



## BMR 350 X250/531

### 1300-1700 W digital quarter brick DC/DC IBC

The BMR350 X250/531 is a new generation of high-power digital DC/DC converter. The impressive performance of this converter includes an efficiency of 97.7% at 54V<sub>in</sub> and half load.

The BMR350 X250/531 is a non-isolated quarter brick, and has a low building height of only 12 mm. The converter delivers a fully regulated 12.12 V. BMR350 X250/531 delivers a continuous power level of 1300 W and has a peak power capability of up to 1700 W for limited time.

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



### Key features

- High efficiency with 97.7%
- Non-isolated
- 12.12V fully regulated
- Event data recorder (black-box)
- Active current sharing
- Screwed baseplate
- Monotonic start-up
- Output over voltage protection
- Over temperature protection
- Output short-circuit protection
- Remote control
- PMBus configuration

### Soldering methods

- Reflow soldering Pin In Paste
- Wave soldering
- Manual soldering

### Key electrical information

Parameter	Values
Input range	40-60 V
Output voltage	12.12 V
Output current	140 A
Output power	1300 W
Peak power	1700 W

### Mechanical

58.4 x 36.8 x 12 mm / 2.30 x 1.45 x 0.47 in

### Application areas

- Datacom applications

## Product options

The table below describes the different product options.

Example: BMR350 2 2 50 /531						H	Definitions
<b>Product family</b>	BMR350						
<b>Pin length options</b>		2					0 = 5.33 mm / 0.21 in 2 = 3.69 mm / 0.15 in 3 = 4.57 mm / 0.18 in 4 = 2.79 mm / 0.11 in
<b>Baseplate / HS option</b>			2				2 = Base plate top and bottom heat sink
<b>Other hardware options</b>				50			50 = 7-pin digital header. Dual output pins
<b>Configuration code</b>					/531		/531=12.12 V <sub>out</sub> Current share
<b>Packaging options</b>						H	E = soft tray, dry pack (PIP reflow soldering) H = hard tray, dry pack (PIP reflow soldering) blank = foam tray (no dry pack, wave soldering)

For more information, please refer to Part 3 [Mechanical information](#).

If you do not find the variant you are looking for, please contact us at [Flex Power Modules](#).

## Order number examples

Part number	V <sub>in</sub>	Outputs	Configuration
BMR350 2250/531H	40-60 V	12.12V / 108A/ 1300W	3.69 mm pins / 7-pin digital header / base plate / current share / dry pack, hard tray

## Part 1: Electrical specifications

### Absolute maximum ratings

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

Characteristics	min	typ	max	Unit
Operating temperature (T <sub>P1</sub> )	-40		+125	°C
Storage temperature	-55		+125	°C
Input voltage (V <sub>in</sub> )	-0.5		+65	V
Input voltage transient (100 ms)			+80	V
Isolation voltage (input to output)			0	V
Isolation voltage (baseplate to output)			0	V
Remote control pin voltage	-0.3		5	V

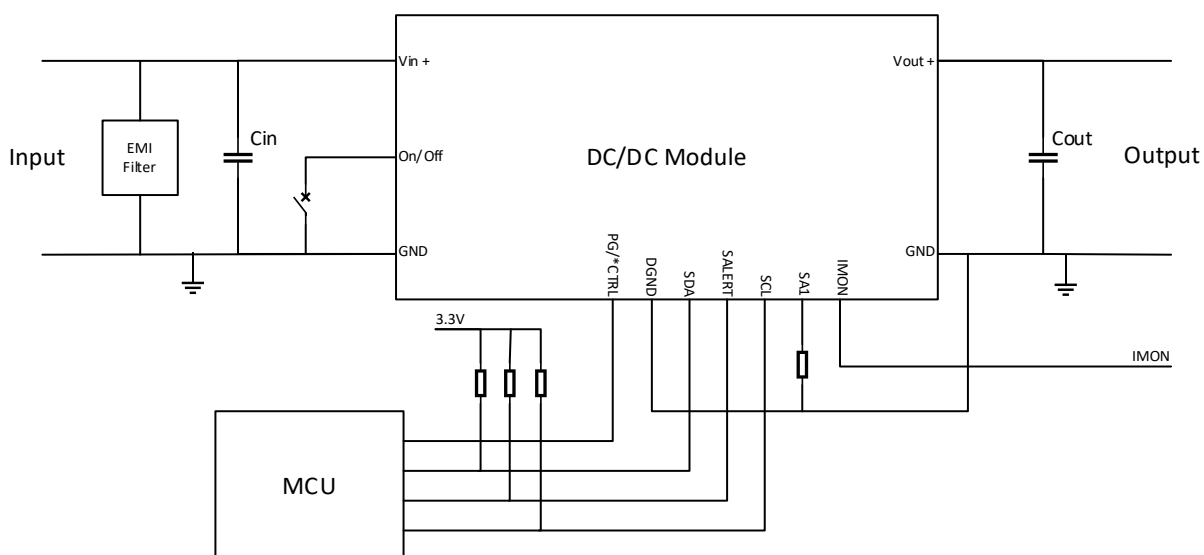
### Reliability

Failure rate ( $\lambda$ ) and mean time between failures (MTBF= 1/  $\lambda$ ) are calculated based on *Telcordia SR-332 Issue 4: Method 1, Case 3, (80% of I<sub>out\_TDP</sub>, T<sub>P1</sub>=40°C, Airflow=200 LFM)*.

	Mean	90% confidence level	Unit
Steady-state failure rate ( $\lambda$ )	123	151	nfailures/h
Standard deviation ( $\sigma$ )	22.2		nfailures/h
MTBF	8.1	6.6	MHr

### Typical application diagram

Capacitor values are defined in the Electrical Specification tables. The EMI filter is defined in the [EMC Part 2](#).



## Part 1: Electrical specifications

**Electrical specifications for BMR350 X250/531****12.12V, 108A (140A) ≤ 1300W (1700W)**

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

Additional external  $C_{in} = 220\ \mu\text{F}$ ,  $C_{out} = 1.5\ \text{mF}$

Characteristic	conditions	minimum	typical	maximum	unit
<b>Key features</b>					
Efficiency ( $\eta$ )	50% of $P_{out\_TDP}$		97.7		%
	100% of $P_{out\_TDP}$		96.9		%
	50% of $P_{out\_TDP}$ $V_{in} = 48\ \text{V}$		97.9		%
	100% of $P_{out\_TDP}$ $V_{in} = 48\ \text{V}$		96.9		%
$P_{out\_TDP}$ thermal design power (TDP)	See Note 1			1300	W
$P_{out\_MAX}$ peak power ( $t \leq 1000\text{ms}$ )	See Note 1			1700	W
Power dissipation	100% of $P_{out\_TDP}$		42.4	57.6	W
Switching frequency ( $f_s$ )	0-100 % of $P_{out\_TDP}$		150		kHz
Recommend capacitive load		1500		20000	$\mu\text{F}$
<b>Input characteristics</b>					
Input voltage range ( $V_{in}$ )		40		60	V
Input idling power	$P_{out} = 0\ \text{W}$		5.4	12.1	W
Input standby power	(turned off with RC)		552	768	mW
Input OVP			85		V
Internal input capacitance			90		$\mu\text{F}$
Recommended external input capacitance		220			$\mu\text{F}$

Note 1: Max. output current is rated at 140 A. Max power is  $\leq 1700\ \text{W}$  and continuous power (thermal design power (TDP)) is  $\leq 1300\ \text{W}$  depending on thermal conditions.)

**Electrical specifications for BMR350 X250/531****12.12V, 108A (140A) ≤ 1300W (1700W)**

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

Additional external  $C_{in} = 220\ \mu\text{F}$ ,  $C_{out} = 1.5\ \text{mF}$

Characteristic	conditions	minimum	typical	maximum	unit
<b>Output characteristics</b>					
Output voltage initial setting and accuracy	$P_{out} = 0\ \text{W}$	12.09	12.12	12.15	V
Output voltage tolerance band	0 – 100% of max $P_{out\_TDP}$ $V_{in} = 40\text{-}60\ \text{V}$	11.82		12.30	V
Output adjust range	0-100% of max $P_{out\_TDP}$	8		13.2	V
Idling voltage	$P_{out} = 0\ \text{W}$ , 48 V	11.94		12.30	V
Line regulation	$V_{in} = 40 - 60\ \text{V}$ 0 – 100% of max $P_{out\_TDP}$		4	13	mV
Load regulation	0 - 100% of max $P_{out\_TDP}$	74	110	149	mV
Output current ( $I_{out}$ )	$V_{in} = 40 - 60\ \text{V}$	0		108	A
Load transient voltage deviation	Load step 25-75-25% of max $P_{out\_TDP}$ $di/dt = 5\ \text{A}/\mu\text{s}$ . See Note 2		$\pm 232$	$\pm 434$	mV
Load transient recovery time			55	135	$\mu\text{s}$
Output ripple & noise	max $P_{out\_TDP}$ See Note 3		50	160	$\text{mV}_{p-p}$

Note 1: Max. output current is rated at 140 A. Max power is  $\leq 1700\ \text{W}$  and continuous power (thermal design power (TDP)) is  $\leq 1300\ \text{W}$  depending on thermal conditions.

Note 2:  $C_{out}$  is  $2 \times 2.2\ \text{mF}$

Note 3: See Technical Reference doc: Design considerations

**Electrical specifications for BMR350 X250/531****12.12V, 108A (140A) ≤ 1300W (1700W)**

Characteristic	conditions	minimum	typical	maximum	unit
<b>On/off control</b>					
Turn-off input voltage	Decreasing input voltage	34	35	37	V
Turn-on input voltage	Increasing input voltage	35	37	39	V
Ramp-up time (from 0–100% of $V_{out}$ )		9	10	11	ms
Start-up time (from $V_{in}$ connection to 100% of $V_{out}$ )			38		ms
RC start-up time			25		ms
Logic high: trigger level			1.4		V
Logic low: trigger level			1.3		V
Logic low: response time		0.1	0.2	0.3	ms
Sink current		0.4			mA
<b>Protection features</b>					
Current limit threshold (OCP)	$T_{P1} < \max T_{P1}$	176	190	204	A
Output current limit (OCP) response time and type	Hiccup, retry 3 times		25		μs
Current limit threshold (Slow OCP)			115		A
Current limit Off Delay (Slow OCP)	Load step 108-140A. See note 1			1000	ms
	Load step 108-170A. See note 1			500	ms
Output overvoltage protection (OVP)			14.2		V
Output overvoltage protection (OVP) response time and type	Disabled until fault cleared		70		μs
Over temperature protection (OTP)	See note 2		125		°C
Over temperature protection (OTP) re-start temperature and type	Disabled until fault cleared		90		°C

Note 1: Off Delay is dependent on averaging power level above TDP, 108A. Product is configured to allow 140A/1700W for max 1000ms. High  $di/dt$  on load step up to peak power, might cause current overshoot resulting in OCP fault. See Technical Reference Document Design & Application Guidelines BMR350X250/531 for detailed information.

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

**Electrical specifications for BMR350 X250/531****12.12V, 108A (140A) ≤ 1300W (1700W)**

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

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

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

Command	Conditions	minimum	typical	maximum	Unit
<b>Monitoring accuracy</b>					
Input voltage READ_VIN			±125		mV
Output voltage READ_VOUT			±40		mV
Output current READ_IOUT	$T_{P1} = 25\text{ °C}, V_O = 12\text{ V}$		±0.5		A
	$T_{P1} = -20\text{--}120\text{ °C}, V_O = 12\text{ V}$		±2.5		A
Duty cycle READ_DUTY_CYCLE	No tolerance, Read value is the actual value applied by PWM controller				
Temperature READ_TEMPERATURE_1	Temperature sensor		±5		°C

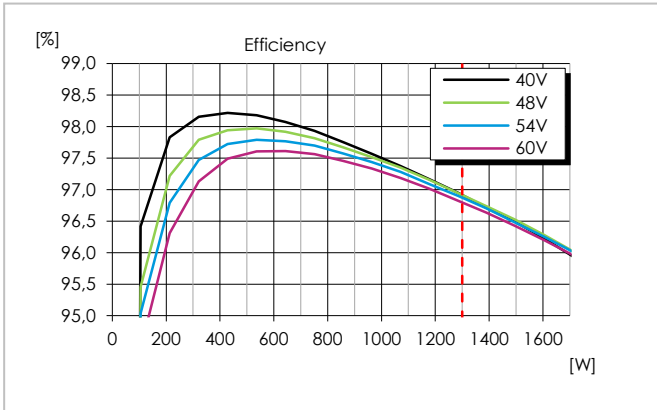
For more detailed information please refer to Technical Reference Document: PMBus commands.

This product is supported by the [Flex Power Designer tool](#).

## Electrical graphs for BMR350 X250/531

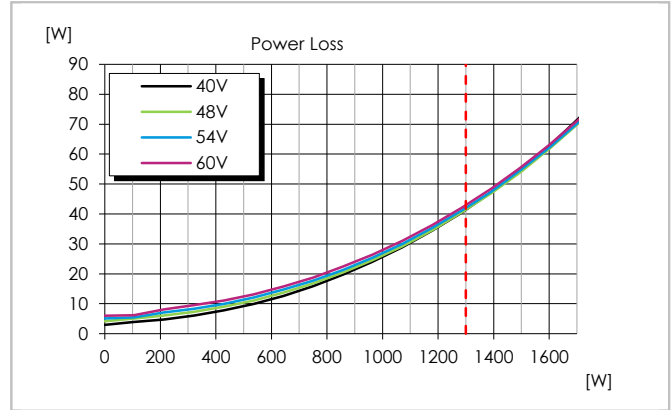
12.12V, 108A (140A) ≤ 1300W (1700W)

### Efficiency



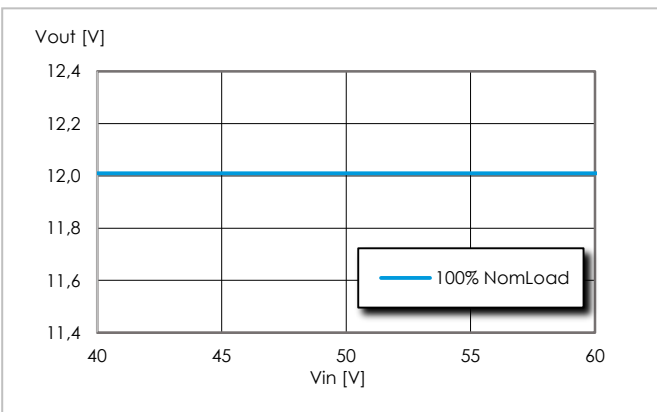
Efficiency vs. output power and input voltage at  $T_{P1} = +25^{\circ}\text{C}$ . Above  $P_{out\_TDP}$ , 1300W only peak  $t \leq 1000\text{ms}$

### Power dissipation



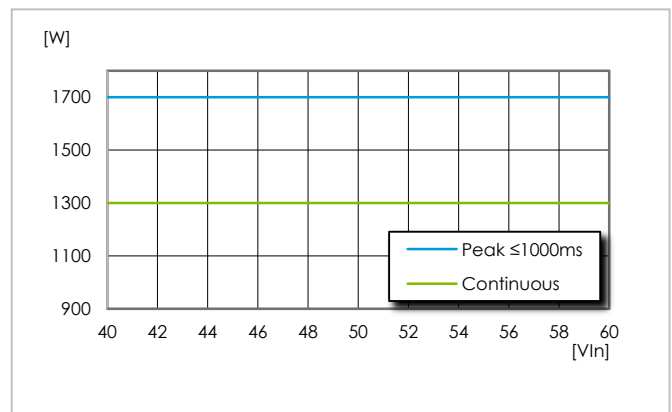
Dissipated power vs. load power at  $T_{P1} = +25^{\circ}\text{C}$ . Above  $P_{out\_TDP}$ , 1300W only peak  $t \leq 1000\text{ms}$

### Line regulation



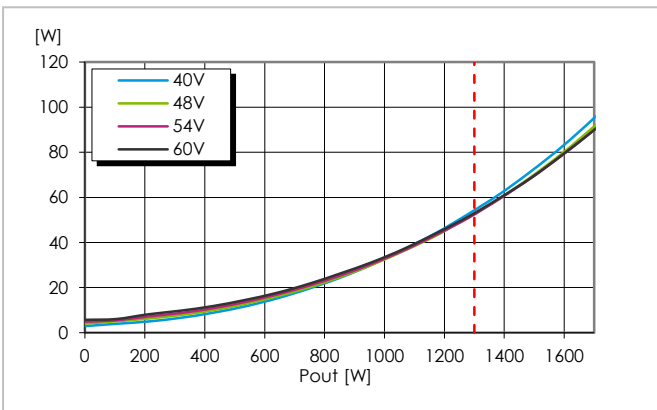
Output voltage vs. input voltage at  $T_{P1} = +90^{\circ}\text{C}$ , 100% of max  $P_{out\_TDP}$ , 1300W.

### Available power



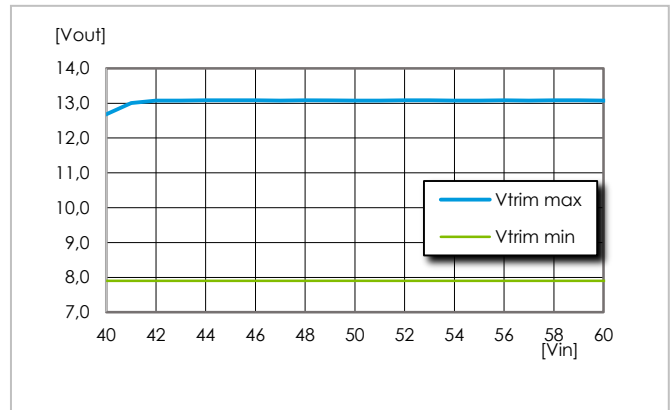
Available output power vs. input voltage,  $T_{P1} = +90^{\circ}\text{C}$

### Power loss at max temperature



Dissipated power vs. output power and input voltage at  $T_{P1} = +90^{\circ}\text{C}$ , Above  $P_{out\_TDP}$ , 1300W only peak  $t \leq 1000\text{ms}$

### Output voltage adjust range



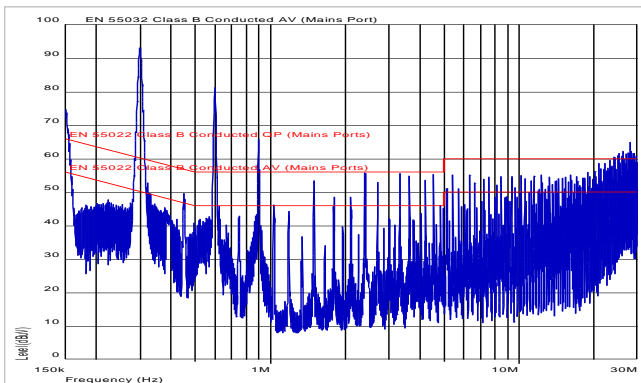
Max and min  $V_{out}$  trim vs  $V_{in}$ . At  $P_{out\_TDP}$ , 1300W.



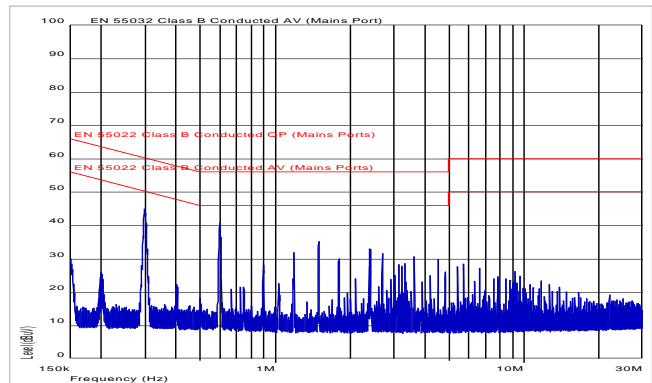
## Part 2: EMC

### 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 150 kHz for BMR350. The EMI characteristics below is measured at  $V_{in} = 54\text{ V}$  and max  $I_{out}$ .



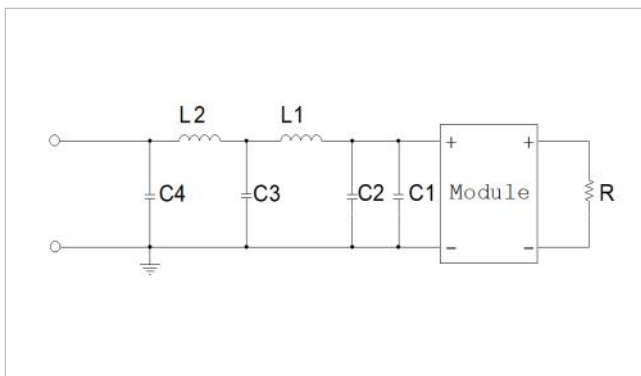
EMI without filter. EN55032 test method and limits are the same as EN55022. 1000  $\mu\text{F}$  100V input capacitor and 1mF + 470 $\mu\text{F}$  16 V OS-CON output capacitors used



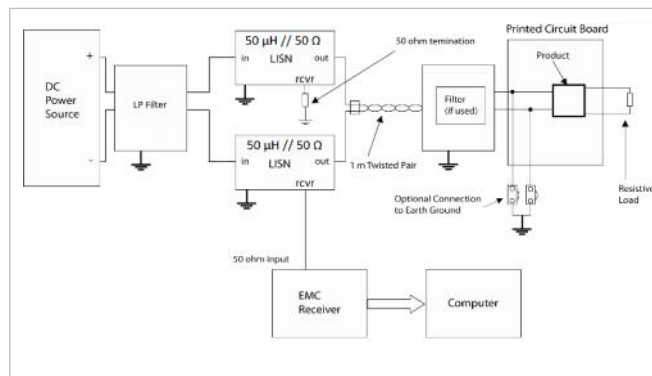
EMI with filter, EN55032 test methods and limits are the same as EN55022

### Optional external filter for Class B

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



Filter components:  
C1 = 1000 $\mu\text{F}$  (e-lyt)  
C2 = 2 x 2.2  $\mu\text{F}$   
C3, C4 = 10  $\mu\text{F}$   
L1, L2 = 4.7  $\mu\text{H}$



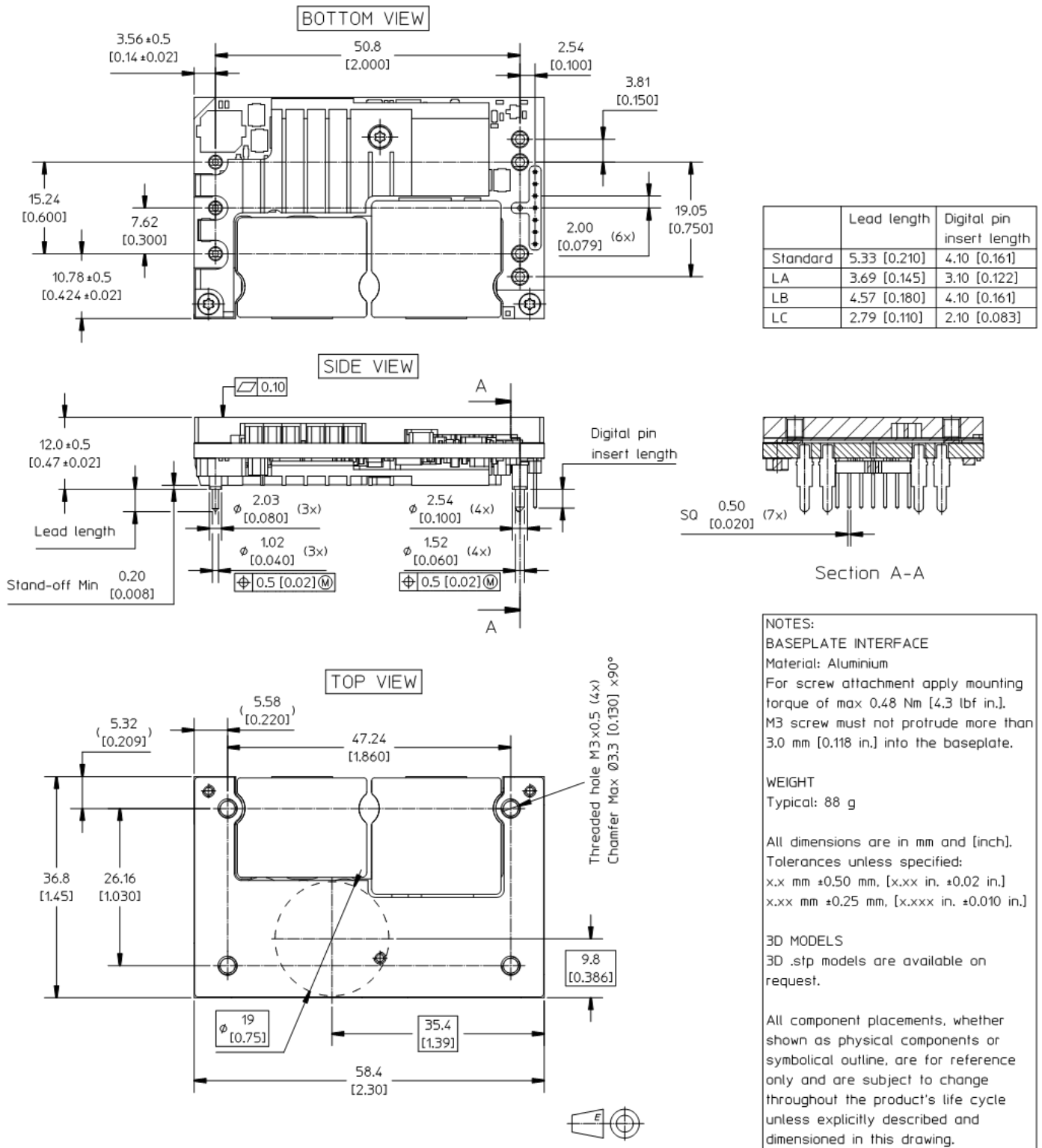
Test set-up

### Layout recommendations

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

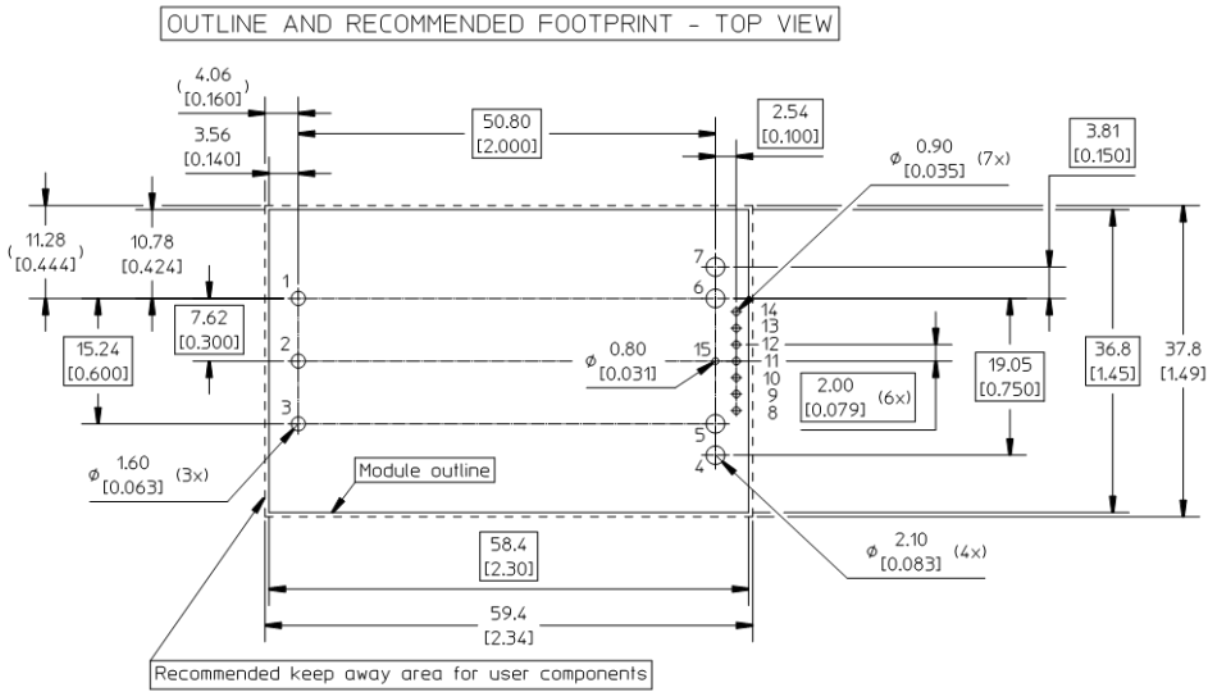
A ground layer will increase the stray capacitance in the PWB and improve the high frequency EMC performance.

**Part 3: Mechanical information**  
**BMR350 x250/xxx: hole mounted, baseplate version**

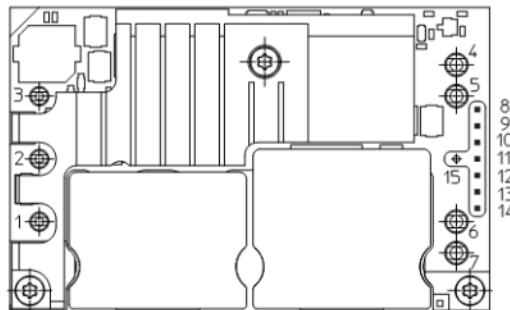


The mechanical information is based on a module which is hole mounted and has a baseplate.

Footprint and pin positions



CONNECTIONS - BOTTOM VIEW



**PIN SPECIFICATIONS:**

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

Pin 8-14 Material: Brass  
Plating: Min Au 0.1 µm over Ni 1-3 µm

Pin 15 Not mounted (Option)

Pin	Designation	Function 7 pin
1	+In	Positive Input
2	RC	Remote Control
3	-In	Negative Input
4	-Out	Negative Output
5	-Out	Negative Output
6	+Out	Positive Output
7	+Out	Positive Output

Pin	Designation	Function 7 pin
8	PG	Power Good
9	DGND	PMBus ground
10	SDA	PMBus Data
11	SALERT	PMBus alert signal
12	SCL	PMBus Clock
13	SA1	PMBus Address 1
14	IMON	Current Share

## Part 4: Thermal considerations

### Thermal considerations

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

#### General

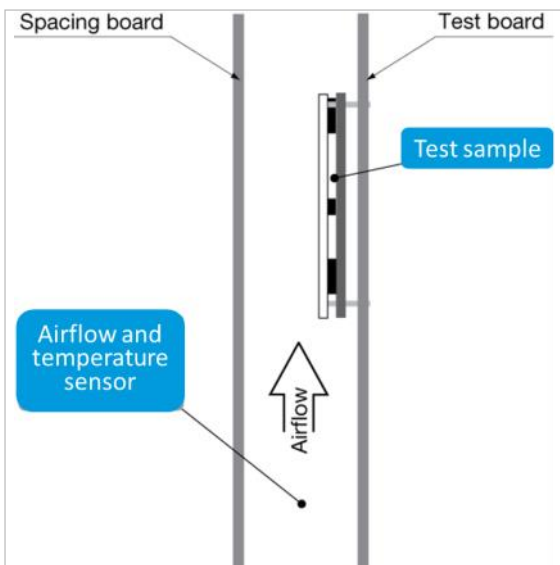
For products mounted on a PWB without a heatsink attached, cooling is achieved mainly by conduction, from the pins to the host board, and convection, which is dependent on the airflow across the product. Increased airflow enhances the cooling of the product. The wind speed and temperature are measured in a point upstream the device. The *output current derating graphs* found later in this section for each model provide the available output current vs. ambient air temperature and air velocity at  $V_{in} = 54\text{ V}$ .

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

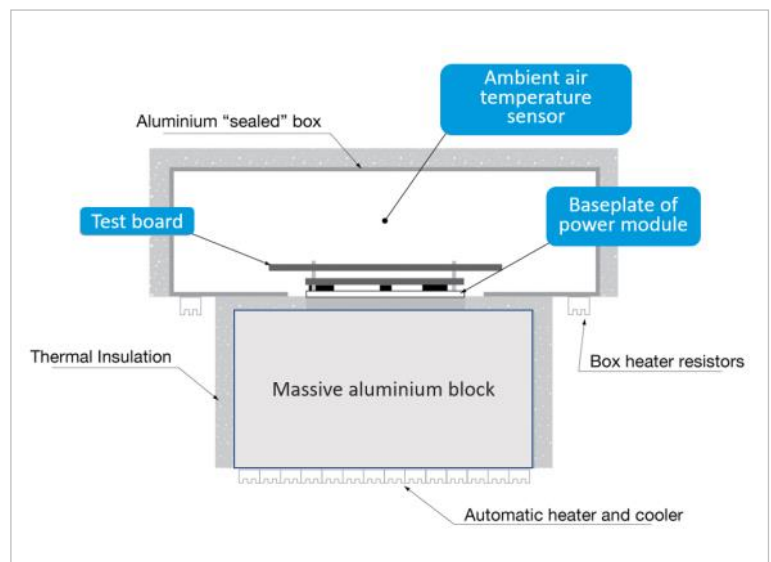
Distance between the tested device and the top space board and the side airflow guides are  $6.35\text{ mm} \pm 1\text{ mm}$ .

The product is tested on a  $185 \times 185\text{ mm}$ ,  $105\text{ }\mu\text{m}$  (3 oz), 6-layer test board mounted vertically in a wind tunnel.

For products with baseplate used in a sealed box/cold wall application, cooling is achieved mainly by conduction through the cold wall. The product is tested in a sealed box test set up with ambient temperatures  $85^\circ\text{C}$ . See [Design Note 028](#) for further details.



Picture: general test set-up



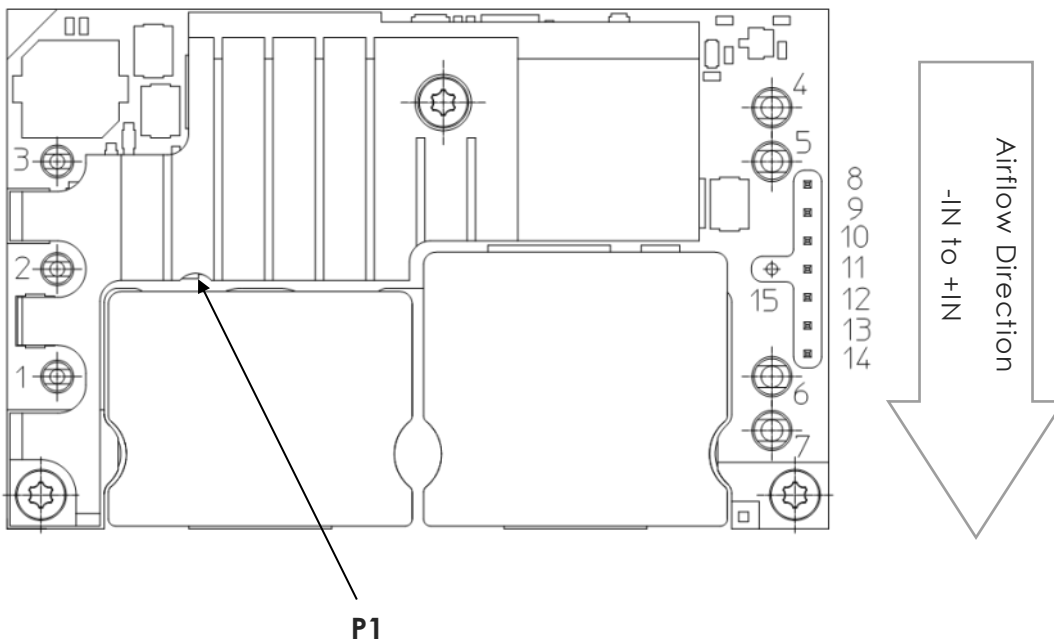
Picture: cold wall test set-up

## Part 4: Thermal considerations

**Definition of product operating temperature**

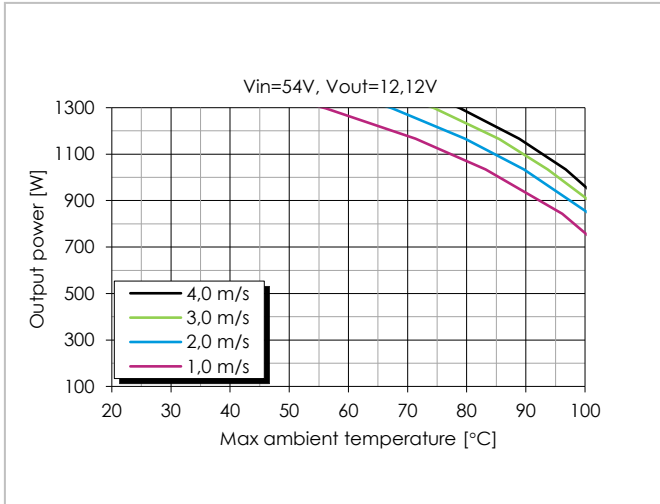
Proper thermal conditions can be verified by measuring the temperature at position P1 as shown below. The temperature at this position ( $T_{P1}$ ) should not exceed the maximum temperatures in the table below. The number of measurement points may vary with different thermal design and topology. Temperatures above maximum  $T_{P1}$ , measured at the reference point P1 are not allowed and may cause permanent damage.

Position	Description	Max. Temp.
P1	PWB reference point	$T_{P1} = 125\text{ °C}$

**Bottom view**

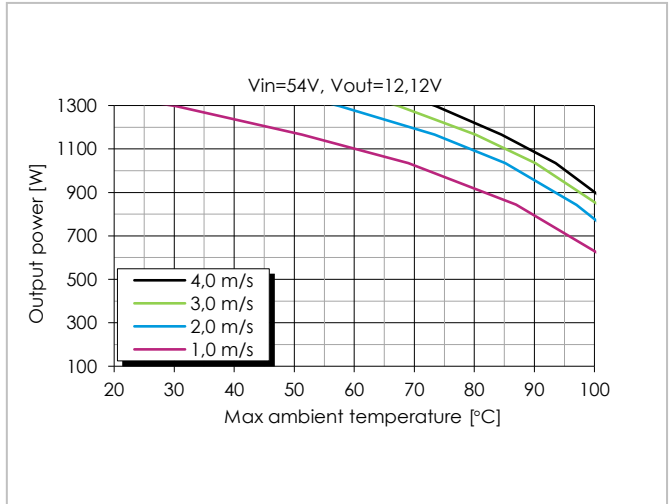
Thermal graphs

Output power derating - 1.0 inch heatsink



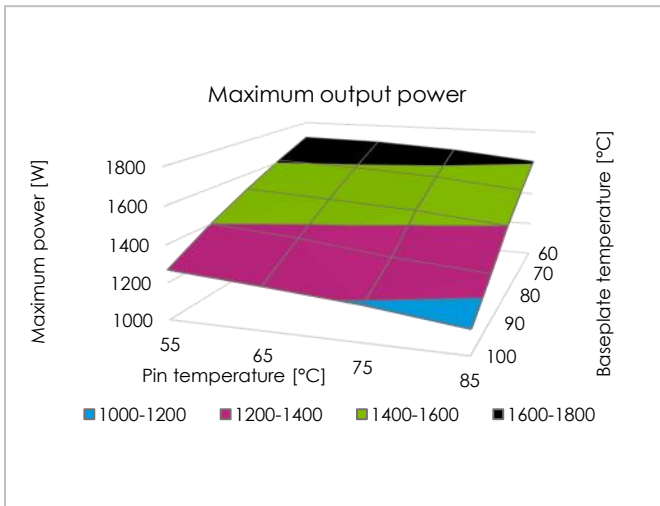
Available output power vs. ambient air temperature and airflow. Above Pout\_TDP, 1300W only for a limited time. Airflow Direction -IN to +IN.

Output power derating - 0.5 inch heatsink



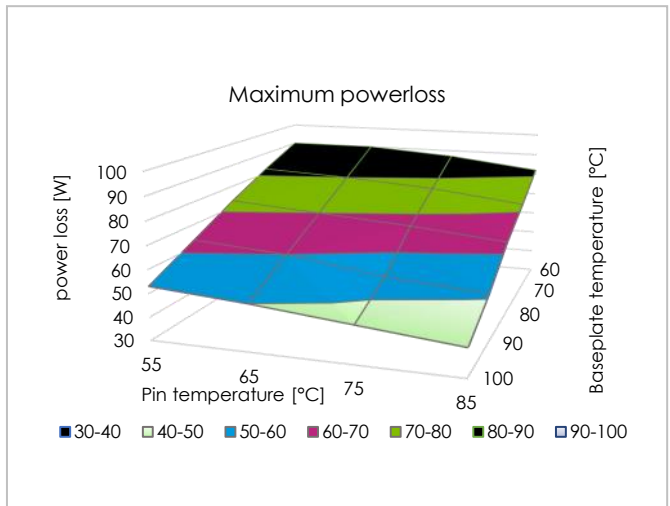
Available output power vs. ambient air temperature and airflow. Above Pout\_TDP, 1300W only for a limited time. Airflow Direction -IN to +IN.

Maximum Output Power



Maximum allowed thermal power (restriction by POMAX might occur). Above Pout\_TDP, 1300W only for a limited time.

Maximum Allowed Power Loss



Available output power vs. pin and baseplate temperature See Thermal Consideration section. Above Pout\_TDP, 1300W only for a limited time.

For more information, please refer to our [thermal models](#) on the website.

## Part 5: Packaging

### Packaging information

**H option:** Select for PIP reflow solder and pick & place - dry packed

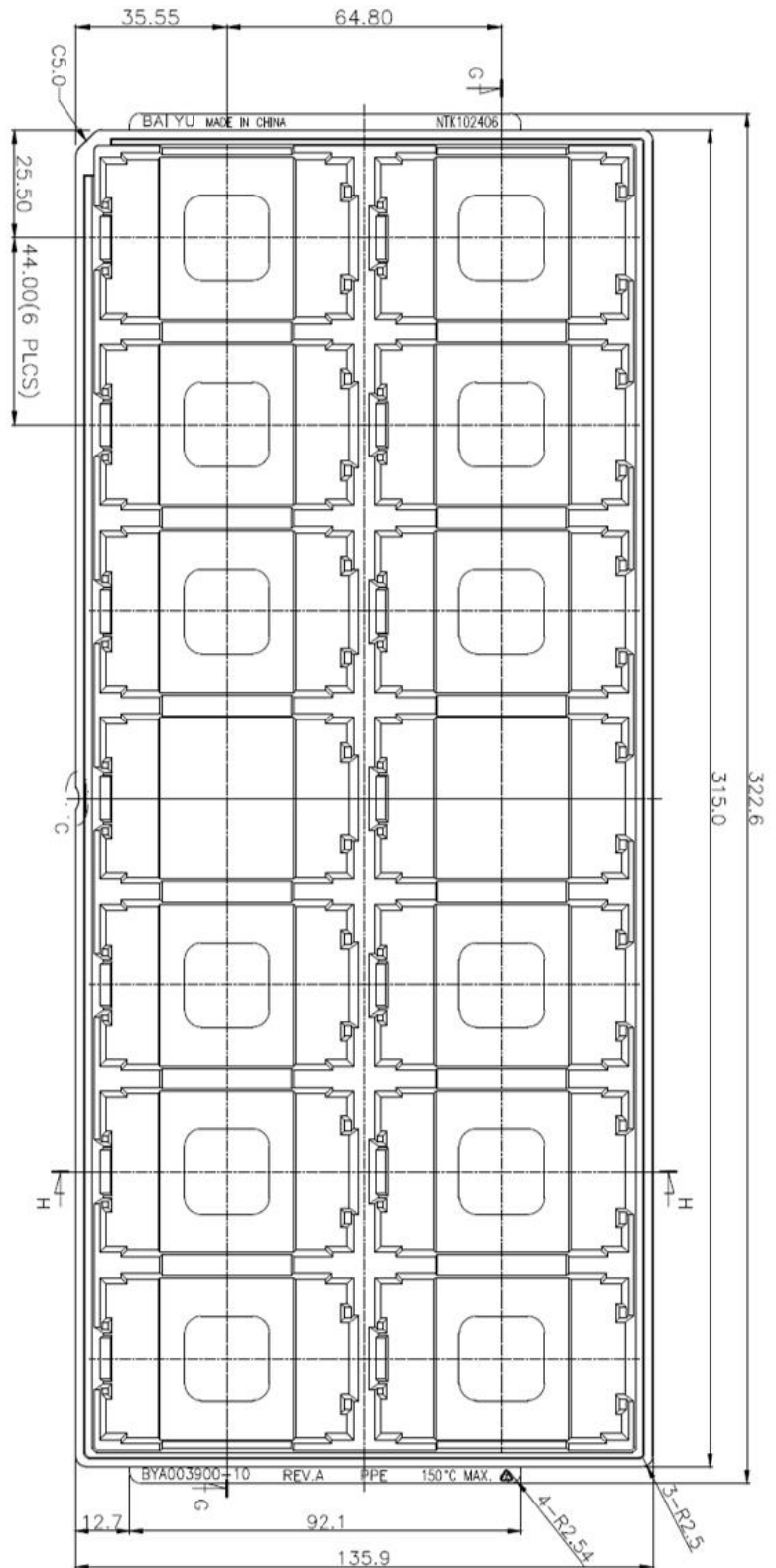
<b>Material</b>	Antistatic Polyphenylene Ester (PPE)
<b>Surface resistance</b>	$\geq 1 \times 10^4$ to $< 1 \times 10^{11}$ ohms
<b>Bakability</b>	Tray can be baked at max. 125 °C for 24 h. Please remove the fitments before baking.
<b>Tray capacity</b>	14 converters/tray
<b>Box capacity</b>	42 products (3 full trays/ box)
<b>Tray weight</b>	214 g empty tray, TBD g full tray closed deck baseplate.

JEDEC standard tray.  
All dimensions in mm

Tolerances: X.x  $\pm 0.26$  [0.01], X.xx  $\pm 0.13$  [0.005]

**Note:** Pick up positions refer to center of pocket.

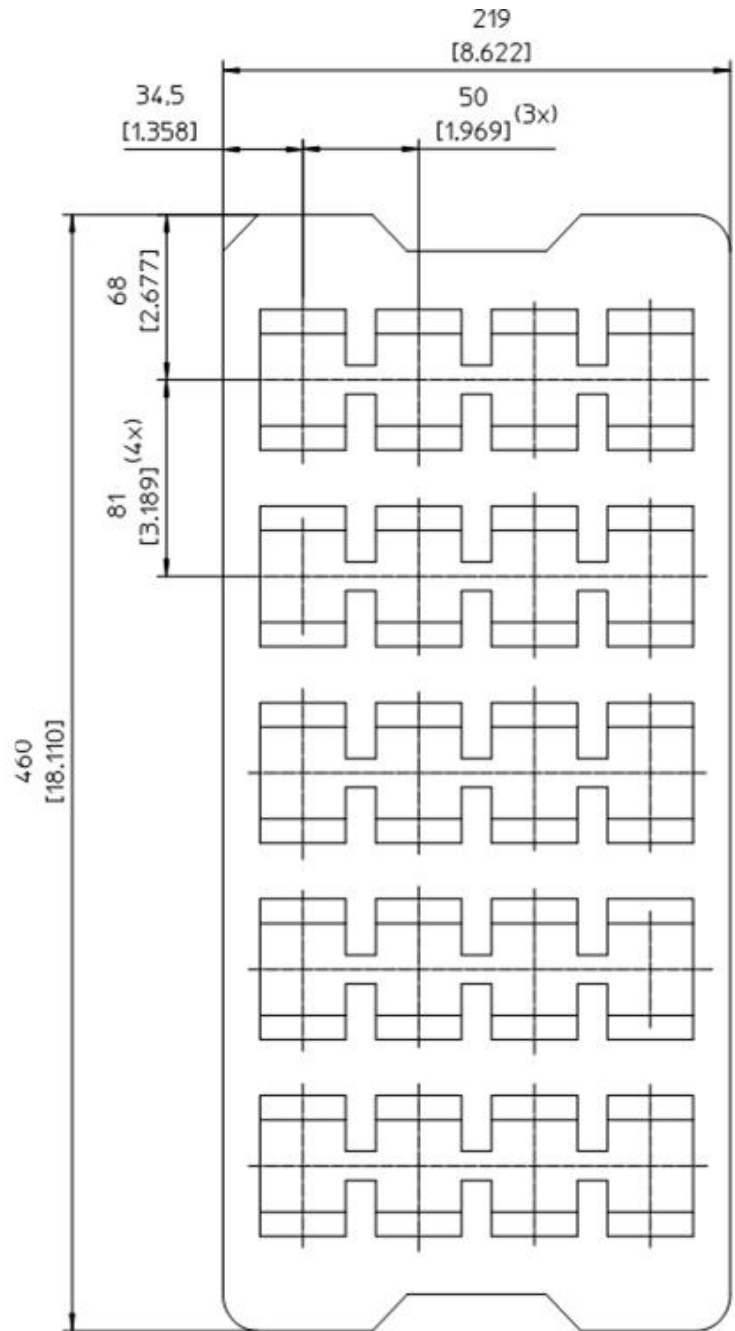
See [mechanical drawing](#) for exact location on product.



**Packaging information**

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

<b>Material</b>	Antistatic Polyethylene (PE) foam
<b>Surface resistance</b>	$\geq 1 \times 10^4$ to $< 1 \times 10^{11}$ ohms
<b>Bakability</b>	Tray cannot be baked
<b>Tray capacity</b>	20 converters / tray
<b>Box capacity</b>	60 products (3 full trays/ box)
<b>Weight</b>	48 g empty tray, TBD g full tray.



Example PE foam tray



## Part 6: Revision history

### Revision table

Revision number	revision change	date	revisor
Rev. A	New document	Sep 28th, 2022	jidmawan
Rev. B	Update product picture	Oct 25th, 2022	jidmawan
Rev. C	Update product picture	Oct 27th , 2022	kartwaer

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# flex.

Flex Power Modules, a business line of Flex, is a leading manufacturer and solution provider of scalable DC/DC converter primarily serving the data processing, communications, industrial and transportation markets. Offering a wide range of both isolated and non-isolated solutions, its digitally-enabled DC/DC converters include PMBus compatibility supported by the powerful [Flex Power Designer](#).



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