BMR314

Ultra-small Intermediate Bus Converter

The BMR314 is a powerful and compact digital, non-isolated, unregulated DC/DC converter designed to support Artificial Intelligence applications as a first IBC step before voltage regulation module (VRM) or Point of Load (PoL) solutions are used to further convert the desired downstream core voltages.

The converter has a ratio conversion of 4:1 and provides 800W continuous power and has peak power capabilities of up to 1500W.

The BMR314 delivers a power density of more than 0.3kW/cm³ or 5kW/in³ when delivering peak power to the load.

Key features

- Horizontal mounting non-isolated DC/DC converter
- High power density IBC up to 0.45 kW/cm³
- Ratio conversion 4:1, 800W continuously, 1500W peak power
- Peak efficiency 97.5 %
- LGA industry standard footprint and pinout
- Optimized thermal design for cold wall mounting
- MTBF 7.49 million hours
- Meets safety requirements per IEC/EN/UL 62368-1
- PMBus configuration

Soldering methods

- Pb free SMD reflow

Key electrical information

Parameter	Values
Input range	38-60V
Output voltage	9.5-15V
Output current	62A
Output power	800W
Peak power	1500W

Mechanical

28.2 x 17.8 x 9.65 mm / 1.1 x 0.7 x 0.38 in

Application areas

- Designed for AI applications

Product options

The table below describes the different product options.

Example:	BMR314	1	01	1	/001	C	Definitions
Product family	BMR314						
Mech. solution		1					0 = Open frame 1 = Baseplate, LGA
Sequence number			01				01 = Input 38-60 V, Output 9.5 -15 V, 800 W continuously, 1500 W peak
Function				1			1 = Stacked module
Configuration code					/001		001 = Default config for Input 38-60 V, Output 9.5-15 V, 800 W continuously, 1500 W peak
Packaging options						C	C = Antistatic tape and reel package

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

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

Order number examples

Part number	V_{in}	Output	Configuration
BMR3141011/001C	38-60 V	9.5-15 V / 62 A / 800 W	Baseplate / stacked module / antistatic tape and reel package

Part 1: Electrical specifications

Absolute maximum ratings

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

Characteristics	min	max	Unit
Operating temperature (T_{P1})	-20	125	°C
Storage temperature	-40	125	°C
Input voltage (V_{in}) continious operation	-0.3	60	V
Input voltage transient	-0.3	68	V
C_{out}	0.1	6	mF
Signal I/O voltage (EN, PG, ALERT, ADDR, SCL, SDA)	-0.3	7	V

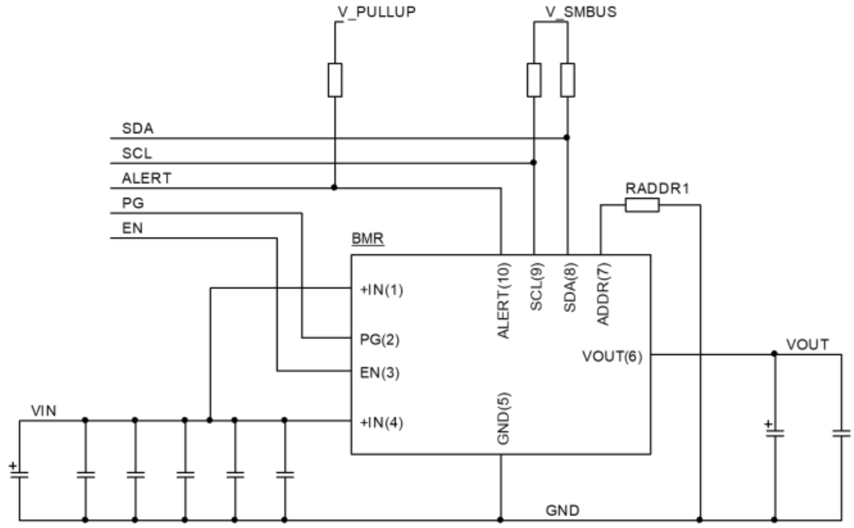
Reliability

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. Flex Power Modules uses Telcordia SR-332 Issue 4 Method 1 to calculate the mean steady-state failure rate and standard deviation (σ). Telcordia SR-332 Issue 4 also provides techniques to estimate the upper confidence levels of failure rates based on the mean and standard deviation.

	Mean	90% confidence level	Unit
Steady-state failure rate (λ)	134	169	nfailures/h
Standard deviation (σ)	27.2		nfailures/h
MTBF	7.5	5.9	MHr

Typical application diagram

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



Electrical specifications for BMR3141011/001

13.5 V, 62 A (115 A peak) / 800 W (1500 W peak)

Min and max values are valid for: T_{P1} = -20 to + 95 °C, V_{in} = 38 to 60 V, I_{out} = 62 A, unless otherwise specified under conditions. Typical values given at: T_{P1} = +25 °C, V_{in} = 54 V, max P_{out_TDP}, unless otherwise specified under conditions, see *Note 1*.

Additional external C_{in} = 470 µF + 2 x 2.2 µF ceramic, C_{out} = 2 x 470 µF

Characteristic	conditions	minimum	typical	maximum	unit
Key features					
Efficiency (η)	Peak		97.5		%
	100 % of P_{out_TDP}		96.5		%
	50 % of P_{out_TDP} V_{in} = 48 V		97.3		%
	100 % of P_{out_TDP} V_{in} = 48 V		96.2		%
P_{out_TDP} thermal design power (TDP)	See Note 1		800		W
P_{out_MAX} peak power	See Note 1		1500		W
Power dissipation	100 % of P_{out_TDP}		29.4		W
Switching frequency (f_s)	0-100 % of P_{out_TDP}		1250		kHz
Recommended capacitive load		40	470	6000	µF
Input characteristics					
Input voltage range (V_{in})		38		60	V
Input idling power	P_{out} = 0 W		4.9		W
Input standby power	(turned off with EN)		560		mW
Input OVP				68	V
Internal input capacitance			14.1		µF
Recommended external input capacitance	See Note 2	100			µF

Note 1: Max. peak power is ≤ 1500 W and continuous power (thermal design power TDP) is ≤ 800 W depending on thermal conditions. Max. output current is rated at 115 A. Max. peak output current is also limited by the Timed OCP threshold and response time, see table Protection features.

*Note 2: Typical value (recommended) is 100 µF + 5*10 µF.*

Electrical specifications for BMR3141011/001

13.5 V, 62 A (115 A peak) / 800 W (1500 W peak)

Min and max values are valid for: T_{P1} = -20 to + 95 °C, V_{in} = 38 to 60 V, I_{out} = 62 A, unless otherwise specified under conditions. Typical values given at: T_{P1} = +25 °C, V_{in} = 54 V, max P_{out_TDP}, unless otherwise specified under conditions, see *Note 1*.

Additional external C_{in} = 470 µF + 2 x 2.2 µF ceramic, C_{out} = 2 x 470 µF

Characteristic	conditions	minimum	typical	maximum	unit
Output characteristics					
Output voltage	P_{out} = 0 W		13.54		V
Output voltage	Disabled, no load		2.7		V
Output voltage	Disabled, 1 kΩ load		0.15		V
Output current (I_{out})	V_{in} = 38 - 60 V, PG asserted		62	115	A
Output current (I_{out})	Before PG, V_{in} = 54 V, C_{out} = 1.0 mF, Note 2			31	A
Output current (I_{out})	Before PG, V_{in} = 38 V, C_{out} = 6 mF, Note 2			9	A
Output voltage droop	I_{out} from 0 to 62 A		407		mV
Output ripple & noise	20 MHz BW, see Note 3		16		mV_{p-p}
Internal output capacitance	V_{out} = 0V			140	µF
On/off control					
Initialization Time	From V_{in} > 8.5 V to ready to be enabled		33		ms
Turn-off input voltage	Decreasing input voltage		32		V
Turn-on input voltage	Increasing input voltage		37		V
On Delay Time	From EN asserted to ramp start		0		ms
Ramp-up time	From 10% to 95% of V_{out}, I_{out} = 0 A		6.5		ms
Start-up time	From V_{in} = 37 V to PG		36		ms
Enable start-up time	From EN = 600mV to PG		9.8		ms
Logic high: trigger level	EN pin	0.7			V
Logic low: trigger level	EN pin			0.6	V
Source current	EN pin (Internal pull up)			0	µA
Sink current	EN pin			100	µA

Note 1: Max. output current is rated at 115 A. Max power is ≤ 1500 W and continuous power (thermal design power (TDP) is ≤ 800 W depending on thermal conditions).

Note 2: Resistive load. The output current value is evaluated after PG. For example, max resistive load before PG at V_{in} = 38 V, C_{out} = 6 mF is a load that gives 9 A current at V_{out} = V_{in} /4 = 9.5 V

Note 3: See Technical Reference: Application and design considerations.

Electrical specifications for BMR3141011/001

13.5 V, 62 A (115 A peak) / 800 W (1500 W peak)

Characteristic	conditions	minimum	typical	maximum	unit
Protection features					
Input Under Voltage fault limit (IUVP)	Latch (0x80)		32		V
Input Over Voltage fault limit (IOVP)	Latch (0x80)		68		V
Output Under Voltage fault limit (UVP)	Latch (0x80)		7.5		V
Output Under Voltage warning limit			8.5		V
Output Over Voltage fault limit (OVP)	Latch (0x80)		17		V
Output Over Voltage warning limit			15.5		V
Over temperature fault limit (OTP)	Latch (0x80)		120		°C
Over temperature warning limit	See Note 3		1023		°C
Over Current Protection (OCP) See Note 1	Comparator OCP threshold	150	200		A
	Comparator OCP response time			1	µs
	Average OCP, IOUT_OC_FAULT_LIMIT	115	140		A
	Timed OCP, IOUT_OC_WARN_LIMIT	70	90		A
	Timed OCP response time		37		ms
	Timed OCP response time set point accuracy		0.55		ms
Short circuit output current	T_{P1} = 25 °C, start against short			6.5	A
Protection response time (IUVP, IOVP, UVP, OVP, OTP, Average OCP)	See Note 2	0.75		1	ms

Note 1: Response time = transient duration required to trig an OCP fault. See section Over Current Protection in “Technical Reference: Application and design considerations” for a detailed description of the OCP functionality.

Note 2: The threshold is compared against a moving average value of four samples with 0.25 ms sampling interval. In addition, up to 0.3 ms may pass after a fault is trigged before switching stops.

Note 3: The threshold is set to max logic value to disable the OT warn functionality, to provide robust startup during cold conditions.

Electrical specifications for BMR3141011/001

13.5 V, 62 A (115 A peak) / 800 W (1500 W peak)

Characteristic	conditions	minimum	typical	maximum	unit
Monitoring & Control					
$UVLO_{VI}$ - Under Voltage Lock-Out	V_{in} rising threshold		8.5		V
	Hysteresis		2.5		V
Power Good Delay Time	From V_{out} = 100 % to PG asserted		0.8		ms
Power Good Threshold	Low to high transition		100		% V_{out}
	High to low transition, Note 1				
V_{IL} - Logic input low	SCL, SDA			0.8	V
V_{IL}- Logic input high	SCL, SDA	1.7			V
V_{OL} - Logic output low	SDA, ALERT, PG			65	mV
I_{OL} - Logic output low sink current	SDA			20	mA
I_{OL} - Logic output low sink current	ALERT, PG			5	mA
I_{LEAK} - Logic leakage current	SDA, SCL, ALERT, PG			10	µA
C_{I_PIN} - Logic input capacitance	SDA, SCL, EN		10		pF
f_{SMB} - SMBus Operating frequency		10		400	kHz
EN - Enable	See page 5 "On/Off control"				

Note 1: Power Good is deasserted when the output voltage is disabled, regardless of the output voltage level.

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

T_{P1} = -20 to + 95 °C, V_{in}= 38 to 60 V, unless otherwise specified under conditions.
Typical values given at: T_{P1} = +25 °C, V_{in} = 54 V, max P_{out_TDP}, unless otherwise specified under conditions

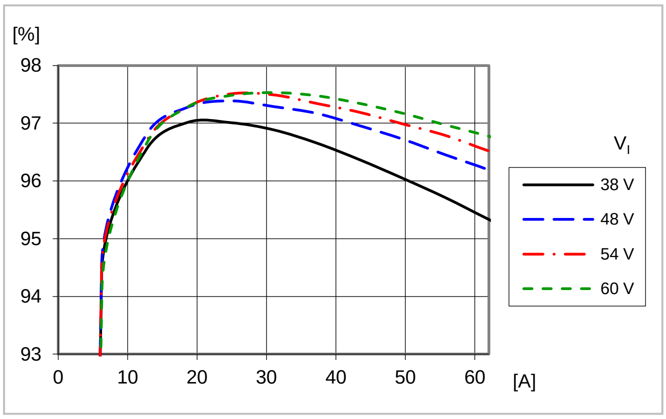
Command	conditions	minimum	typical	maximum	Unit
Monitoring accuracy					
Input voltage READ_VIN			±1		%
Output voltage READ_VOUT			±1		%
Output current READ_IOUT	V_{in} = 54 V, I_{out} = 62 A		±5		%
Temperature READ_TEMPERATURE_1	T ≥ 25 °C		±3		°C

For more detailed information please refer to Technical Reference Document: PMBus commands. This product is supported by the [Flex Power Designer tool.]

Electrical graphs for BMR3141011/001

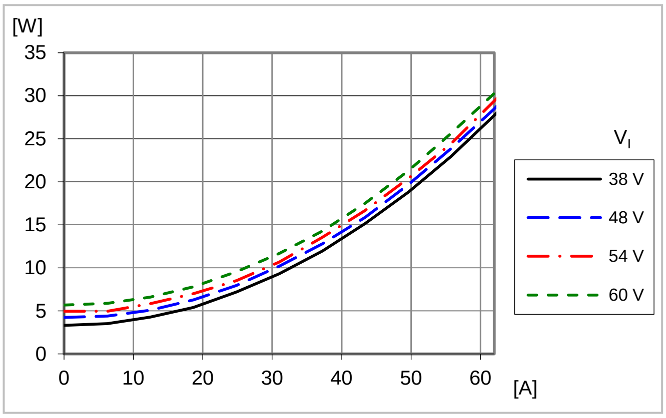
13.5 V, 62 A (115 A peak) / 800 W (1500 W peak)

Efficiency



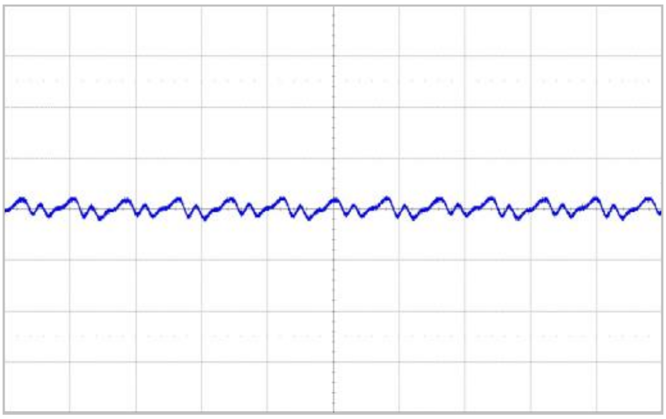
Efficiency vs. output current and input voltage at T_{P1} = +25 °C.

Power dissipation



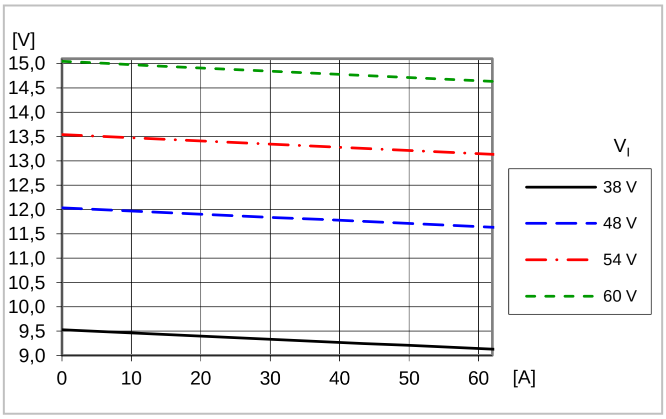
Dissipated power vs. load current at T_{P1} = +25 °C.

Output Ripple and Noise



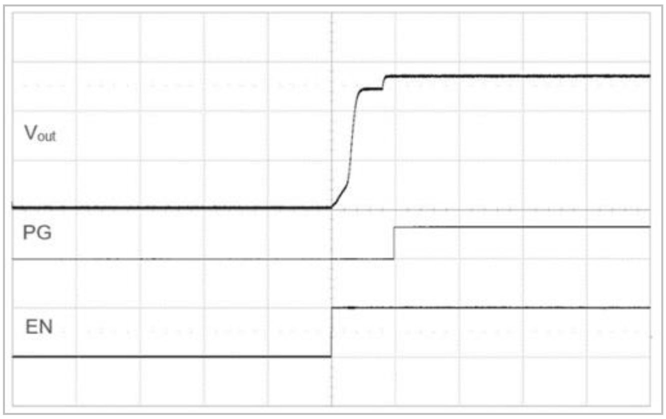
V_{in} = 54 V, I_{out} = 62 A, 20 MHz BW. Scale 20 mV/div, 500 ns/div.

Output voltage droop



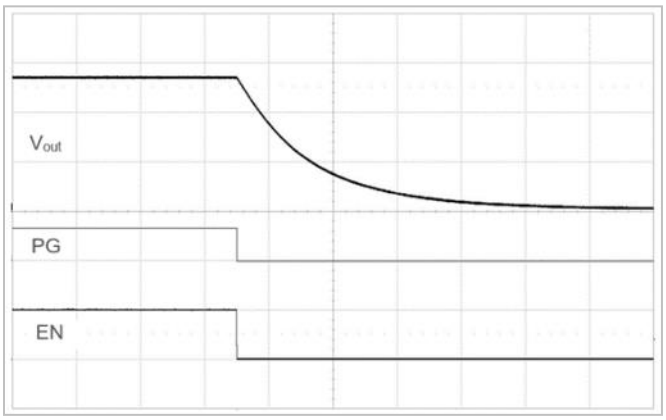
Output voltage vs output current.

Startup



Output enabled by EN pin. V_{in} = 54 V, I_{out} = 1 A
Scale from top: 5, 5, 5 V/div, 10 ms/div.

Shutdown

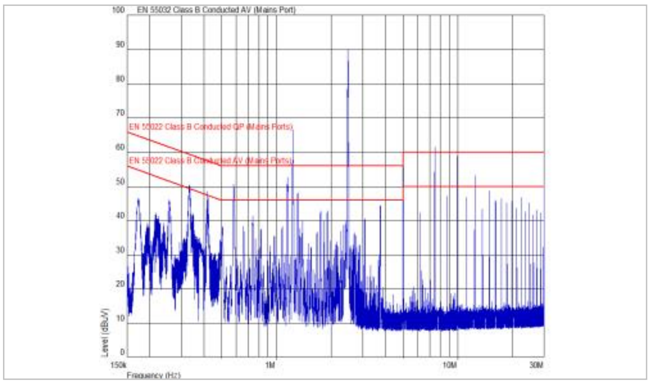


Output disabled by EN pin. V_{in} = 54 V, I_{out} = 1 A
Scale from top: 5, 5, 5 V/div, 10 ms/div.

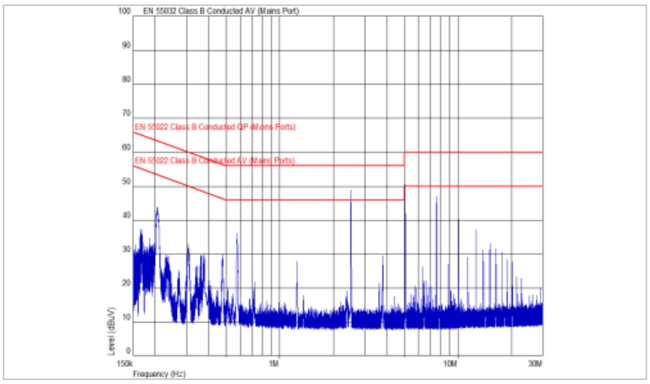
Part 2: EMC

EMC specifications

Conducted EMI measured according to EN55022 / EN55032, CISPR 22 / CISPR 32 and FCC part 15J (see test set-up below). The fundamental switching frequency is 1.25 MHz for BMR314. The EMI characteristics below is measured at V_{in} = 54 V and max I_{out}.



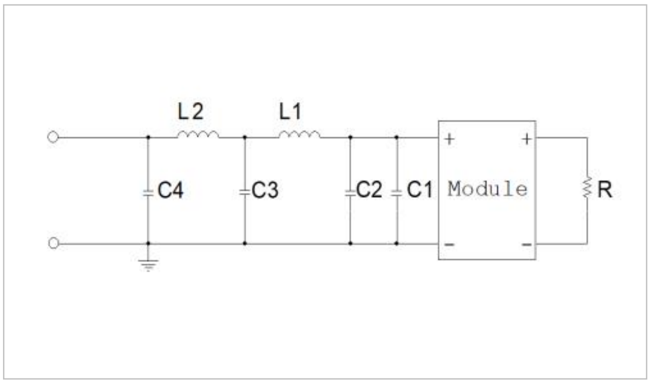
EMI without filter. (Blue graph = QP values)



EMI with an optional external filter, EN55032. Test method and limits are the same as EN55022. (Blue graph = QP values)

Optional external filter for Class B

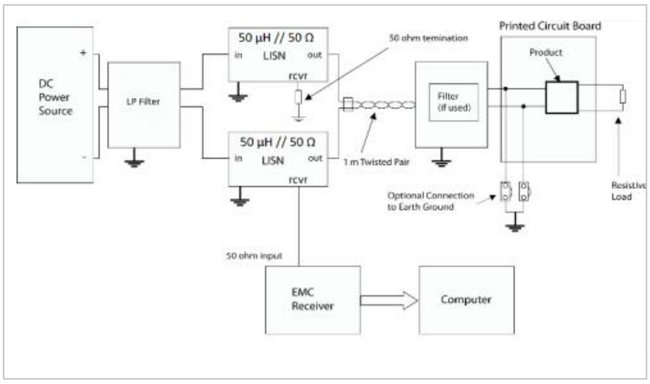
Suggested external input filter in order to meet Class B in EN 55022 / EN 55032, CISPR 22 / CISPR 32 and FCC part 15J.



Filter components:
C1 = 2 x 2.2 µF + 100 µF (Oscon)
C2 = 5 x 10 µF
C3 = 5 x 10 µF

L1 = 100 nH

C4, L2 not populated.



Test set-up

Layout recommendations

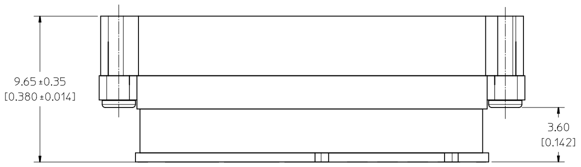
The radiated EMI performance of the product will depend on the PCB layout and ground layer design. It is also important to consider the stand-off of the product. If a ground layer is used, it should be connected to the output of the product and the equipment ground or chassis. A ground layer will increase the stray capacitance in the PCB and improve the high frequency EMC performance.

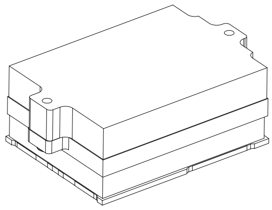
Part 3: Mechanical information

BMR3141011/001: SMD mounted, baseplate version

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

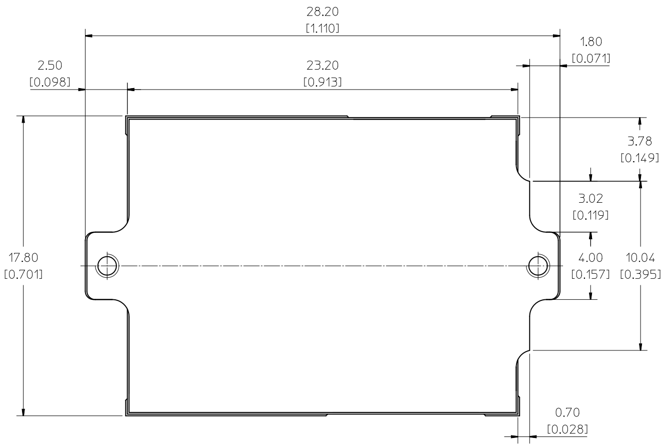
Side view





Top view

Product overall X/Y dimension including both top and bottom boards.



Weight: typical 12.6 g

All dimensions in mm [inches]

Tolerances unless specified:

x.x ±0.5 mm [0.02 inch]

x.xx ±0.25 mm [0.01 inch]

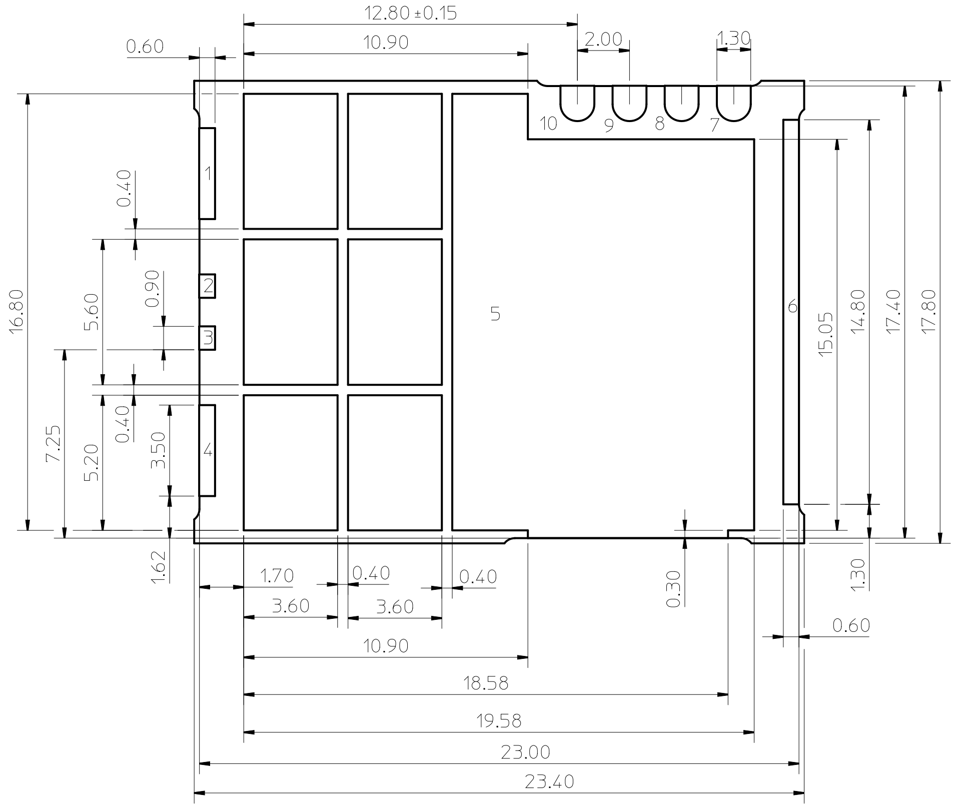
(not applied on footprint or typical values)

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.

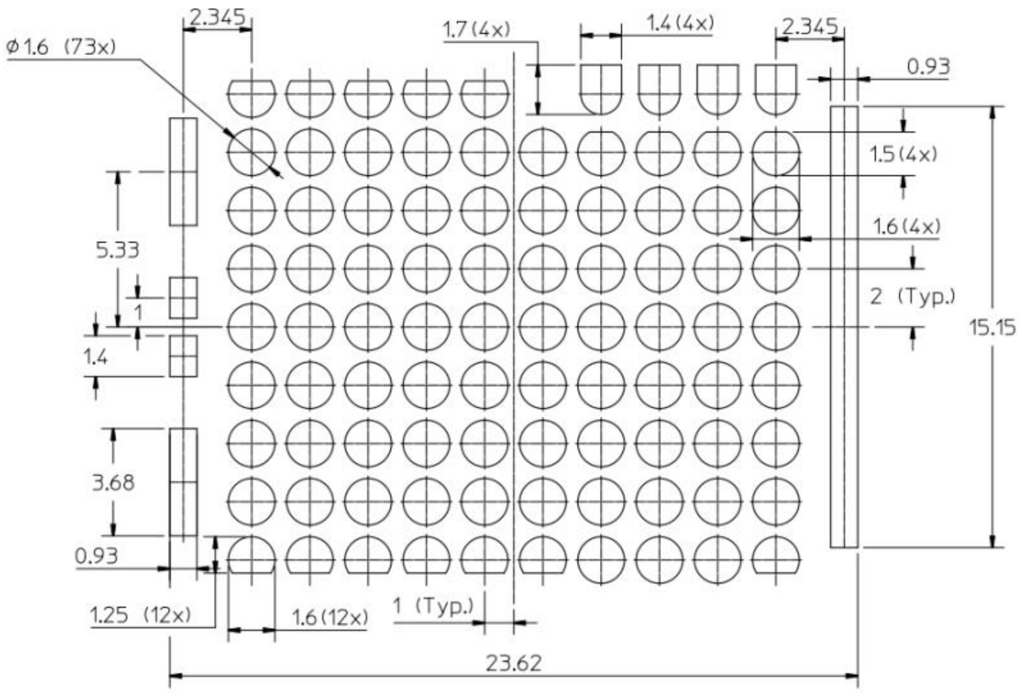
BMR3141011/001: SMD mounted, baseplate version

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

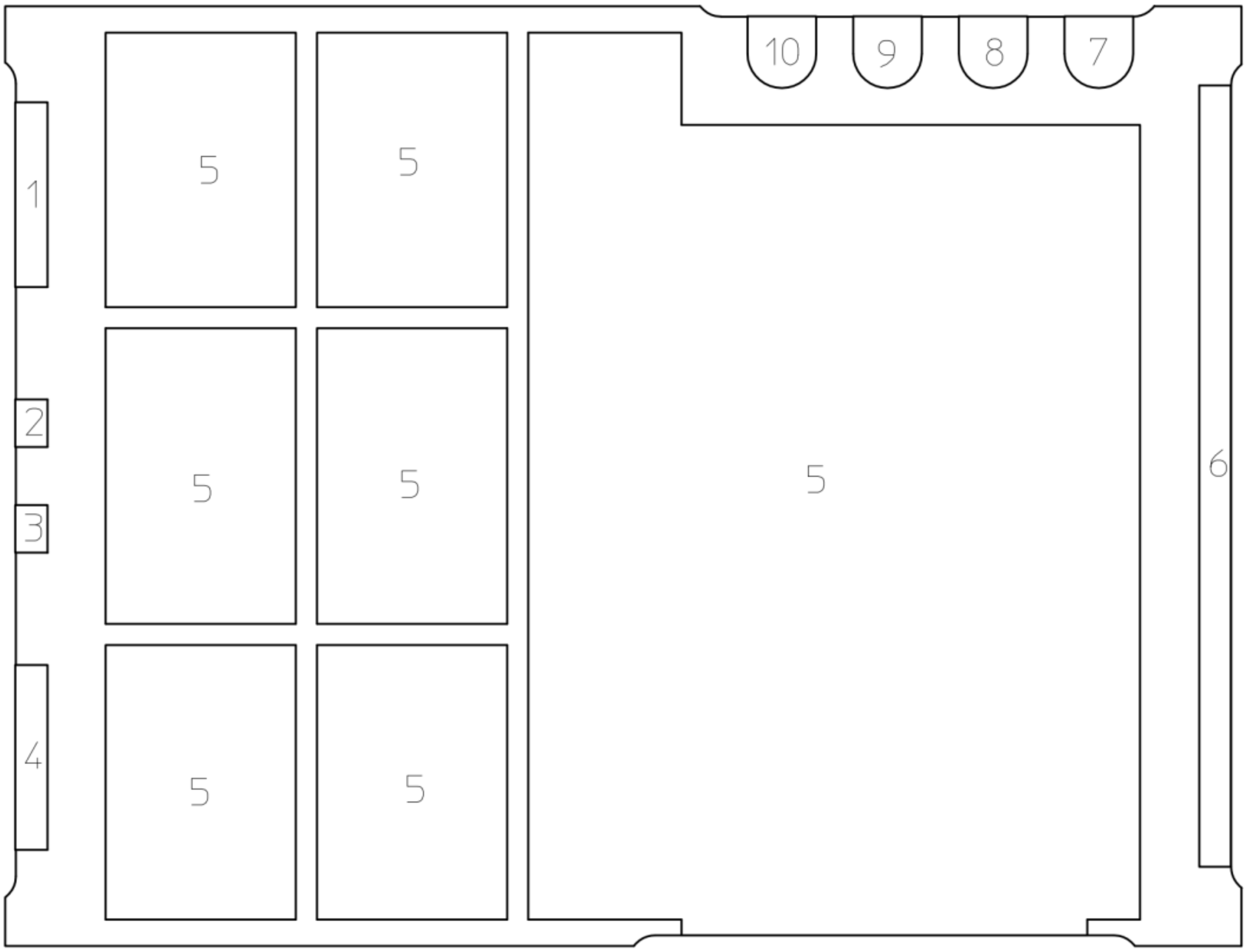
Pin layout and footprint top view through the product.



Recommended footprint top view through the product



TOP VIEW - Pin-out description and pin positions



Pin	Designation	Type	Function
1	+IN	Power	Input voltage
2	PG	Open Drain	Power good, active high (has internal pull-up resistor)
3	EN	Input	Enable, active high (has internal pull-up resistor)
4	+IN	Power	Input voltage
5	GND	Power	Power ground
6	VOUT	Power	Output voltage
7	ADDR	Input	PMBus address pin strap
8	SDA	Input/Output	PMBus data
9	SCL	Input	PMBus clock
10	ALERT	Open Drain	Alert signal, active low. Asserted when an over current warning condition or an over temperature warning condition occurs. Can be connected to GND if unused.

Part 4: Thermal considerations

Thermal considerations

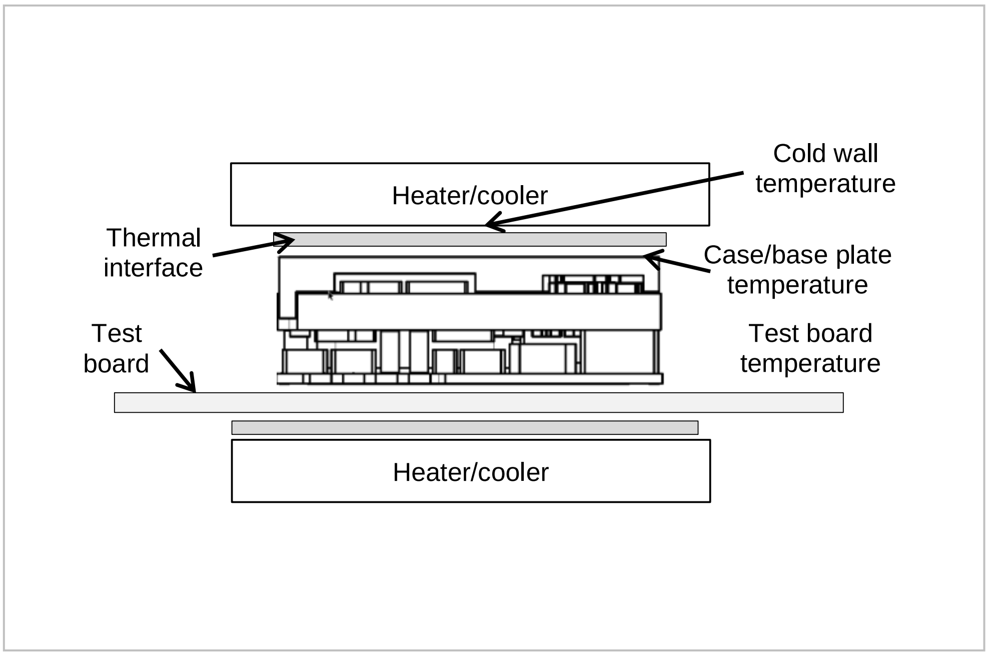
General

The product is designed with power switches on top to operate with top side cooling towards a heat sink or a cold plate. This is required to handle operation with high load. Cooling is also achieved by conduction to the host board and surrounding air. Sufficient cooling must be provided to ensure reliable operation.

The Output Current Derating graph found in the Electrical Specification section provides the available output current versus case temperature and host board temperature.

Test Setup – Cold Plate

The product is tested in a box with two heater/coolers; one as a cold plate to control the temperature at the top of the product, another on the bottom side of the test board to control the host board temperature. The test board used is 130 x 160 mm in size with 1.6 mm thickness and 6 layers of 3 oz.

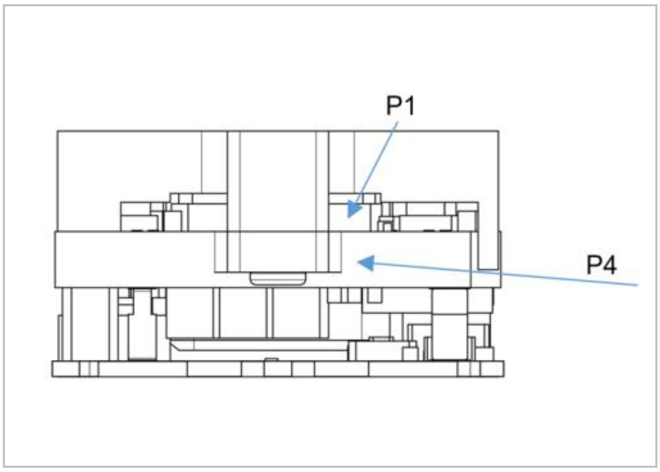


Test set-up: Cold plate

Definition of product operating temperature

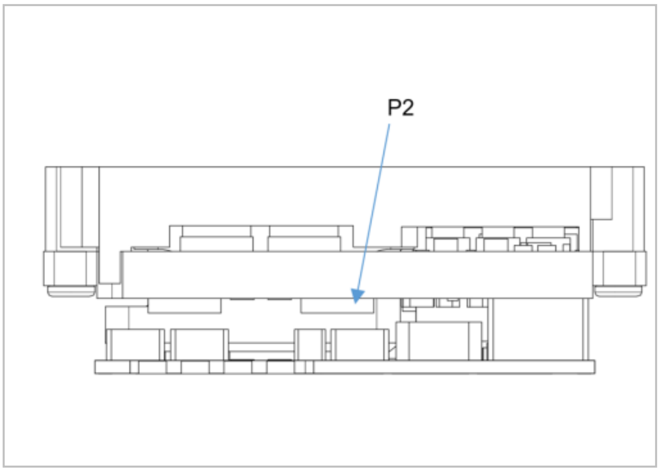
The product operating temperatures are used to monitor the temperature of the product, and proper thermal conditions can be verified by measuring the temperature at positions P1, P2, P3. The temperature at these positions (T_{P1}, T_{P2}, T_{P3}) should not exceed the maximum temperatures in the table below. The number of measurement points may vary with different thermal design and topology. Temperatures above maximum are not allowed and may cause permanent damage.

Position	Description	Max. Temp.
P1	MOSFET case	T_{P1} = 125 °C
P2	MOSFET case	T_{P2} = 125 °C
P3	Magnetic core	T_{P3} = 125 °C
P4	PCB side, close to P1	T_{P4}= 125 °C

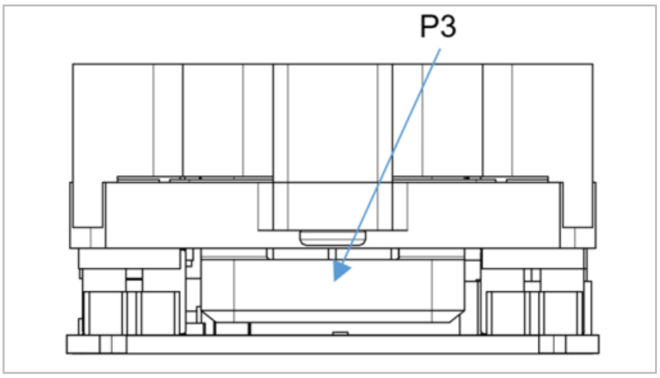


Temperature position (short side view).

Alternative position P4, see note 1.



Temperature position (long side view).

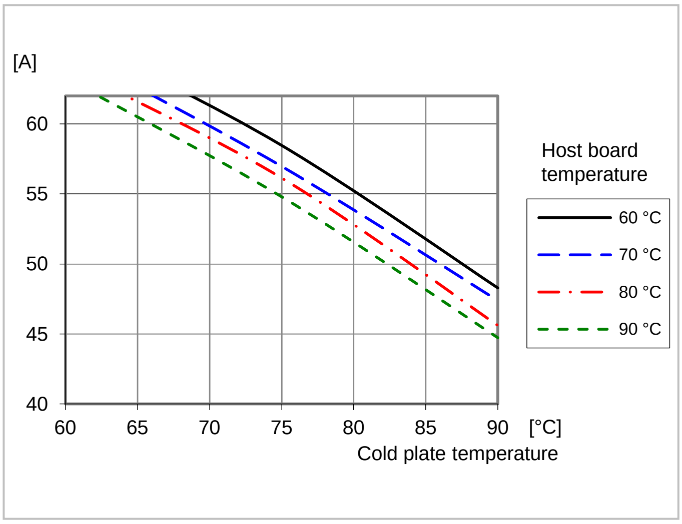


Temperature position (short side view).

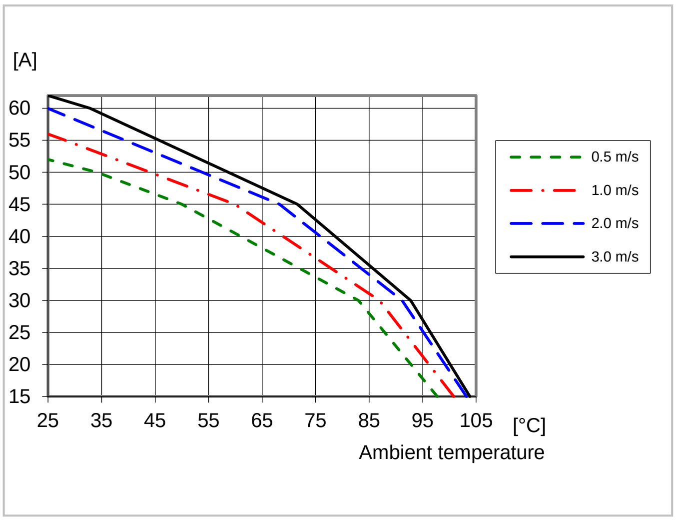
Note 1: A temperature probe glued at position P1 may connect with the baseplate, causing a faulty temperature reading. Therefore, a probe glued to the side of the PCB, position P4, can be used instead, since the temperature at P4 is close to the temperature at P1.

Thermal graphs

Output current derating

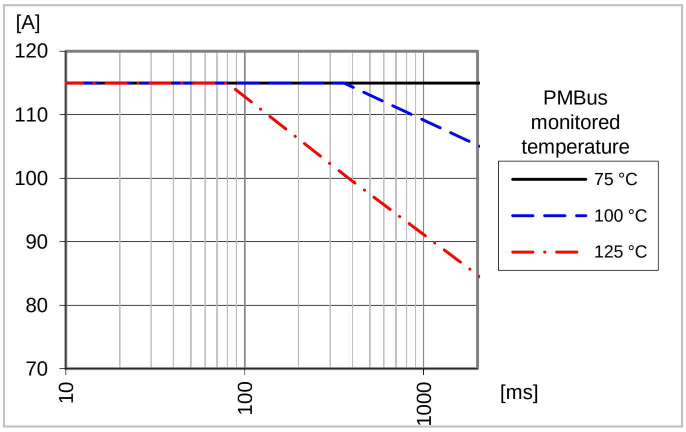


Max. average output current vs. cold plate temperature and host board temperature. Thermal interface gap pad 1.0 mm, 8 W/mK.



Max. average output current vs. ambient temperature and wind speed, using a 1 inch heatsink ATS-1141-C1-R0. Thermal interface gap pad 1.0 mm, 8 W/mK.

Peak current capability



Max. peak output current vs pulse duration and PMBus monitored temperature when pulse starts. Initial Iout = 70 A. Simulated limit given by max. internal junction temperature (150 °C) of hotspot component. In practise, the max. peak current is also limited by the Timed OCP threshold and response time.

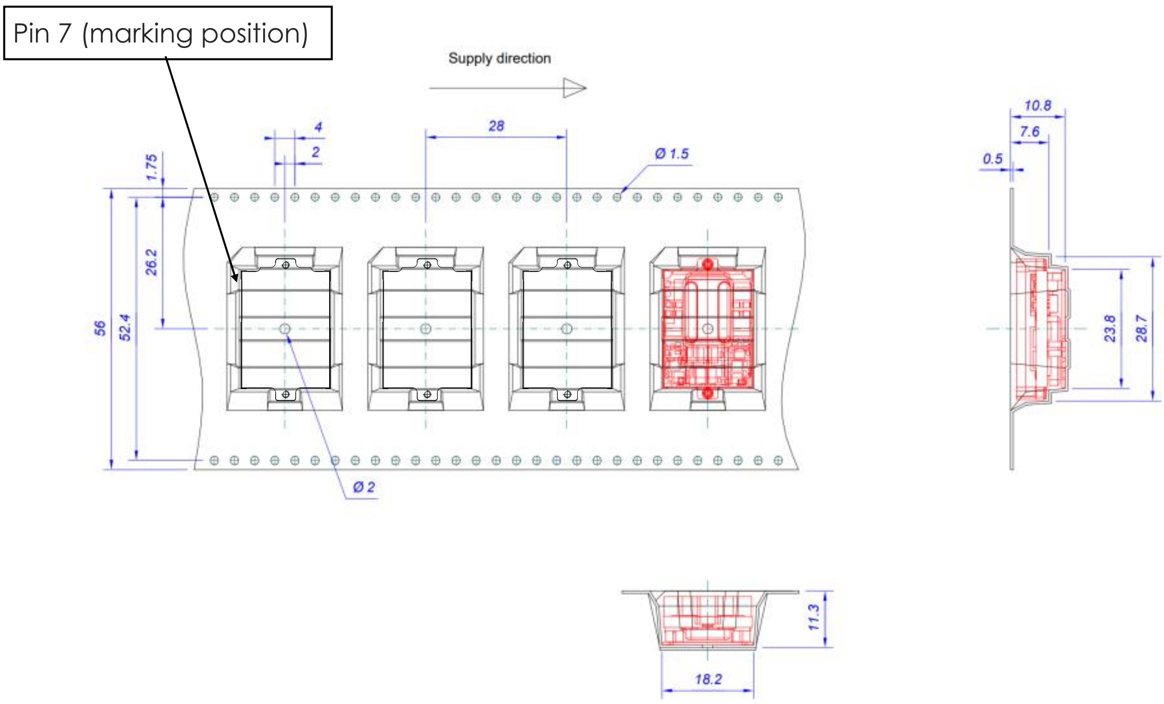
For more information, please refer to our thermal models on the website.

Part 5: Packaging

Packaging information

The products are delivered in antistatic carrier tape (EIA 481 standard).

Carrier Tape Specifications	
Material	PS, Antistatic
Surface resistance	< 10^7 Ω/square
Bakabilty	The tape is not bakeable
Tape width, W	56 mm
Pocket pitch, P1	28 mm
Pocket depth, K0	10.8 mm
Reel diameter	330 mm
Reel capacity	150 products /reel
Reel weight	2450 g/full reel



Part 6: Revision history

Revision table

Revision number	revision change	date	revisor
Rev. A	New document.	2024-02-02	KARFWAHL
Rev. B	General corrections and an additional thermal graph describing output current derating with wind cooling.	2024-09-16	KARJNILS
Rev. C	Minor updates.	2024-09-25	KARTWAER
Rev. D	Updated tolerance for product overall dimension.	2024-09-25	KARALARS
Rev. E	Minor changes.	2024-09-27	KARJNILS
Rev. F	Corrected typos in Product options and Order number examples.	2024-10-08	JIDGEZOU
Rev. G	Changed OT warn limit to 1023 °C, added Note 3 on page 6.	2024-10-11	KARALARS
Rev. H	Formatting updates.	2024-10-16	KARTWAER
Rev. J	Clarified peak power capability on page 4 (Note 1) and page 15 (graph + text).	2024-10-21	KARALARS
Rev. K	Minor changes to mechanical and packaging information.	2024-10-25	JIDJLIAA
Rev. L	Clarified information about pull-up resistors for EN and PG.	2024-11-28	KARCLYRB