Technical Specification

BMR 453 series DC/DC converters, Input 36-75 V, Output up to 33 A/396 W	EN/LZT 146 395 R2A April 2009
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Key Features

- Industry standard Quarter-brick
  57.9 x 36.8 x 11.6 mm (2.28 x 1.45 x 0.46 in.)
- High efficiency, typ. 96% at half load, 12 Vout
- +/- 2% output voltage tolerance band
- 1500 Vdc input to output isolation
- 1.1 million hours MTBF
- Optional baseplate
- ISO 9001/14001 certified supplier
- PMBus Revision 1.1 compliant

Power Management

- Programmable Build-in Active Current Share
  up to 792 W in parallel configuration
- Configurable soft start/stop
- Precision delay and ramp-up
- Voltage sequencing and margining
- Voltage/current/temperature monitoring
- Configurable output voltage
- Power good
- Synchronization
- Voltage track

Safety Approvals

SE-57003M1

Design for Environment

Meets requirements in high-temperature lead-free soldering processes.

Contents

General Information

Ordering Information

Product Program

Standard products	Product number
9 V/33 A, 297 W	BMR4530000/002
12 V/33 A, 396 W	BMR4530000/001

Product Number

BMR453	n_1	n_2	n_3	n_4	/	n_5	n_6	n_7
Mechanical pin option	x				/			
Mechanical option		x			/			
Digital Interface 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) 5 = Lead length 2.79 mm stand off 6.7 mm
n_2	0 = Open frame 1 = Baseplate 2 = Baseplate with GND-pin
n_3 n_4	00 = With digital interface 01 = Without digital interface
n_5 n_6 n_7	001 = 12 V Standard configuration 002 = 9 V Standard configuration xxx = Application Specific Configuration
Packaging	20 converters/tray/box PE foam dissipative

Example: Product number BMR4532000/002 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.

Reliability

The Mean Time Between Failure (MTBF) is calculated at full output power and an operating ambient temperature (T_A) of +40°C, which is a typical condition in Information and Communication Technology (ICT) equipment. Different methods could be used to calculate the predicted MTBF and failure rate which may give different results. Ericsson Power Modules currently uses Telcordia SR332. Predicted MTBF for the series is:

- 1.1 million hours according to Telcordia SR332, issue 1, Black box technique.

Telcordia SR332 is a commonly used standard method intended for reliability calculations in ICT equipment. The parts count procedure used in this method was originally modelled on the methods from MIL-HDBK-217F, Reliability Predictions of Electronic Equipment. It assumes that no reliability data is available on the actual units and devices for which the predictions are to be made, i.e. all predictions are based on generic reliability parameters.

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 include:

- Lead in high melting temperature type solder (used to solder the die in semiconductor packages)
- Lead in glass of electronics components and in electronic ceramic parts (e.g. fill material in chip resistors)
- Lead as an alloying element in copper alloy containing up to 4% lead by weight (used in connection pins made of Brass)

Quality Statement

The products are designed and manufactured in an industrial environment where quality systems and methods like ISO 9000, 6σ (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 our products.

Warranty

Warranty period and conditions are defined in Ericsson AB's General Terms and Conditions of Sale. Ericsson AB does not make any other warranties, expressed or implied including any warranty of merchantability, effects of product configurations made by customers or fitness for a particular purpose.

Safety Specification

General information

Ericsson Power Modules DC/DC converters and DC/DC regulators are designed in accordance with safety standards IEC/EN/UL60950, *Safety of Information Technology Equipment*.

IEC/EN/UL60950 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 Directives for the final product.

Component power supplies for general use should comply with the requirements in IEC60950, EN60950 and UL60950 *"Safety of information technology equipment".* There are other more product related standards, e.g. IEEE802.3af "Ethernet LAN/MAN Data terminal equipment power", and ETS300132-2 "Power supply interface at the input to telecommunications equipment; part 2: DC", but all of these standards are based on IEC/EN/UL60950 with regards to safety.

Ericsson Power Modules DC/DC converters and DC/DC regulators are UL60950 recognized and certified in accordance with EN60950.

The flammability rating for all construction parts of the products meets requirements for V-0 class material according to IEC 60695-11-10.

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/UL60950.

Isolated DC/DC converters

It is recommended that a slow blow fuse with a rating twice the maximum input current per selected product 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 in the input filter or in the DC/DC converter that imposes a short circuit on the input source, this fuse will provide the following functions:

- Isolate the faulty DC/DC converter 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 for 60 seconds (refer to Absolute maximum ratings).
Leakage current is less than 1 μA at nominal input voltage.

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 TNV2 circuit and testing has demonstrated compliance with SELV limits and isolation requirements equivalent to Basic Insulation in accordance with IEC/EN/UL60950.

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.

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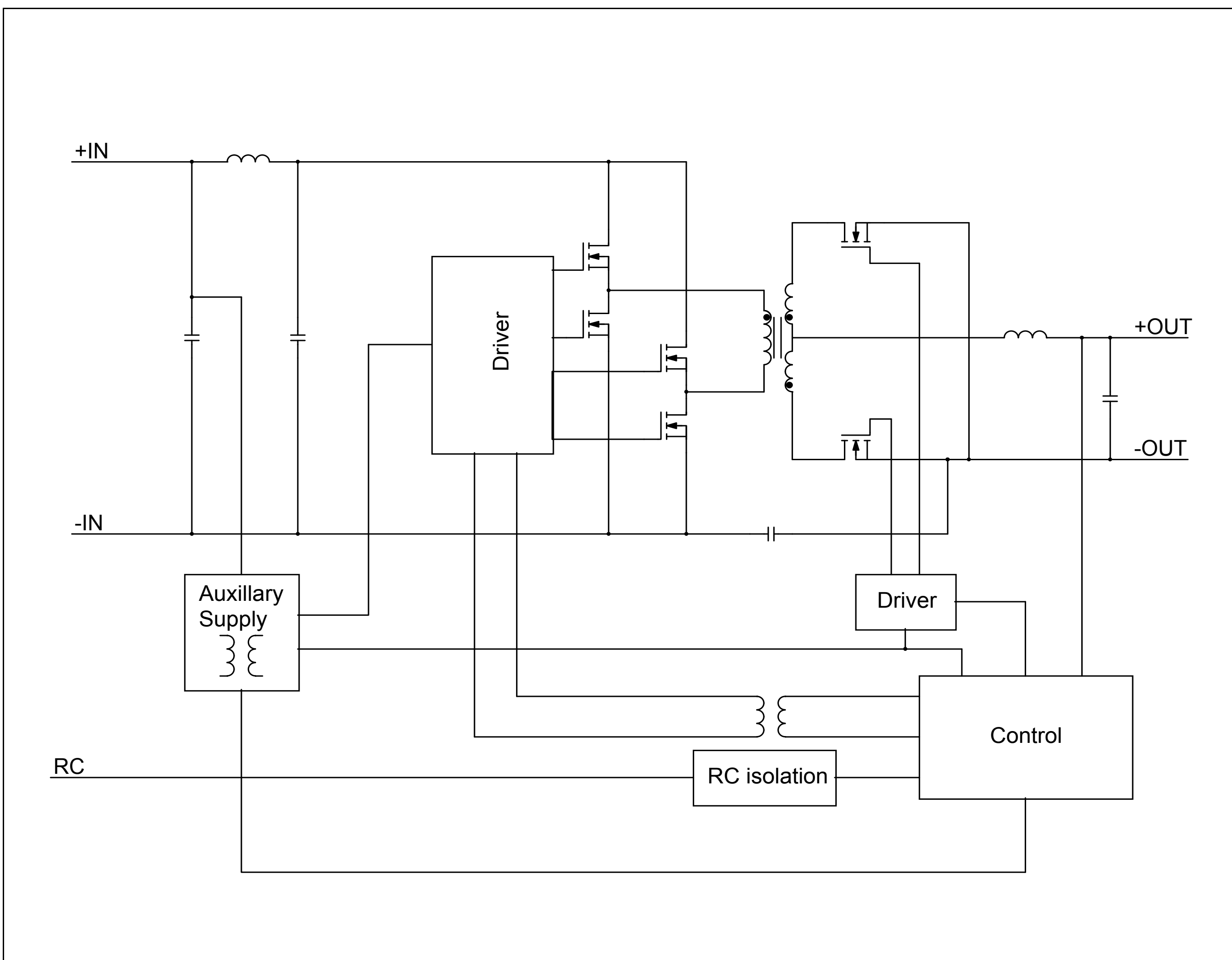
Absolute Maximum Ratings

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	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 102 935/001 rev D

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	-0.1	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	-	38	-	A
		Configurable via PMBus, Note 1	0	-	100	A
	fault response time		-	200	-	µs
Over Temperature Protection, OTP	OTP_FAULT_LIMIT	Factory default	-	135	-	°C
		Configurable via PMBus, Note 1	-50		135	°C
	OTP hysteresis	Factory default		10		°C
		Configurable via PMBus, Note 1	0		165	°C
	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})		CTRL_CS, SA0, SA1, PG_SYNC, SCL, SDA,	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.

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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.
Additional C_{out} = 0.1 mF, Configuration File: 190 10-CDA 102 935/002 rev D

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			18		µF
P_O	Output power		0		297	W
η	Efficiency	50 % of max I_O		96		%
		max I_O		95		%
		50 % of max I_O , V_I = 48 V		96		%
		max I_O , V_I = 48 V		95		%
P_d	Power Dissipation	max I_O		15.5	24.7	W
P_{li}	Input idling power	I_O = 0 A, V_I = 53 V		2.1		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		190		mW
f_s	Default switching frequency	0-100 % of max I_O see Note 1	133	140	145	kHz

V_{Oi}	Output voltage initial setting and accuracy	T_{P1} = +25°C, V_I = 53 V, I_O = 33 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		15	50	mV
	Load regulation	V_I = 53 V, 1-100% of max I_O		60	85	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		8		ms
t_s	Start-up time (from V_I connection to 90% of V_{Oi})			140		ms
t_f	Vin shutdown fall time (from V_I off to 10% of V_O)	max I_O		0.4		ms
		I_O = 0 A		8		s
t_{RC}	RC start-up time	max I_O		53		ms
	RC shutdown fall time (from RC off to 10% of V_O)	max I_O		3.2		ms
		I_O = 0 A		8		s
I_O	Output current		0		33	A
I_{lim}	Current limit threshold	V_O = 8.1V, T_{P1} < max T_{P1}	34	38	43	A
I_{sc}	Short circuit current	T_{P1} = 25ºC, V_O < 0.2V, see Note 4		6		A
C_{out}	Recommended Capacitive Load	T_{P1} = 25ºC, see Note 5	0.1	3.3	6	mF
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O, V_{Oi}		50	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.

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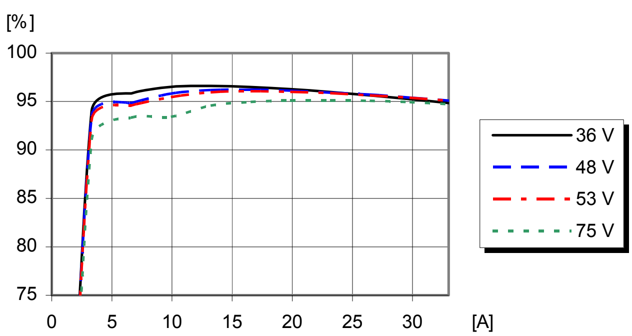
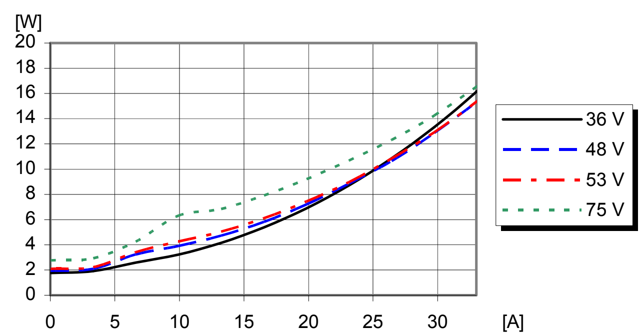
Efficiency



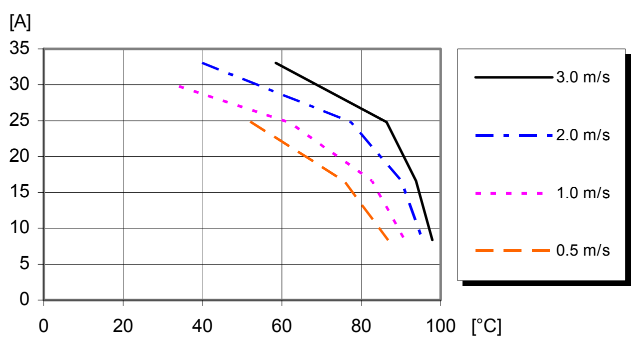
Efficiency vs. load current and input voltage at T_{P1} = +25°C

Power Dissipation



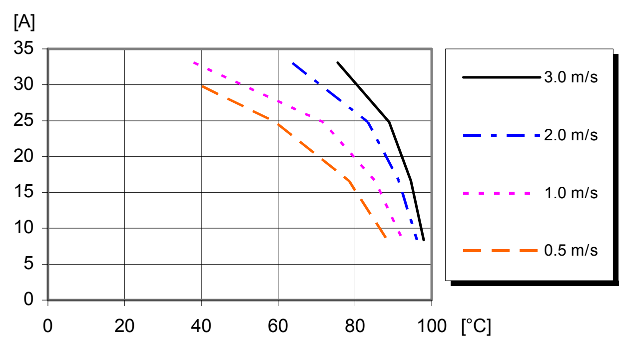
Dissipated power vs. load current and input voltage at T_{P1} = +25°C

Output Current Derating, open frame



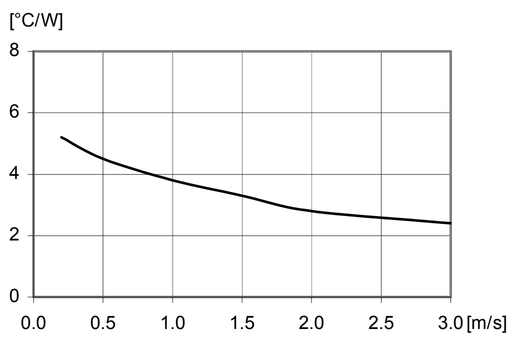
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

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

9.0 V, 33 A/297 W Electrical Specification

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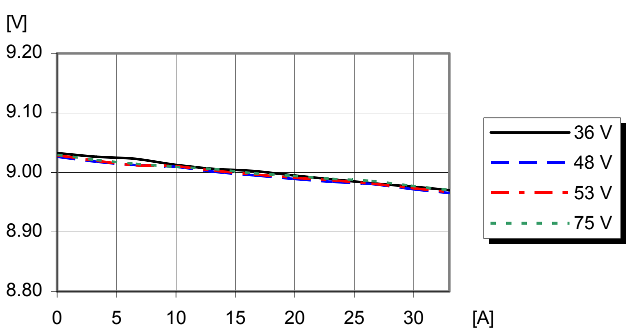
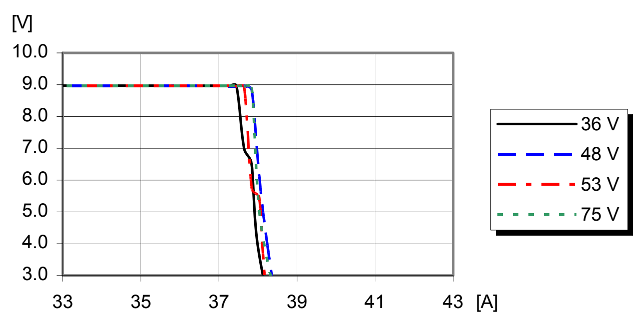
Output Characteristics



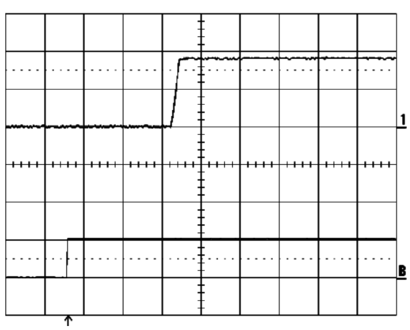
Output voltage vs. load current at T_{P1} = +25°C

Current Limit Characteristics



Output voltage vs. load current at I_O > max I_O , T_{P1} = +25°C

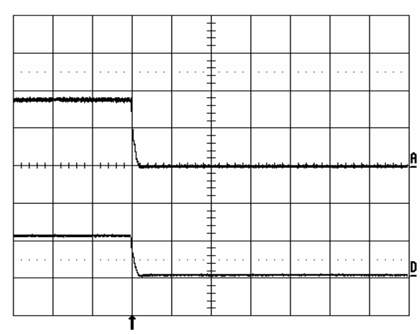
Start-up Start-up



Start-up enabled by connecting V_I at:
T_{P1} = +25°C, V_I = 53 V,
I_O = 33 A resistive load.

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

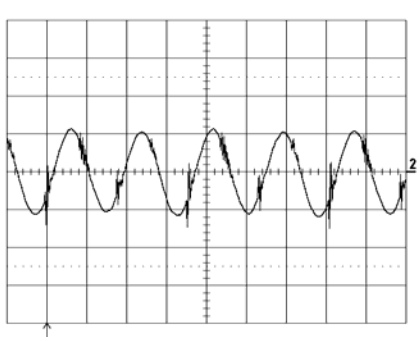
Shut-down



Shut-down enabled by disconnecting V_I at:
T_{P1} = +25°C, V_I = 53 V,
I_O =33 A resistive load.

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

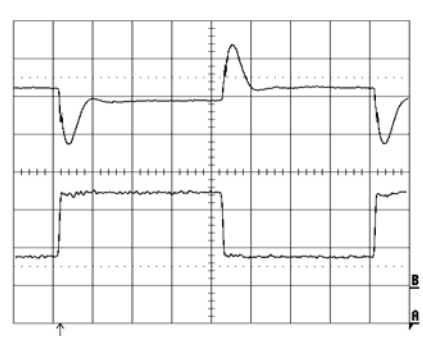
Output Ripple & Noise



Output voltage ripple at:
T_{P1} = +25°C, V_I = 53 V,
I_O = 33 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 (8.25-24.75-8.25 A) at:
T_{P1} =+25°C, V_I = 53 V.

Top trace: output voltage (0.2 V/div.).
Bottom trace: output current (10A/div.).
Time scale: (0.5 ms/div.).

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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.
Additional C_{out} = 0.1 mF, Configuration File: 190 10-CDA 102 935/001 rev D

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			18		μF
P_O	Output power		0		396	W
η	Efficiency	50 % of max I_O		96.5		%
		max I_O		95.5		%
		50 % of max I_O , V_I = 48 V		96.5		%
		max I_O , V_I = 48 V		95.5		%
P_d	Power Dissipation	max I_O		18.3	27.1	W
P_{li}	Input idling power	I_O = 0 A, V_I = 53 V		2.4		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		190		mW
f_s	Default switching frequency	0-100 % of max I_O see Note 2	133	140	145	kHz

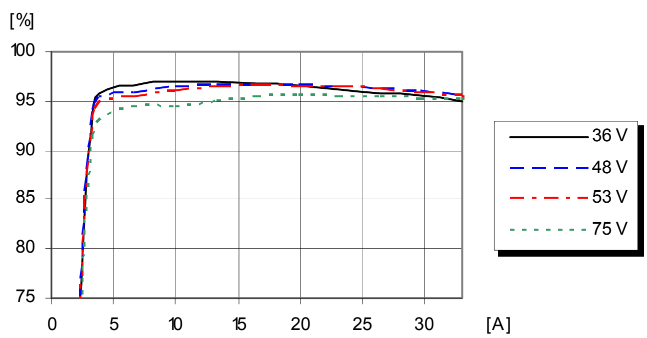
V_{Oi}	Output voltage initial setting and accuracy	T_{P1} = +25°C, V_I = 53 V, I_O = 33 A	11.88	12.0	12.12	V
V_O	Output adjust range	See operating information	8.1		13.2	V
	Output voltage tolerance band	0-100% of max I_O, see Note 1	11.76		12.24	V
	Line regulation	max I_O, see Note 1		20	60	mV
	Load regulation	V_I = 53 V, 1-100% of max I_O, see Note 1		60	90	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		±0.4		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	Vin shutdown fall time (from V_I off to 10% of V_O)	max I_O		0.4		ms
		I_O = 0 A		7		s
t_{RC}	RC start-up time	max I_O		53		ms
	RC shutdown fall time (from RC off to 10% of V_O)	max I_O		3.2		ms
		I_O = 0 A		7		s
I_O	Output current		0		33	A
I_{lim}	Current limit threshold	V_O = 10.8 V, T_{P1} < max T_{ref}	34	38	43	A
I_{sc}	Short circuit current	T_{P1} = 25ºC, see Note 5		-		A
C_{out}	Recommended Capacitive Load	T_{P1} = 25ºC, see Note 6	0.1	3.3	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 = 3.3mF 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 latch mode
Note 6: Low ESR-value
Note 7: OVP-level can be adjusted via PMBus, see Operation Information.

12.0 V, 33 A/396 W Electrical Specification

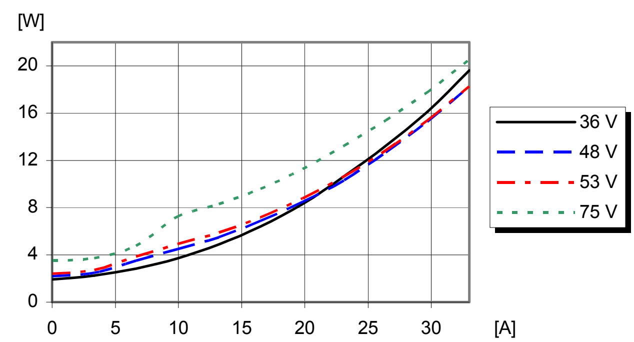
BMR 453 0000/001

Efficiency



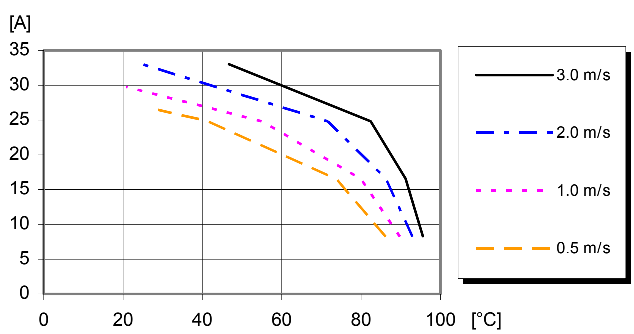
Efficiency vs. load current and input voltage at T_{P1} = +25°C

Power Dissipation



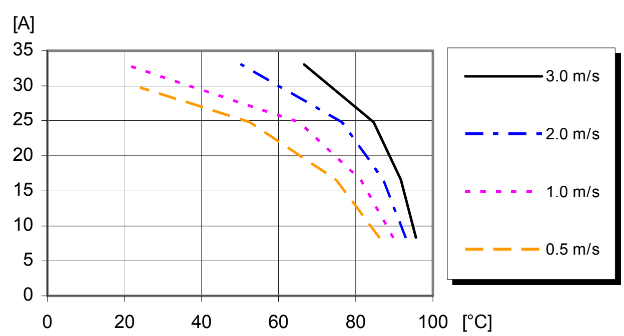
Dissipated power vs. load current and input voltage at T_{P1} = +25°C

Output Current Derating, open frame



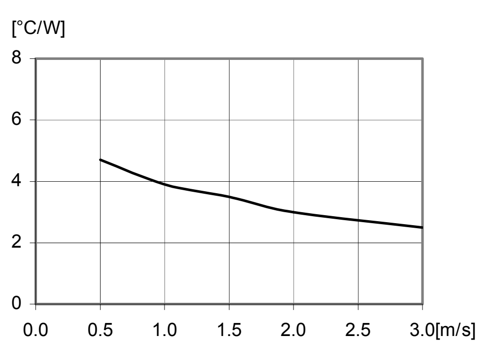
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

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

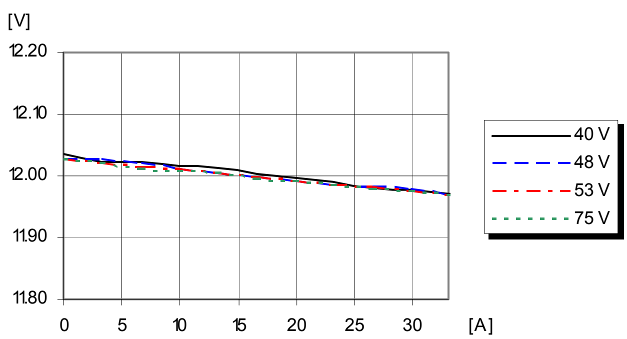


Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section. V_I = 53 V, I_O = 25 A

12.0 V, 33 A/396 W Electrical Specification

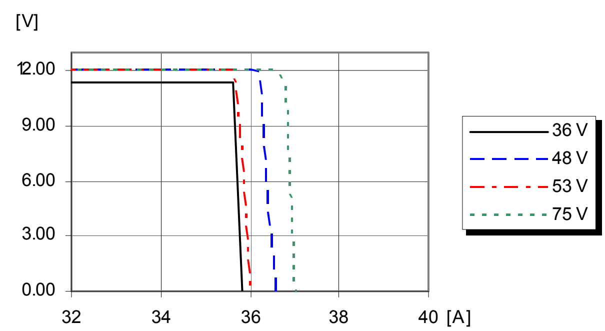
BMR 453 0000/001

Output Characteristics



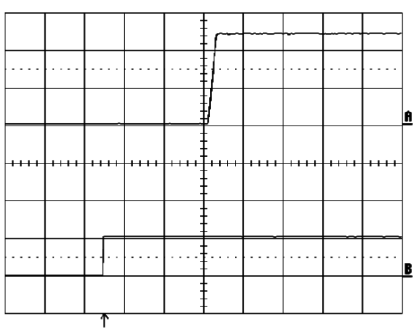
Output voltage vs. load current at T_{P1} = +25°C
The output voltage range is limited at 36V input voltage.

Current Limit Characteristics



Output voltage vs. load current at I_O > max I_O , T_{P1} = +25°C

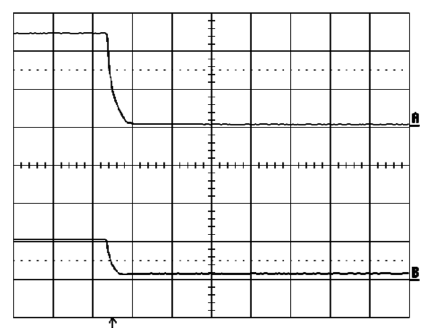
Start-up



Start-up enabled by connecting V_I at:
T_{ref} = +25°C, V_I = 53 V,
I_O = 33 A resistive load.

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

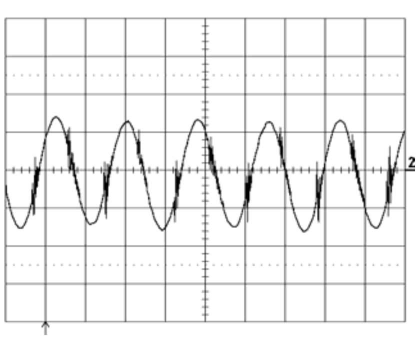
Shut-down



Shut-down enabled by disconnecting V_I at:
T_{P1} = +25°C, V_I = 53 V,
I_O =33 A resistive load.

Top trace: output voltage (5 V/div.).
Bottom trace: input voltage (50 V/div.).
Time scale: (1 ms/div.).

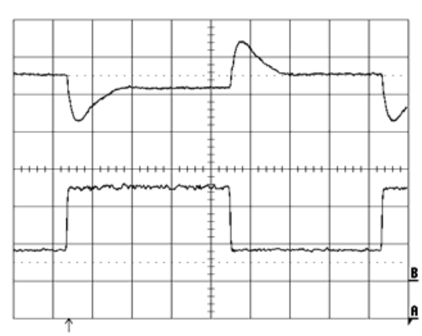
Output Ripple & Noise



Output voltage ripple at:
T_{P1} = +25°C, V_I = 53 V,
I_O = 33 A resistive load.

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

Output Load Transient Response



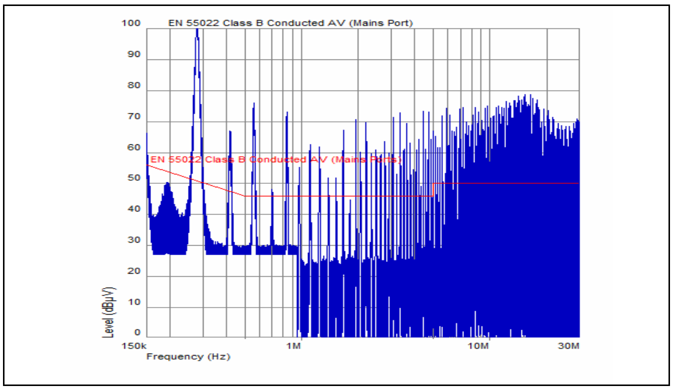
Output voltage response to load current step-change (8.25-24.75-8.25 A) at:
T_{P1} =+25°C, V_I = 53 V, C_O = 3.3mF.

Top trace: output voltage (0.2 V/div.).
Bottom trace: output current (10A/div.).
Time scale: (0.5 ms/div.).

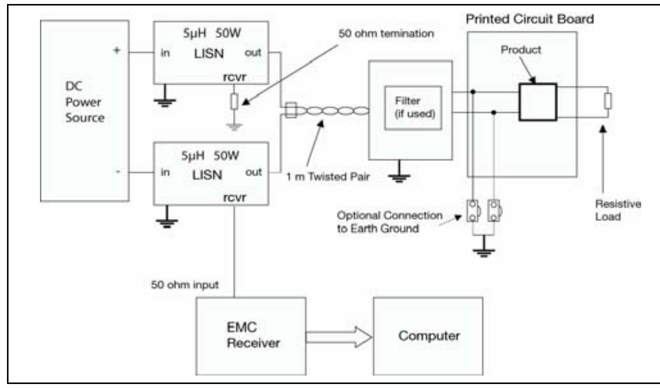
EMC Specification

Conducted EMI measured according to EN55022, CISPR 22 and FCC part 15J (see test set-up). See Design Note 009 for further information. The fundamental switching frequency is 140 kHz for BMR 453 @ V_I = 53 V, max I_O.

Conducted EMI Input terminal value (typ)



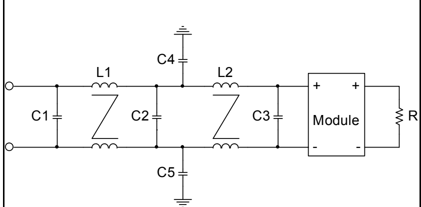
EMI without filter



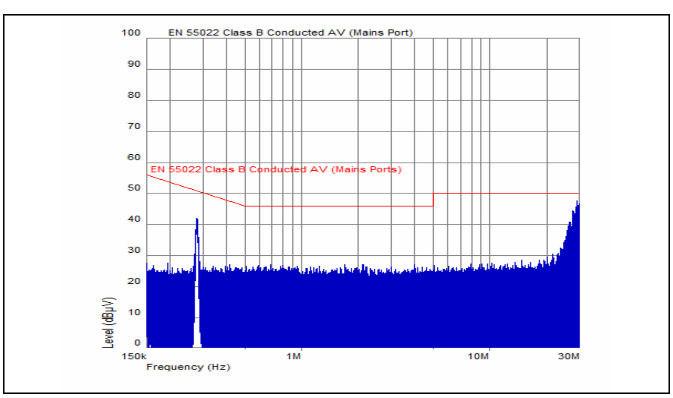
Test set-up

External filter (class B)

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



Filter components:
C1 = 1 + 1 µF
C2 = 1 + 1 µF
C3 = 220 µF
C4 = 2.2 nF
C5 = 2.2 nF
L1 = 0.81 mH
L2 = 0.81 mH



EMI with filter

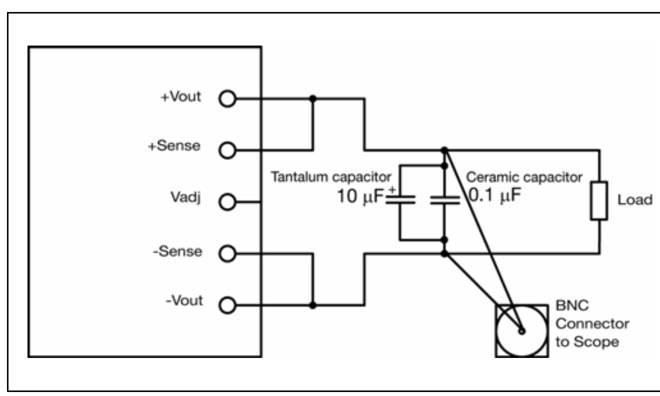
Layout recommendation

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 one of the output terminals 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.

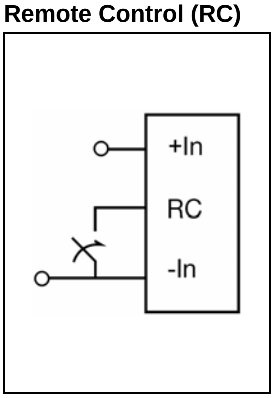


Output ripple and noise test setup

Operating information

Input Voltage
The input voltage range 36 to 75 Vdc meets the requirements of the European Telecom Standard ETS 300 132-2 for normal input voltage range in -48 and -60 Vdc systems, -40.5 to -57.0 V and –50.0 to -72 V respectively.
At input voltages exceeding 75 V, the power loss will be higher than at normal input voltage and T_{P1} must be limited to absolute max +125°C. The absolute maximum continuous input voltage is 80 Vdc.

Turn-off Input Voltage
The product monitors the input voltage and will turn on and turn off at predetermined levels. The turn on and turn off level and the hysteresis in between can be configured via the PMBus. The default hysteresis between turn on and turn off input voltage is set to 2 V.

Remote Control (RC)


The products are fitted with a configurable remote control function. The primary remote control is referenced to the primary negative input connection (-In). The RC function allows the converter 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 remote control functions can also be configured using the PMBus.

The maximum required sink current is 1 mA. When the RC pin is left open, the voltage generated on the RC pin is max 6 V. The logic options for the primary remote control is configured using the PMBus. The default setting is negative logic.

Remote Control (secondary side)
The CTRL CS pin can be configured as remote control via the PMBus interface. In the default configuration the CTRL CS pin is disabled and the output has an internal pull-up to 3.3 V. The CTRL CS pin can be left open when not used. The logic options for the secondary remote control can be positive or negative logic.

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 input source has low characteristic impedance. Minimum recommended external input capacitance is 100 uF. The performance in some applications can be enhanced by addition of external capacitance as described under External Decoupling Capacitors.

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 recommended minimum capacitance on the output is 100 uF. 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. Ceramic capacitors will also reduce any high frequency noise across the load.

It is equally important to use low resistance and low inductance PWB layouts and cabling.
External decoupling capacitors will become part of the control loop of the product and may affect the stability margins. As a “rule of thumb”, 100 µF/A of output current can be added without any additional analysis. The ESR of the capacitors is a very important parameter. Power Modules guarantee stable operation with a verified ESR value of >10 mΩ across the output connections.
For further information please contact your local Ericsson Power Modules representative.

PMBus configuration and support
The products provide 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. Please contact your local Ericsson Power Modules representative for appropriate SW tools to down-load new configurations.

Output Voltage Adjust using PMBus
The output voltage of the product can be reconfigured using the PMBus interface. The output voltage can be adjusted from 8.1 V to 13.2 V.

Margin Up/Down Controls
These controls allow the output voltage to be momentarily adjusted, either up or down, by a nominal 10%. This provides a convenient method for dynamically testing the operation of the load circuit over its supply margin or range. It can also be used to verify the function of supply voltage supervisors.
The margin up and down levels of the product can be re-configured using the PMBus interface.

Operating information continued

Soft-start Power Up

The soft-start control introduces a time-delay (default setting 40 ms) before allowing the output voltage to rise. The default rise time of the ramp up is 10 ms. Power-up is hence completed within 50 ms in default configuration using remote control. When starting by applying input voltage the control circuit boot-up time adds an additional 100 ms delay. The soft-start power up of the product can be reconfigured using the PMBus interface.

Remote Sense

The products have remote sense that can be used to compensate for voltage drops between the output and the point of load. The sense traces should be located close to the PWB ground layer to reduce noise susceptibility. The remote sense circuitry will compensate for up to 10% voltage drop between output pins and the point of load. If the remote sense is not needed +Sense should be connected to
+Out and -Sense should be connected to -Out. To be able to use remote sense the converter must be equipped with a digital connector.

Temperature Protection (OTP, UTP)

The products are protected from thermal overload by an internal temperature shutdown protection.
When T_{P1} as defined in thermal consideration section is exceeded the product will shut down. 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, the hysteresis is defined in general electrical specification.
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 of the product.

Over Voltage Protection (OVP)

The product has output over voltage protection that will shut down the converter in over voltage conditions (latching mode) The OVP fault level and fault response can be re-configured using the PMBus interface.

Over Current Protection (OCP)

The product includes current limiting circuitry for protection at continuous overload. The product will shut down if the max output current (max I_O) is exceeded and the output voltage is below 3.6 V. The load distribution should be designed for the maximum output short circuit current specified. The OCP level and fault response can be re-configured using the PMBus interface. The default configuration is set to hic-up mode for the over current protection.

Input Over/Under voltage protection

The input of the product can be protected agains high input voltage and low input voltage. The over- and under-voltage fault level and fault response can be configured via the PMBus interface.

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.

Power Good

The PG SYNC pin can be configured as an output (POWER GOOD). The power good signal (TTL level) indicates proper operation of the product and can also be used as an error flag indicator. The PG SYNC pin has POWER GOOD as default configuration with the output set as active low. The PG SYNC pin is configured via the PMBus interface.

Tracking and External reference

The PG SYNC pin can be configured as an input for voltage tracking or an external analogue reference.
The PG SYNC pin is configured via the PMBus interface and has default setting Power Good.

Switching frequency adjust using PMBus

The switching frequency is set to 140 kHz 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, (125 kHz – 150 kHz). However the output performance is not specified if the frequency is changed.

BMR 453 series DC/DC converters, Input 36-75 V, Output up to 33 A/396 W	EN/LZT 146 395 R2A April 2009 © Ericsson AB

Parallel Operation

Two products can be directly connected in parallel for active current sharing. No external current sharing circuit are required. However both modules need to be pre-configured: one as a “master” the other one as a “slave”. The recommended configuration parameters are presented in the table below.

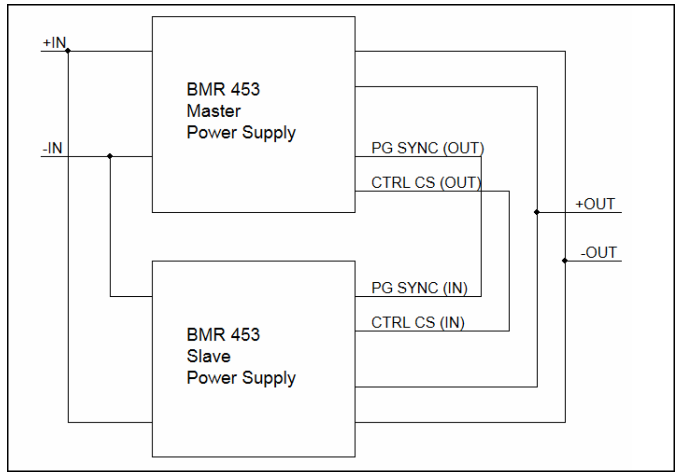
The slave module will be synchronized with the master via the PG_SYNC-pin and output current information will be sent to the slave via the CTRL CS-pin. Frequency Interleaving will be provided which will reduce the input line current ripple. The switching frequencies 125 kHz, 140 kHz and 150 kHz, may be used in order to support synchronisation during current share mode.

The same frequency should be selected on both paralleled products. The necessary electrical connections are showed in the figure. With a good PWB layout (equal trace resistances from each module to the connection point), the current sharing is very well balanced and both products are able to provide their full output current, i.e. the total maximum output current is 2x$I_O$max. **During start-up (i.e. until both master and slave unit reach the requested output voltage) the load current must be limited to 33 A and the master must start-up before the slave.** See table below for recommended master and slave configuration.

When two products are paralleled the output voltage may be limited depending on input voltage and load current. The graphs below show examples of the maximum available output voltage vs. input voltage and output current.

Synchronization with Frequency Interleaving

In order to reduce the input line current ripple, two products may be synchronized including frequency interleaving. Similarly as in the parallel configuration one module must be configured as a master, the other one as a slave. Only the sync signal should be provided from the master to the slave module. The same switching frequency restrictions as for the paralleling are valid. When the PG SYNC pin is configured as an input (SYNC IN) the device will automatically check for a clock signal on the PG SYNC pin each time the module is enabled by RC or via PMBus.

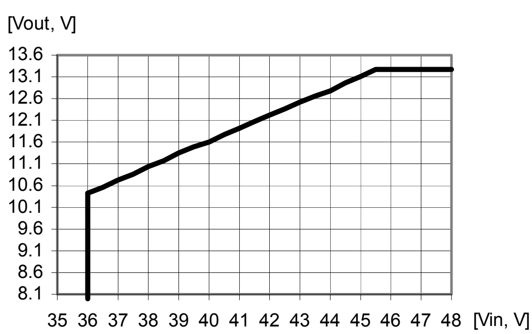


Pin	Designation	Function
1	+IN	Positive input voltage
4	-IN	Negative input voltage
5	-OUT	Negative output voltage
12	PG SYNC (IN) Slave	Sync signal (input)
12	PG SYNC (OUT) Master	Sync signal (output)
15	CTRL CS (IN) Slave	Current share signal (input)
15	CTRL CS (OUT) Master	Current share signal (output)
16	+OUT	Positive output voltage

Master and slave configuration for current share mode at 12 V output voltage

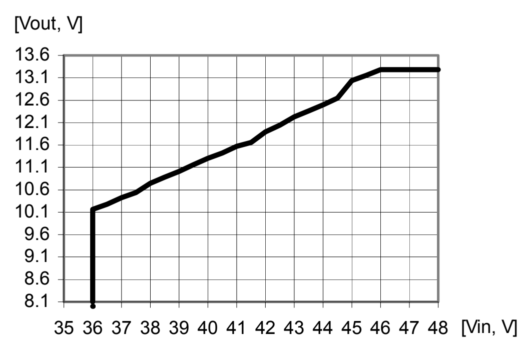
Code	Command	Default setting Current Share mode (Master)	Default setting Current Share mode (Slave)	Comment
0xF9	MULTI_PIN_CONFIG	0xC0	0x60	Configure the multi pin (Pin 12) for master and slave.
0x60	TON_DELAY	0x0028 (40 ms)	0x0037 (55 ms)	The slave must have a 15 ms start-up delay compared to the master if the converters shall start
0x35	VIN_ON	0x0022 (42 V) (For other output voltages see graph “Output voltage regulation”)	0x0023 (43 V) (For other output voltages see graph “Output voltage regulation”)	1 V higher turn on level for the slave. The slave regulation range is ± 1 V, from the initial start up point.
0x33	FREQUENCY_SWITCH	0x008C (140 kHz)	0x008C (140 kHz)	It is important that the same frequency is set in both master and slave, to be able to sync master and slave.

Output voltage regulation @ 33 A and 25°C



Output voltage regulation vs input voltage at: T_{P1} = +25°C, I_O = 33 A resistive load. (Note 33 A is maximum load current at start-up)

Output voltage regulation @ 66 A and 25°C



Output voltage regulation vs input voltage at: T_{P1} = +25°C, I_O = 66 A resistive load.

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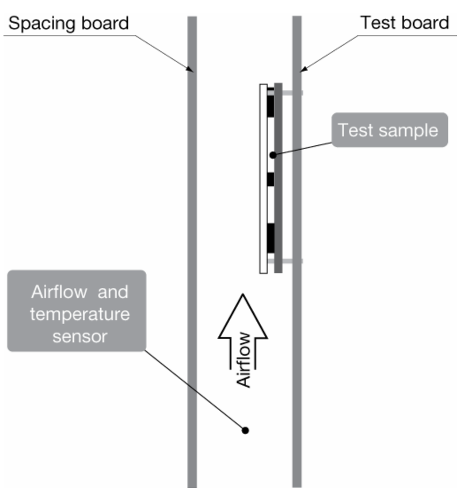
Thermal Consideration

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 dependant 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.

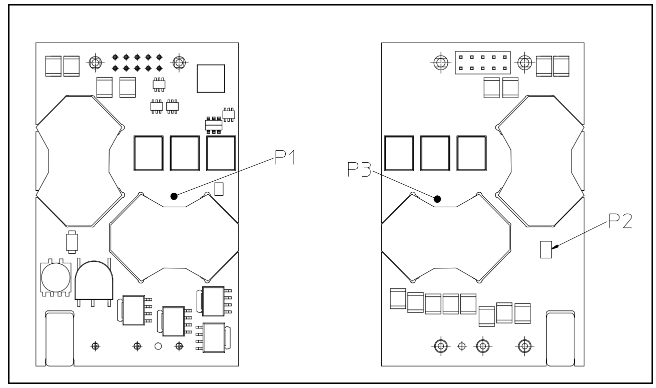
The product is tested on a 254 x 254 mm, 35 µm (1 oz), 8-layer test board mounted vertically in a wind tunnel with a cross-section of 608 x 203 mm.



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, P2, P3. The temperature at these positions (T_{P1}, T_{P2}, T_{P3}) 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 (P3 for base plate versions) are not allowed and may cause permanent damage.

Position	Description	Max temperature
P1	PWB (reference point)	T_{P1}=125° C
P3	PWB (reference point for base-plate version)	T_{P1}=125° C
P2	Opto-coupler	T_{P2}=105° C



Top view

Bottom view (base plate version)

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 ((1/η) - 1) × output power = power losses (Pd).
η = efficiency of product. E.g. 95% = 0.95

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 significantly reduced if a heat sink is mounted on the top of the base plate.***

Calculate the temperature increase (ΔT).
ΔT = Rth x Pd

3. Max allowed ambient temperature is:
Max T_{P1} - ΔT.

E.g. BMR 453 5100/001 at 2 m/s:

1. $((\frac{1}{0.944}) - 1) \times 396\text{ W} = 23.5\text{ W}$

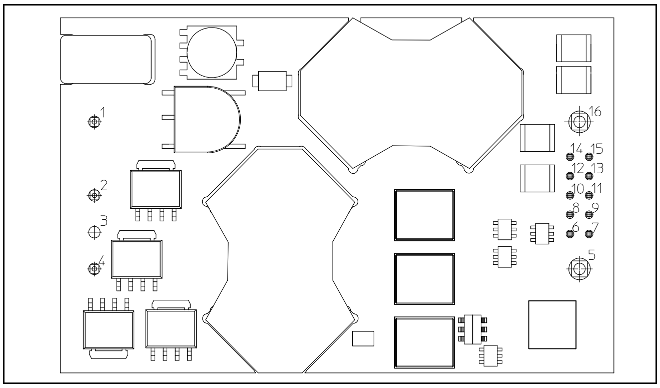
2. 23.5 W × 3.1°C/W = 73°C

3. 125 °C – 73°C = max ambient temperature is 52°C

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

BMR 453 series DC/DC converters, Input 36-75 V, Output up to 33 A/396 W	EN/LZT 146 395 R2A April 2009 © Ericsson AB

Connections (Top view)



Pin	Designation	Function
1	+In	Positive Input
2	RC	Remote Control
3	Case	Case to GND (optinal)
4	-In	Negative Input
5	-Out	Negative Output
6	S+	Positive Remote Sense
7	S-	Negative Remote Sense
8	SA0	Address pin 0
9	SA1	Address pin 1
10	SCL	PMBus Clock
11	SDA	PMBus Data
12	PG SYNC	Configurable I/O pin: Power Good output, SYNC-, tracking-, or ext ref-input
13	DGND	PMBus ground
14	SALERT	PMBus alert signal
15	CTRL CS	PMBus remote control or Current share
16	+Out	Positive Output

PMBus Communications

The products provide 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 products can be used with any standard two-wire I^2C or SMBus host device. In addition, the device is compatible with PMBus version 1.1 and includes an SALERT line to help mitigate bandwidth limitations related to continuous fault monitoring.

Monitoring via PMBus

A system controller can monitor a wide variety of different parameters through the PMBus interface. The controller can monitor for fault condition by monitoring the SALERT pin, which will be asserted when any number of pre-configured fault or warning conditions occur. The system controller can also continuously monitor for any number of power conversion parameters including but not limited to the following:

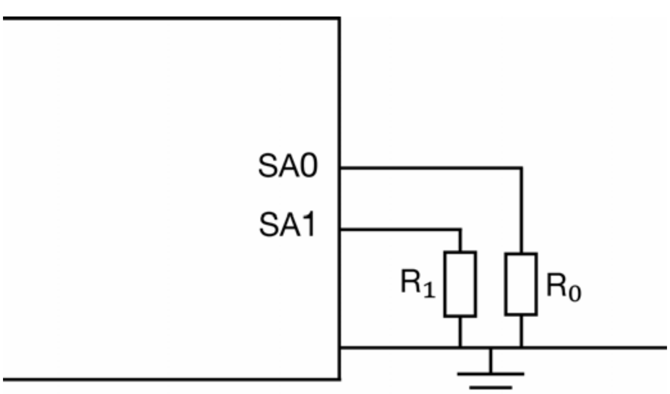
- Input voltage
- Output voltage
- Output current
- Internal junction temperature
- Switching frequency
- Duty cycle

Evaluation software

A Configuration Monitoring and Management (CMM) evaluation software, is available for the products.
For more information please contact your local Ericsson Power Modules sales representative.

Addressing

The figure and table below show recommended resistor values with min and max voltage range for hard-wiring PMBus addresses (series E96, 1% tolerance resistors suggested):



SA0/SA1	R_1 /R_0 [kΩ]	Min voltage[V]	Max voltage[V]
0	24.9	0.261	0.438
1	49.9	0.524	0.679
2	75	0.749	0.871
3	100	0.926	1.024
4	124	1.065	1.146
5	150	1.187	1.256
6	174	1.285	1.345
7	200	1.371	1.428

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

PMBus Address = 8 x (SA0value) + (SA1 value)

If any one of those voltage applied to ADC0 and ADC1 is out of the range from the table above, PMBus address 127 is assigned. If the calculated PMBus address is 0 or 12, PMBus address 127 is assigned instead. PMBus address 11 is not to be used. The user shall also be aware of further limitations of the addresses as stated in the PMBus Specification.

PMBus Commands

The DC/DC converter is PMBUS compliant. The following table lists the implemented PMBus commands. For more detailed information see PMBus Power System Management Protocol Specification; Part I – General Requirements, Transport and Electrical Interface and PMBus Power System Management Protocol; Part II – Command Language.

Designation	Cmd	Impl
Standard PMBus Commands		
Control Commands		
PAGE	00h	No
OPERATION	01h	Yes
ON_OFF_CONFIG	02h	Yes
WRITE_PROTECT	10h	Yes
Output Commands		
VOUT_MODE	20h	Yes
VOUT_COMMAND	21h	Yes
VOUT_TRIM	22h	Yes
VOUT_GAIN	23h	Yes
VOUT_MAX	24h	Yes
VOUT_MARGIN_HIGH	25h	Yes
VOUT_MARGIN_LOW	26h	Yes
VOUT_TRANSITION_RATE	27h	Yes
VOUT_DROOP	28h	No
VOUT_SCALE_LOOP	29h	Yes
VOUT_SCALE_MONITOR	2Ah	Yes
COEFFICIENTS	30h	No
POUT_MAX	31h	No
MAX_DUTY	32h	Yes
FREQUENCY_SWITCH	33h	Yes
VIN_ON	35h	Yes
VIN_OFF	36h	Yes
IOUT_CAL_GAIN	38h	Yes
IOUT_CAL_OFFSET	39h	Yes
Fault Limit Commands		
POWER_GOOD_ON	5Eh	Yes
POWER_GOOD_OFF	5Fh	Yes
VOUT_OV_FAULT_LIMIT	40h	Yes
VOUT_UV_FAULT_LIMIT	44h	Yes
IOUT_OC_FAULT_LIMIT	46h	Yes
IOUT_OC_LV_FAULT_LIMIT	48h	Yes
IOUT_UC_FAULT_LIMIT	4Bh	No
OT_FAULT_LIMIT	4Fh	Yes

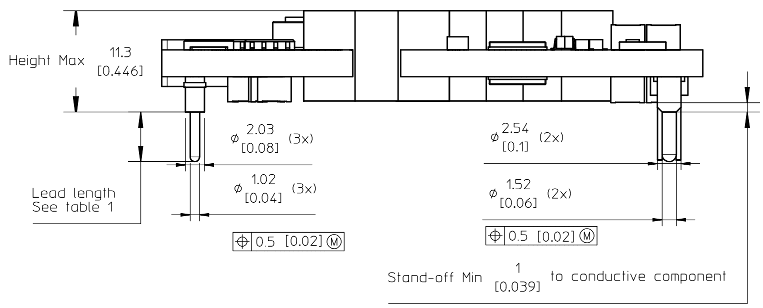
Designation	Cmd	Impl
OT_WARN_LIMIT	51h	Yes
UT_WARN_LIMIT	52h	Yes
UT_FAULT_LIMIT	53h	Yes
VIN_OV_FAULT_LIMIT	55h	Yes
VIN_OV_WARN_LIMIT	57h	Yes
VIN_UV_WARN_LIMIT	58h	Yes
VIN_UV_FAULT_LIMIT	59h	Yes
VOUT_OV_WARN_LIMIT	42h	Yes
VOUT_UV_WARN_LIMIT	43h	Yes
IOUT_OC_WARN_LIMIT	4Ah	Yes
IIN_OC_FAULT_LIMIT	5Bh	No
IIN_OC_WARN_LIMIT	5Dh	No
Fault Response Commands		
VOUT_OV_FAULT_RESPONSE	41h	Yes
VOUT_UV_FAULT_RESPONSE	45h	Yes
OT_FAULT_RESPONSE	50h	Yes
UT_FAULT_RESPONSE	54h	Yes
VIN_OV_FAULT_RESPONSE	56h	Yes
VIN_UV_FAULT_RESPONSE	5Ah	Yes
IOUT_OC_FAULT_RESPONSE	47h	Yes
IOUT_UC_FAULT_RESPONSE	4Ch	No
IIN_OC_FAULT_RESPONSE	5Ch	No
Time setting Commands		
TON_DELAY	60h	Yes
TON_RISE	61h	Yes
TON_MAX_FAULT_LIMIT	62h	Yes
TON_MAX_FAULT_RESPONSE	63h	Yes
TOFF_DELAY	64h	Yes
TOFF_FALL	65h	Yes
TOFF_MAX_WARN_LIMIT	66h	Yes
Status Commands (Read Only)		
CLEAR_FAULTS	03h	Yes
STATUS_BYTES	78h	Yes
STATUS_WORD	79h	Yes
STATUS_VOUT	7Ah	Yes
STATUS_IOUT	7Bh	Yes
STATUS_INPUT	7Ch	Yes
STATUS_TEMPERATURE	7Dh	Yes
STATUS_CML	7Eh	Yes
STATUS_OTHER	7Fh	Yes
Monitor Commands (Read Only)		
READ_VIN	88h	Yes

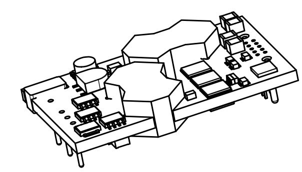
Designation	Cmd	Impl
READ_VOUT	8Bh	Yes
READ_IOUT	8Ch	Yes
READ_TEMPERATURE_1	8Dh	Yes
READ_TEMPERATURE_2	8Eh	Yes
READ_FAN_SPEED_1	90h	No
READ_DUTY_CYCLE	94h	Yes
READ_FREQUENCY	95h	Yes
READ_POUT	96h	No
READ_PIN	97h	No
Identification Commands (Read Only)		
PMBUS_REVISION	98h	Yes
MFR_ID	99h	Yes
MFR_MODEL	9Ah	Yes
MFR_REVISION	9Bh	Yes
MFR_LOCATION	9Ch	Yes
MFR_DATE	9Dh	Yes
MFR_SERIAL	9Eh	Yes
Group Commands		
INTERLEAVE	37h	No
Supervisory Commands		
STORE_DEFAULT_ALL	11h	Yes
RESTORE_DEFAULT_ALL	12h	Yes
STORE_USER_ALL	15h	Yes
RESTORE_USER_ALL	16h	Yes
BMR 453 Specific Commands		
MFR_POWER_GOOD_POLARITY	D0h	Yes
MFR_VOUT_UPPER_RESISTOR	D2h	Yes
MFR_VIN_SCALE_MONITOR	D3h	Yes
MFR_CLA_TABLE_NUM_ROW	D4h	Yes
MFR_CLA_ROW_COEFFICIENTS	D5h	Yes
MFR_STORE_CLA_TABLE	D6h	Yes
MFR_ACTIVE_COEFF_CLA_TABLE	D8h	Yes
MFR_SELECT_TEMP_SENSOR	DCh	Yes
MFR_VIN_OFFSET	DDh	Yes
MFR_REMOTE_TEMP_CAL	E2h	Yes
MFR_REMOTE_CONTROL	E3h	Yes
MFR_DEAD_BAND_MODE	E4h	Yes
MFR_DEAD_BAND_DELAY	E5h	Yes
MFR_TEMP_COEFF	E7h	Yes
MFR_VOUT_ANALOG_SCALE	E8h	Yes
MFR_READ_VOUT_ANALOG_REF	E9h	Yes
MFR_DEBUG_BUFF	F0h	Yes

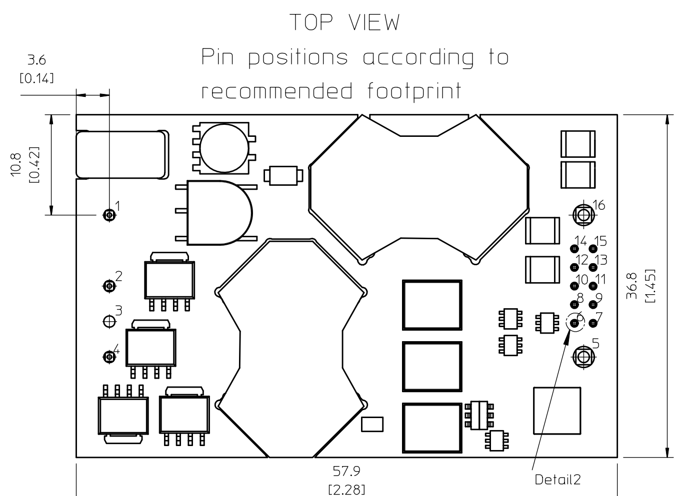
Designation	Cmd	Impl
MFR_SETUP_PASSWORD	F1h	Yes
MFR_DISABLE_SECURITY	F2h	Yes
MFR_DEAD_BAND_IOUT_THRESHOLD	F3h	Yes
MFR_SECURITY_BIT_MASK	F4h	Yes
MFR_PRIMARY_TURN	F5h	Yes
MFR_SECONDARY_TURN	F6h	Yes
MFR_SET_DPWM_POLARITY	F7h	Yes
MFR_ILIM_SOFTSTART	F8h	Yes
MFR_MULTI_PIN_CONFIG	F9h	Yes
MFR_DEAD_BAND_VIN_THRESHOLD	FAh	Yes
MFR_DEAD_BAND_VIN_IOUT_HYS	FBh	Yes
MFR_FIRMEWARE_VERSION	FCh	Yes
MFR_MESSAGE_CODE_DEVICE_ID	FDh	Yes

Notes:
Cmd is short for Command.
Impl is short for Implemented.

Mechanical Information - Hole Mount, Open Frame Version







X1	Lead length
0	5.33 [0.210]
2	3.69 [0.145] (cut)
3	4.57 [0.180] (cut)
4	2.79 [0.110] (cut)
5	2.79 [0.110]

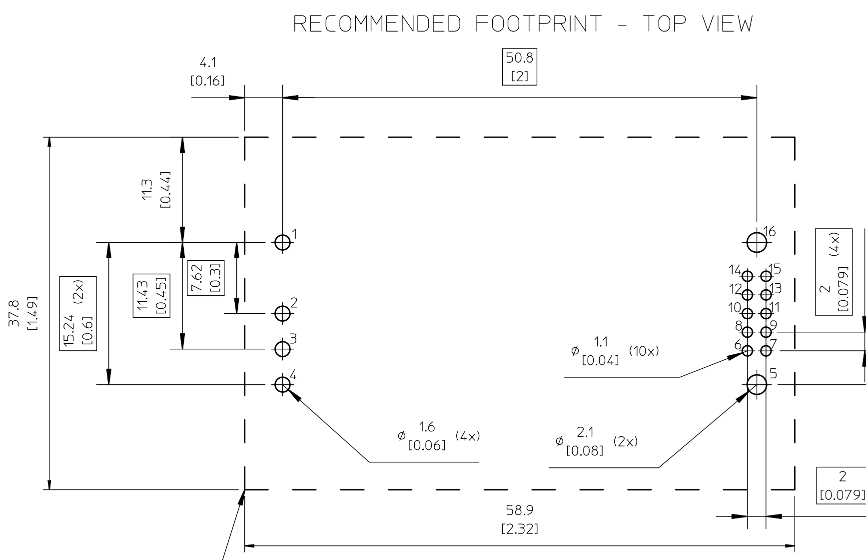
Table 1.
X1 = Ordering information

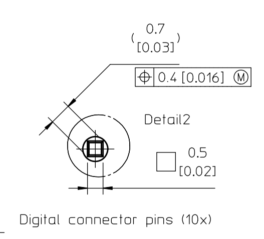
PIN SPECIFICATIONS
Pin 1,2,4,5 & 16 Material: Copper alloy
Plating: Min Au 0.1 µm over 1-3 µm Ni.
Pin 6-15 Material: Brass
Plating: Min Au 0.2 µm over 1.3 µm Ni

NOTE:
Pin 6-15 are optional and only used if digital communication is requested.

X1=5 Are special customer pins with extra stand off 6.7 mm & Max Height 17 mm.

Position 3 is only used for base plate GND connection pin.



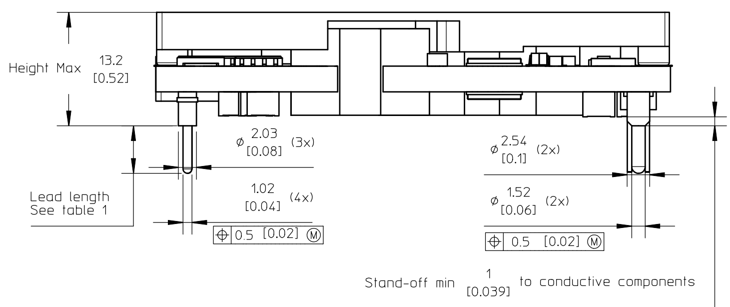


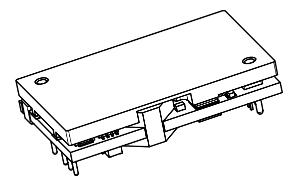
Recommended keep away area for user components.
The stand-off in combination with insulating material ensures that requirements as per IEC/EN/UL60950 are met and 1500 V isolation maintained even if open vias or traces are present under the DC/DC converter.

Weight: Typical 48 g
All dimensions in mm [inch].
Tolerances unless specified:
x.x ±0.50 [0.02], x.xx±0.25 [0.01]
(not applied on footprint or typical values)

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.

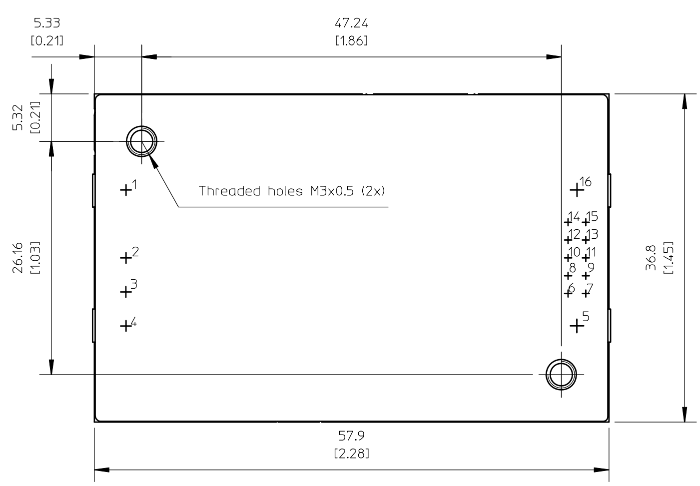
Mechanical Information- Hole Mount, Base Plate Version





TOP VIEW

Pin positions according to recommended footprint



X1	Lead length
0	5.33 [0.210]
2	3.69 [0.145] (cut)
3	4.57 [0.180] (cut)
4	2.79 [0.110] (cut)
5	2.79 [0.110]

Table 1.

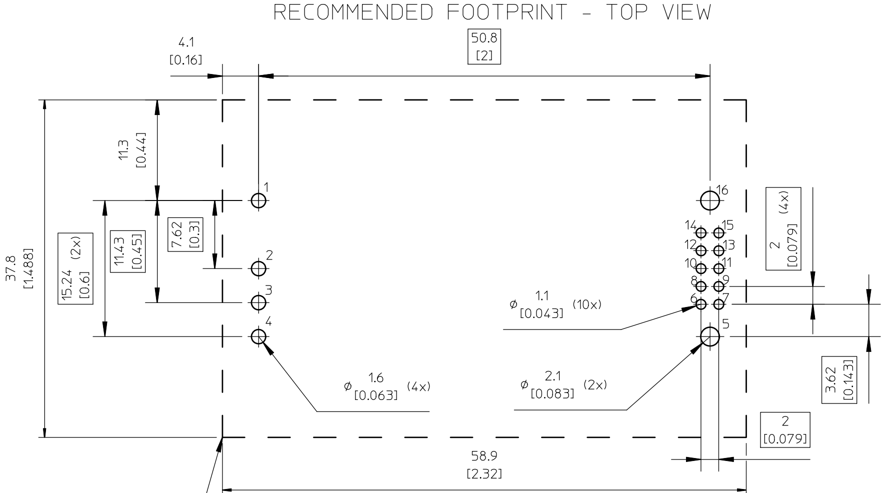
X1 = Ordering information

CASE
Material: Aluminium
For screw attachment apply mounting torque of max 0.44 Nm [3.9 lbf in]. M3 screws must not protrude more than 2.7 mm [0.106] in to the base plate.

PIN SPECIFICATIONS
Pin 1,2,3,4,5 & 16 Material: Copper Alloy
Plating: Min Au 0.1µm over 1-3µm Ni.
Pin 6-15 Material: Brass
Plating: Min Au 0.2µm over 1.3µm Ni.

NOTE
Pin 6-15 are optional and only used if digital communication is requested.
Pin 3 is only used for baseplate GND connection.
X1=5 Are special customer pins with extra stand off 6.7 mm & Max height 18.9 mm.

RECOMMENDED FOOTPRINT - TOP VIEW



Recommended keep away area for user components.
The stand-off in combination with insulating material ensures that requirements as per IEC/EN/UL60950 are met and 1500 V isolation maintained even if open vias or traces are present under the DC/DC converter.

Weight: Typical 67 g
All dimensions in mm [inch].
Tolerances unless specified:
x.x ±0.50 [0.02], x.xx±0.25 [0.01]
(not applied on footprint or typical values)

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.

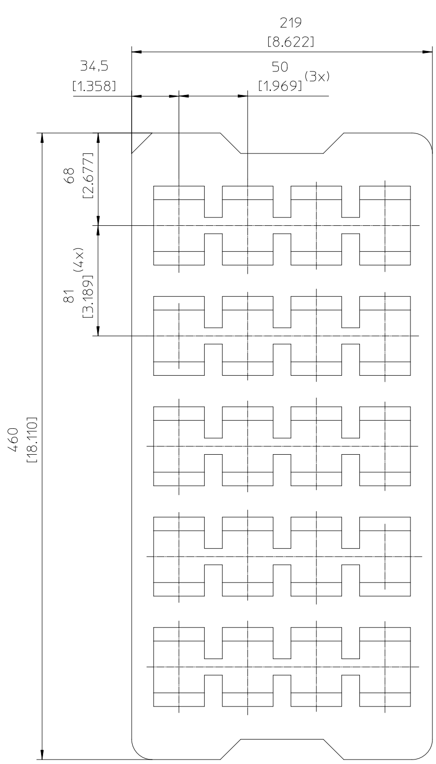
A maximum preheat rate of 4°C/s and maximum preheat temperature of 150°C is suggested. When soldering by hand, care should be taken to avoid direct contact between the hot soldering iron tip and the pins for more than a few seconds in order to prevent overheating.

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 trays.

Tray specifications	
Material	PE foam, dissipative
Surface resistance	10^5 to 10^{12} ohms/square
Tray capacity	20 converters/tray
Box capacity	20 converters
Weight	Product - Open frame 1100 g full tray, 140 g empty tray Product – Base plate option 1480 g full tray, 140 g empty tray



Product Qualification Specification

Characteristics			
External visual inspection	IPC-A-610		
Change of temperature (Temperature cycling)	IEC 60068-2-14 Na	Temperature range Number of cycles Dwell/transfer time	-40 to 100°C 1000 15 min/0-1 min
Cold (in operation)	IEC 60068-2-1 Ad	Temperature T_A Duration	-45°C 72 h
Damp heat	IEC 60068-2-67 Cy	Temperature Humidity Duration	85°C 85 % RH 1000 hours
Dry heat	IEC 60068-2-2 Bd	Temperature Duration	125°C 1000 h
Electrostatic discharge susceptibility	IEC 61340-3-1, JESD 22-A114 IEC 61340-3-2, JESD 22-A115	Human body model (HBM) Machine Model (MM)	Class 2, 2000 V Class 3, 200 V
Immersion in cleaning solvents	IEC 60068-2-45 XA, method 2	Water Glycol ether Isopropyl alcohol	55°C 35°C 35°C
Mechanical shock	IEC 60068-2-27 Ea	Peak acceleration Duration	100 g 6 ms
Moisture reflow sensitivity [1]	J-STD-020C	Level 1 (SnPb-eutectic) Level 3 (Pb Free)	225°C 260°C
Operational life test	MIL-STD-202G, method 108A	Duration	1000 h
Resistance to soldering heat [2]	IEC 60068-2-20 Tb, method 1A	Solder temperature Duration	270°C 10-13 s
Robustness of terminations	IEC 60068-2-21 Test Ua1 IEC 60068-2-21 Test Ue1	Through hole mount products Surface mount products	All leads All leads
Solderability	IEC 60068-2-58 test Td [1] IEC 60068-2-20 test Ta [2]	Preconditioning Temperature, SnPb Eutectic Temperature, Pb-free Preconditioning Temperature, SnPb Eutectic Temperature, Pb-free	150°C dry bake 16 h 215°C 235°C Steam ageing 235°C 245°C
Vibration, broad band random	IEC 60068-2-64 Fh, method 1	Frequency Spectral density Duration	10 to 500 Hz 0.07 g^2/Hz 10 min in each direction

Notes
[1] Only for products intended for reflow soldering (surface mount products)
[2] Only for products intended for wave soldering (plated through hole products)