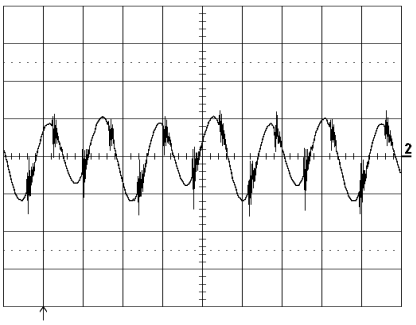
Shut-down



Shut-down enabled by disconnecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O =20 A resistive load.

Top trace: output voltage (5 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (0.5 ms/div.).

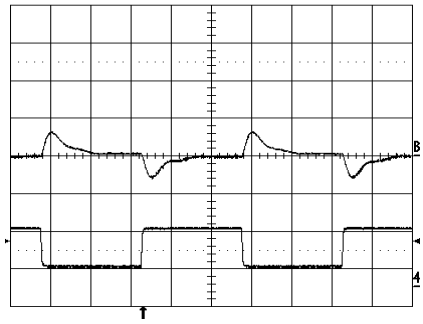
Output Ripple & Noise



Output voltage ripple at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 20 A resistive load.

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

Output Load Transient Response



Output voltage response to load current step-change (5 - 15 - 5 A) at:
T_{ref} =+25°C, V_I = 53 V. Co = 2.2mF

Top trace: output voltage (0.5 V/div.).
Bottom trace: output current (10A/div.).
Time scale: (0.5 ms/div.).

12 V, 20 A / 240 W Electrical Specification

BMR 454 0000/001

T_{P1} = -40 to +90ºC, V_I = 36 to 75 V, sense pins connected to output pins unless otherwise specified under Conditions.
Typical values given at: T_{P1} = +25°C, V_I= 53 V_I max I_O, unless otherwise specified under Conditions.
Additional C_{out} = 0.1 mF, Configuration File: 190 10-CDA 102 1900/001 rev A

Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range		36		75	V
V_{Ioff}	Turn-off input voltage	Decreasing input voltage	32	33	34	V
V_{Ion}	Turn-on input voltage	Increasing input voltage	34	35	36	V
C_I	Internal input capacitance			11		µF
P_O	Output power		0		240	W
η	Efficiency	50 % of max I_O		95.6		%
		max I_O		95.0		
		50 % of max I_O, V_I = 48 V		95.7		
		max I_O, V_I = 48 V		95.0		
P_d	Power Dissipation	max I_O		12.7	17.1	W
P_{li}	Input idling power	I_O = 0 A, V_I = 53 V		2.7		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		184		mW
f_s	Switching frequency	0-100 % of max I_O see Note 2	171	180	189	kHz

V_{Oi}	Output voltage initial setting and accuracy	T_{P1} = +25°C, V_I = 53 V, I_O = 20 A	11.88	12.0	12.12	V
V_O	Output adjust range	See operating information	8.1		13.2	V
	Output voltage tolerance band	0-100 % of max I_O, see Note 1	11.76		12.24	V
	Line regulation	max I_O, see Note 1		20	80	mV
	Load regulation	V_I = 53 V, 0-100 % of max I_O, see Note 1		6	45	mV
V_{tr}	Load transient voltage deviation	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/µs see Note 3		±0.3		V
t_{tr}	Load transient recovery time			250		µs
t_r	Ramp-up time (from 10−90 % of V_{Oi})	10-100% of max I_O, T_{P1} = 25ºC, V_I = 53 V see Note 4		8		ms
t_s	Start-up time (from V_I connection to 90 % of V_{Oi})			140		ms
t_f	V_I shut-down fall time (from V_I off to 10 % of V_O)	max I_O		0.4		ms
		I_O = 0 A		5		s
t_{RC}	RC start-up time	max I_O		55		ms
	RC shut-down fall time (from RC off to 10 % of V_O)	max I_O		2.4		ms
		I_O = 0 A		5		s
I_O	Output current		0		20	A
I_{lim}	Current limit threshold	V_O = 10.8 V , T_{P1} < max T_{ref}	21	25	28	A
I_{sc}	Short circuit current	T_{P1} = 25ºC, see Note 5		4	5	A
C_{out}	Recommended Capacitive Load	T_{P1} = 25ºC, see Note 6	0.1	2.2	6	mF
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O, see Note 1		60	120	mVp-p
OVP	Over voltage protection	T_{P1} = +25°C, V_I = 53 V, 10-100 % of max I_O , see Note 7		15.6		V

Note 1: Vin = 40-75V

Note 2: Frequency may be adjusted with PMBus communication. See Operating Information section

Note 3: Cout = 2.2mF used at load transient test.

Note 4: Start-up and Ramp-up time can be increased via PMBus, see Operation Information section.

Note 5: OCP in hic-up mode

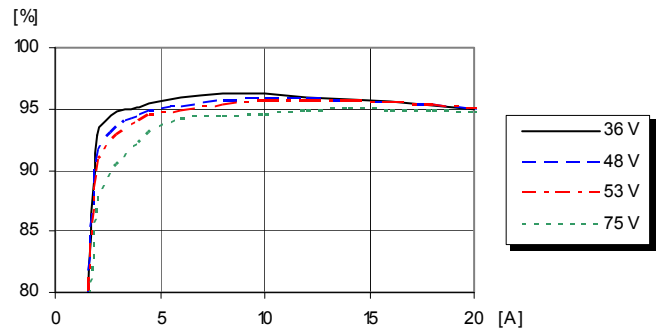
Note 6: Low ESR-value

Note 7: OVP-level can be adjusted via PMBus, see Operation Information.

12 V, 20 A / 240 W Typical Characteristics

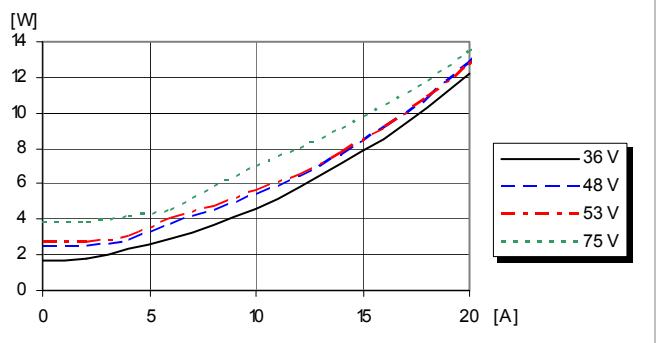
BMR 454 0000/001

Efficiency



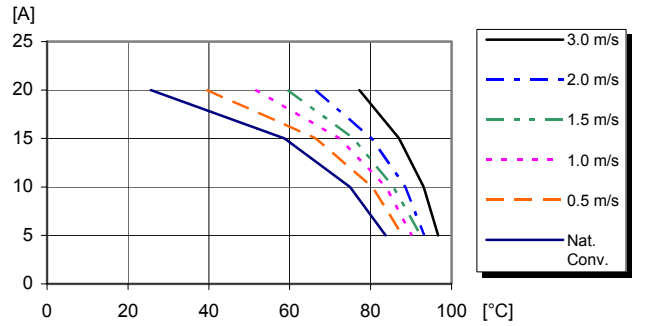
Efficiency vs. load current and input voltage at T_{P1} = +25°C

Power Dissipation



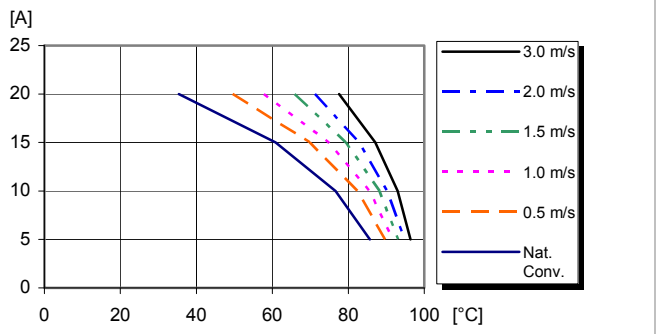
Dissipated power vs. load current and input voltage at T_{P1} = +25°C

Output Current Derating, open frame



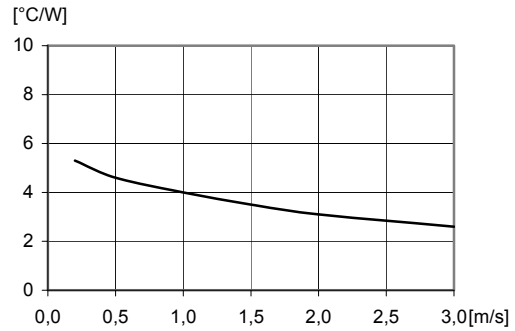
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Output Current Derating, base plate option



Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Thermal Resistance, base plate option

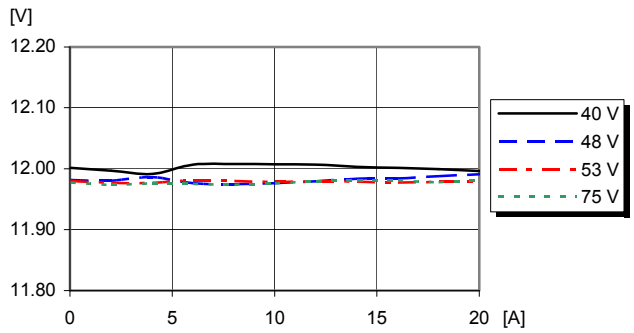


Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section. V_I = 53 V

12 V, 20 A / 240 W Electrical Specification

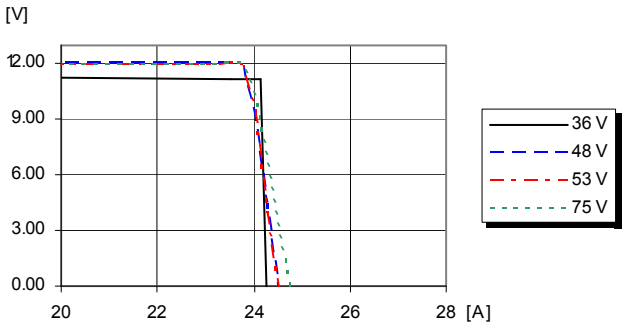
BMR 454 0000/001

Output Characteristics



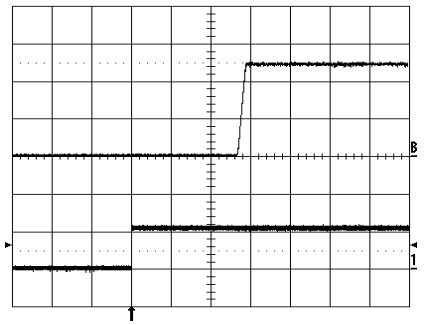
Output voltage vs. load current at T_{ref} = +25°C

Current Limit Characteristics



Output voltage vs. load current at I_O > max I_O , T_{ref} = +25°C

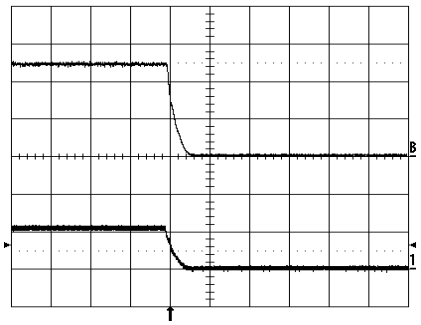
Start-up



Start-up enabled by connecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 20 A resistive load.

Top trace: output voltage (5 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (50 ms/div.).

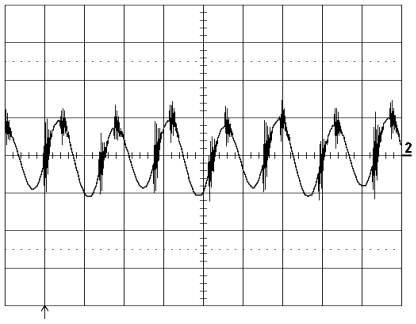
Shut-down



Shut-down enabled by disconnecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O =20 A resistive load.

Top trace: output voltage (5 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (0.5 ms/div.).

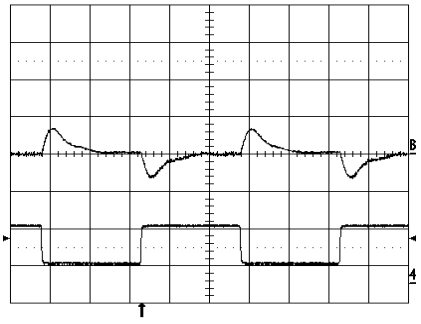
Output Ripple & Noise



Output voltage ripple at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 20 A resistive load.

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

Output Load Transient Response



Output voltage response to load current step-change (5 - 15 - 5 A) at:
T_{ref} =+25°C, V_I = 53 V. Co = 2.2mF

Top trace: output voltage (0.5 V/div.).
Bottom trace: output current (10A/div.).
Time scale: (0.5 ms/div.).

12 V, 20 A / 240 W Electrical Specification — BMR 454 0004/005

T_{P1} = -40 to +90ºC, V_I = 36 to 75 V, sense pins connected to output pins unless otherwise specified under Conditions.
Typical values given at: T_{P1} = +25°C, V_I= 53 V_I max I_O, unless otherwise specified under Conditions.
Additional C_{out} = 0.1 mF, Configuration File: 190 10-CDA 102 1900/005 rev A

Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range		36		75	V
V_{Ioff}	Turn-off input voltage	Decreasing input voltage	32	33	34	V
V_{Ion}	Turn-on input voltage	Increasing input voltage	34	35	36	V
C_I	Internal input capacitance			11		µF
P_O	Output power		0		240	W
η	Efficiency	50 % of max I_O		94.8		%
		max I_O		94.9		
		50 % of max I_O, V_I = 48 V		95.1		
		max I_O, V_I = 48 V		94.9		
P_d	Power Dissipation	max I_O		13.0	17.8	W
P_{li}	Input idling power	I_O = 0 A, V_I = 53 V		3.1		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		123		mW
f_s	Switching frequency	0-100 % of max I_O see Note 2	171	180	189	kHz

V_{Oi}	Output voltage initial setting and accuracy	T_{P1} = +25°C, V_I = 53 V, I_O = 20 A	11.88	12.0	12.12	V
V_O	Output adjust range	See operating information and Note 1	8.1		13.2	V
	Output voltage tolerance band	0-100 % of max I_O	11.76		12.24	V
	Line regulation	max I_O		22	80	mV
	Load regulation	V_I = 53 V, 0-100 % of max I_O		15	57	mV
V_{tr}	Load transient voltage deviation	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/µs see Note 3		±0.3		V
t_{tr}	Load transient recovery time			250		µs
t_r	Ramp-up time (from 10−90 % of V_{Oi})	10-100% of max I_O, T_{P1} = 25ºC, V_I = 53 V see Note 4		8		ms
t_s	Start-up time (from V_I connection to 90 % of V_{Oi})			140		ms
t_f	V_I shut-down fall time (from V_I off to 10 % of V_O)	max I_O		0.4		ms
		I_O = 0 A		5		s
t_{RC}	RC start-up time	max I_O		55		ms
	RC shut-down fall time (from RC off to 10 % of V_O)	max I_O		2.4		ms
		I_O = 0 A		5		s
I_O	Output current		0		20	A
I_{lim}	Current limit threshold	V_O = 10.8 V , T_{P1} < max T_{ref}	21	25	28	A
I_{sc}	Short circuit current	T_{P1} = 25ºC, see Note 5		4	5	A
C_{out}	Recommended Capacitive Load	T_{P1} = 25ºC, see Note 6	0.1	2.2	6	mF
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O		60	120	mVp-p
OVP	Over voltage protection	T_{P1} = +25°C, V_I = 53 V, 10-100 % of max I_O , see Note 7		15.6		V

Note 1: For output voltage below 11V, the BMR 454 0000/XXX is recommended for better efficiency and thermal performance.

Note 2: Frequency may be adjusted with PMBus communication. See Operating Information section

Note 3: Cout = 2.2mF used at load transient test.

Note 4: Start-up and Ramp-up time can be increased via PMBus, see Operation Information section.

Note 5: OCP in hic-up mode

Note 6: Low ESR-value

Note 7: OVP-level can be adjusted via PMBus, see Operation Information.