BMR323

8:1 fixed ratio digital IBC (600 W)

BMR323 is a compact, unregulated and non-isolated intermediate bus converter (IBC). It is intended for applications in need of a low voltage IBC for improved system efficiencies. Typical use areas are AI and Cloud Computing applications.

BMR323 delivers a peak efficiency of 97.8% at half load. It offers a PMBus compatible digital interface, and is supported by the Flex Power Designer tool.

Up to 6 units can be used in parallel to supply an overall output power of up to 3600 W.

Key features

- 8:1 fixed ratio IBC
- Small form factor
- Parallelable - up to 6 units
- Unregulated
- Non-isolated
- Peak efficiency 97.8%
- Digital interface with PMBus
- Meets safety requirements per IEC/EN/UL 62368-1

Key electrical information

Parameter	Values
Input range	40 - 60 V
Output voltage	5 - 7.5 V
Continuous output current	90 A at 54 V_{in}
Continuous output power	600 W
Peak power	1200 W

Mechanical

27.0 x 18.0 x 6.7 mm / 1.06 x 0.71 x 0.26 in

Soldering methods

- Pb Free SMD reflow

Application areas

- Designed for Artificial Intelligence (AI) applications

Product options

The table below describes the different product options.

Example:	BMR323	1	0	00	/001	C	Definitions
Product family	BMR323						
Pin length options		1					1 = SMD
Baseplate / HS option			0				0 = No baseplate
Other hardware options				00			00 = Standard variant
Configuration code					/001		/001 = PMBus base address 0x6n *Note, see resistor table in PMBus addressing section of the Design & Application Guidelines.*
Packaging options						C	C = Tape on Reel

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
BMR3231000/001C	40-60 V	5-7.5 V / 90 A / 600 W	No base plate / standard variant / 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})	-40	125	°C
Storage temperature	-55	125	°C
Input voltage (V_{in})	-0.3	64	V
5V V_{CC}	-0.3	5.5	V
EN, PG, ALERT, ADDR, SCL, SDA	-0.3	3.6	V

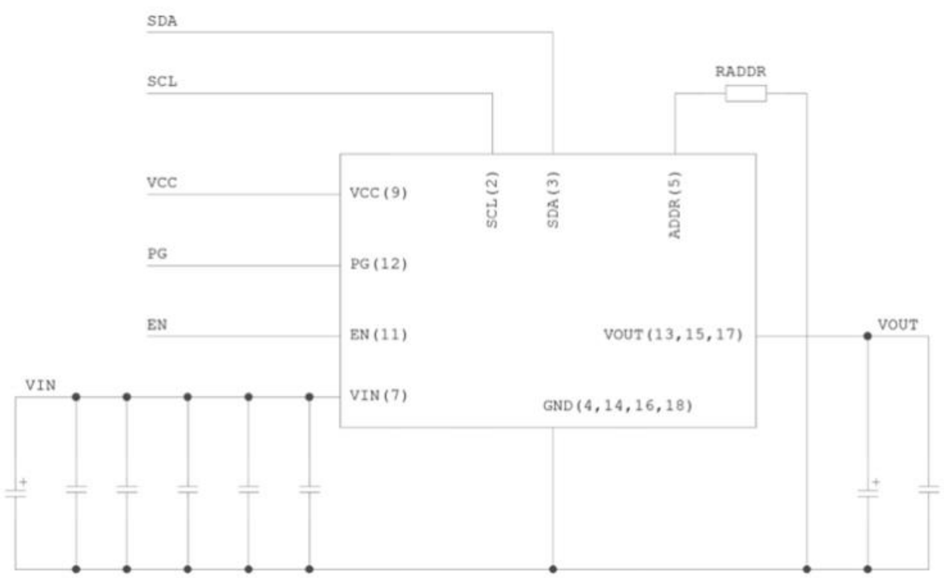
Reliability

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

Typical application diagram

	Mean	90% confidence level	Unit
Steady-state failure rate (λ)	134	163	nfailures/h
Standard deviation (σ)	22.6		nfailures/h
MTBF	7.49	6.15	MHr

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



Electrical specifications for BMR3231000/001

6.75 V, 90 A (175A peak) / 600 W (1200 W peak)

Min and Max values are valid for: T_{P1} = -30 to + 95°C, V_{in} = 40 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, see Note 1.
Additional external C_{in} = 470 µF, C_{out} = 2x470 µF

Characteristic	conditions	minimum	typical	maximum	unit
Key features					
Efficiency (η)	50% of P_{out_TDP}		97.8		%
	100% of P_{out_TDP}		97.0		%
	50% of P_{out_TDP} V_{in} = 40V		97.2		%
	100% of P_{out_TDP} V_{in} = 40V		96.1		%
P_{out_TDP} thermal design power (TDP)	*See Note 1*			600	W
P_{out_MAX} peak power	*See Note 1*			1200	W
Power dissipation	100 % of P_{out_TDP}		18.7		W
Switching frequency (f_s)	0-100 % of P_{out_TDP}		600		kHz
Recommended capacitive load				5000	µF
Input characteristics					
Input voltage range (V_{in})		40	54	60	V
Input idling power	P_{out} = 0 W		3.3		W
Input standby power	(turned off with EN)		91		mW
Input OVP			64		V
Internal input capacitance			28.2		µF
Recommended external input capacitance	*See Note 2*		470		µF

Note 1: Max. output current is rated at 200A at 40Vin. Max power is ≤ 1000W and continuous power (thermal design power TDP) is ≤ 600W depending on thermal conditions.

*Note 2: Typical value (recommended) is 470 µF + 5*2.2 µF*

Electrical specifications for BMR3231000/001

6.75 V, 90 A (175A peak) / 600 W (1200 W peak)

Min and Max values are valid for: T_{P1} = -30 to + 95°C, V_{in} = 40 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, see Note 1.
Additional external C_{in} = 470 µF, C_{out} = 2x470 µF

Characteristic	conditions	minimum	typical	maximum	unit
Output characteristics					
Output voltage	P_{out} = 0 W	5.00	6.75	7.50	V
Output voltage	Disabled, no load		3		mV
Output current (I_{out})	V_{in} = 40- 60 V, PG asserted	0	90	135	A
Max start-up load	Before PG			0	A
Output voltage droop	I_{out} step from 0 to 90 A		200		mV
Output ripple & noise	20 MHz BW, see Note 1		22		mV_{p-p}
Internal output capacitance	V_{out} = 0V		250		µF
On/off control					
Turn-off input voltage	Decreasing input voltage		35		V
Turn-on input voltage	Increasing input voltage		37		V
On Delay Time	From EN asserted to ramp start		1.7		ms
Ramp-up time	From 10% to 90% of V_{out}, I_{out} = 0 A		2.8		ms
Start-up time	From V_{in} > VIN_ON to PG		16		ms
Enable start-up time	FROM EN to PG		15		ms
Logic high: trigger level	EN pin, Voltage Rising	2.1			V
Logic low: trigger level	EN pin, Voltage Falling			1.9	V
Sink current	EN pin		10		mA

Note 1: See Technical Reference: Application and design considerations.

Electrical specifications for BMR3231000/001

6.75 V, 90 A (175A peak) / 600 W (1200 W peak)

Characteristic	conditions	minimum	typical	maximum	unit
Protection features					
Input Over Voltage fault limit (IOVP)	Latch		64		V
Output undervoltage fault limit (UVP)	Latch		2		V
Output overvoltage fault limit (OVP)	Latch		8.25		V
Over temperature fault limit (OTP)	Latch		125		°C
Over temperature warning limit (OTW)			90		°C
Over Current Protection (OCP)	Fast applicable on pulses, shorter than 5 ms.	200	230	250	A
	Average, Note 1	150	155	200	A
Response times	IUVP, IOVP, UVP, OVP, OTP		2		μs
	Fast OCP, 77-160 A		17		ms
	Average OCP, 77A-140 A		170		ms
5.0 V Vcc Auxiliary power					
Voltage		4.5	5.0	5.5	V
Current			250	360	mA

Note 1: See Technical Reference: Application and design considerations. 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.

Electrical specifications for BMR3231000/001

6.75 V, 90 A (175A peak) / 600 W (1200 W peak)

Characteristic	conditions	minimum	typical	maximum	unit
Monitoring & Control					
$UVLO_{VIN}$ - Under Voltage Lock-Out	V_{in} ON	36.1	36.8	37.5	V
	V_{in} OFF	33.5	34.2	34.9	V
Power Good Delay Time	From V_{out} = 100 % to PG asserted		6.5		ms
Power Good Threshold	Low to high transition		4.8		V
	High to low transition, *Note 1*		4.5		V
V_{IL} - Logic input low	SCL, SDA			1.0	V
V_{IL}- Logic input high	SCL, SDA	2.3			V
V_{OL} - Logic output low	SDA, PG			400	mV
I_{OL} - Logic output low sink current	SDA, PG			20	mA
I_{LEAK} - Logic leakage current	SDA, SCL, PG	-5		5	µA
C_{I_PIN} - Logic input capacitance	SDA, SCL, EN		7		pF
f_{SMB} - SMBus Operating frequency		100		400	kHz
EN - Enable	See page 5 "On/Off control"				

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

T_{P1} = -20 to + 95 °C, V_{in}= 40 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

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

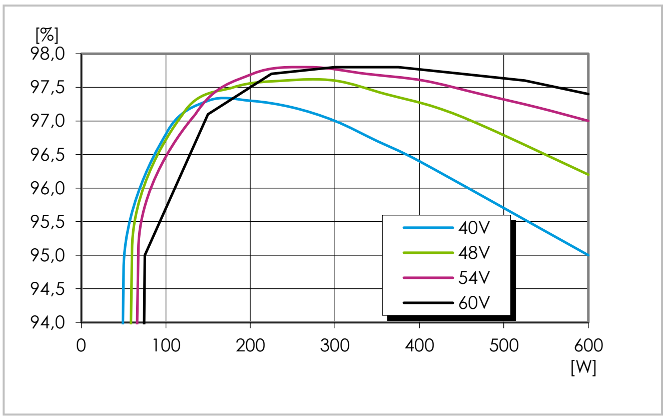
Command	Conditions	minimum	typical	maximum	unit
Monitoring accuracy					
Input voltage READ_VIN			±1		%
Output voltage READ_VOUT			±1		%
Output current READ_IOUT	V_{in} = 54 V, I_{out} = 90 A		±5		%
Temperature READ_TEMPERATURE_1	T ≥ 25 °C		±1		°C

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

Electrical graphs for BMR3231000/001

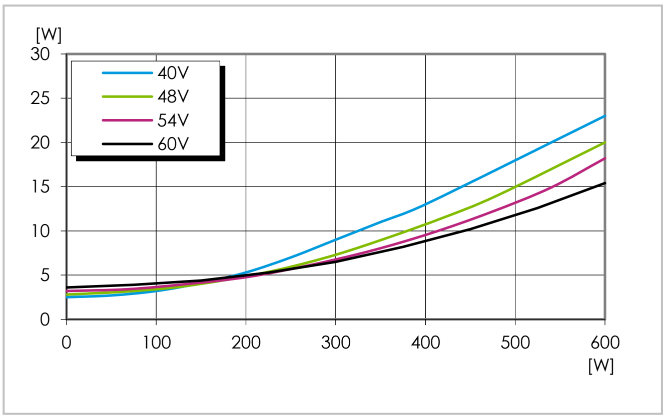
6.75 V, 90 A (175A peak) / 600 W (1200 W peak)

Efficiency



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

Power dissipation



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

Output Ripple and Noise

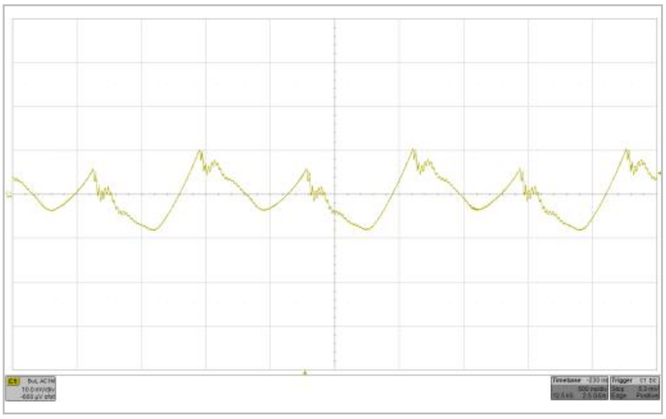


Figure 4: V_{in} = 54V , I_{out} = 90A, 20 MHz BW. Scale 10 mV/div, 500 ns/div

Output voltage droop

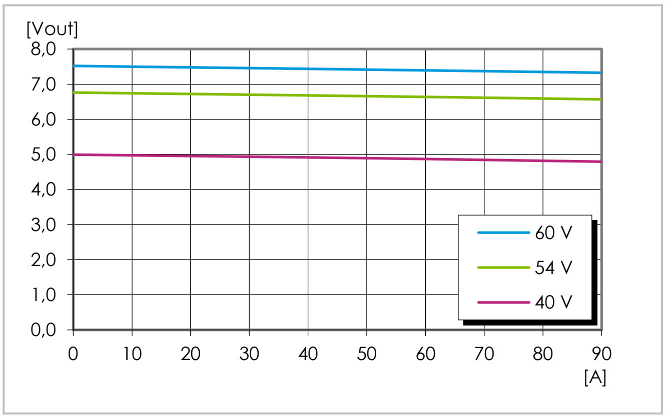


Figure 5: Output voltage vs output current

Startup

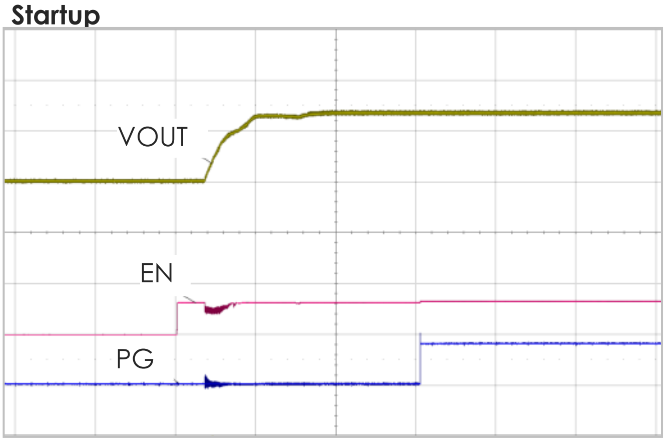


Figure 6: Output enabled by EN pin. V_{in} = 54V, I_{out} = 0A Scale from top: 5, 5, 5 V/div, 5 ms/div.

Shutdown

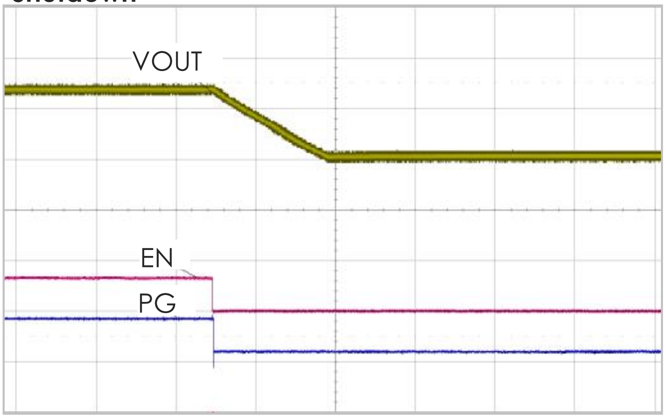


Figure 7: Output disabled by EN pin. V_{in} = 54V, I_{out} = 1A Scale from top: 5, 5, 5 V/div, 5 ms/div.

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 600 kHz for BMR323. The EMI characteristics below is measured at V_{in} = 54V and max I_{out}.

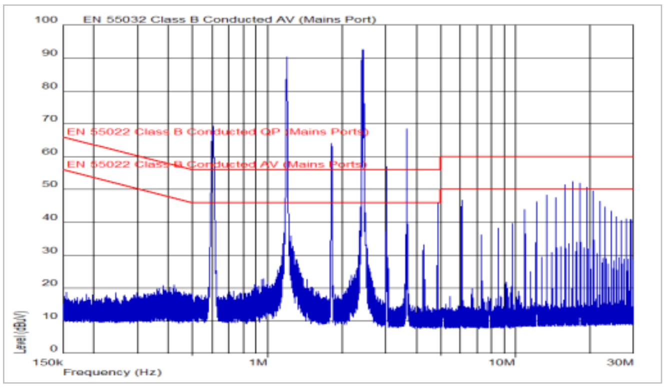


Figure 8: EMI without filter. (Blue graph = QP values)

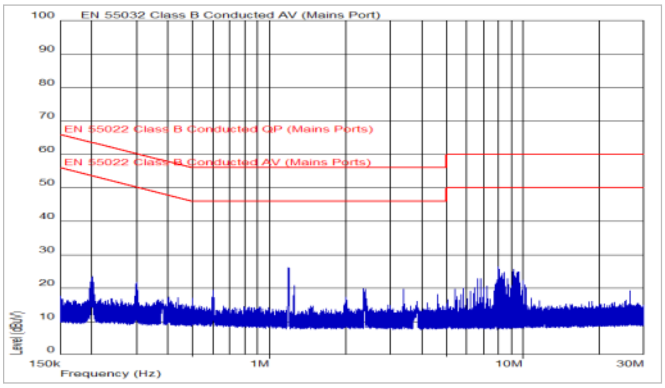


Figure 9: EMI with an optional external filter, EN55032. Test method and limits are the same as EN55022. (Blue graph = QP values)

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.

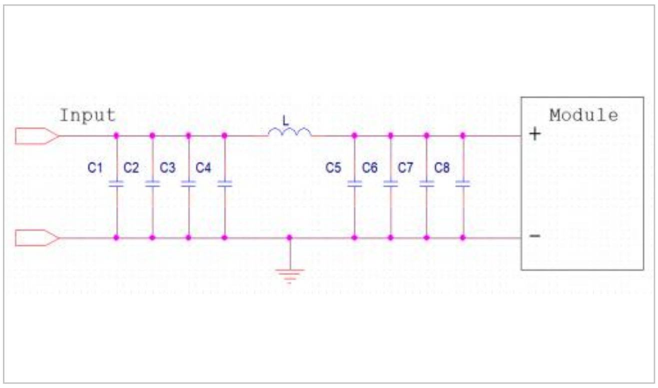


Figure 10: Filter components:

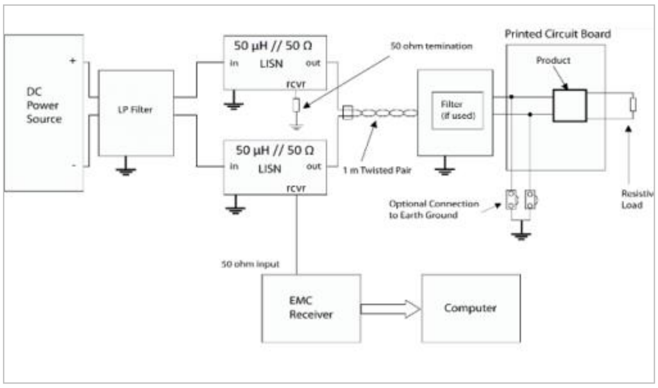


Figure 11: Test set-up

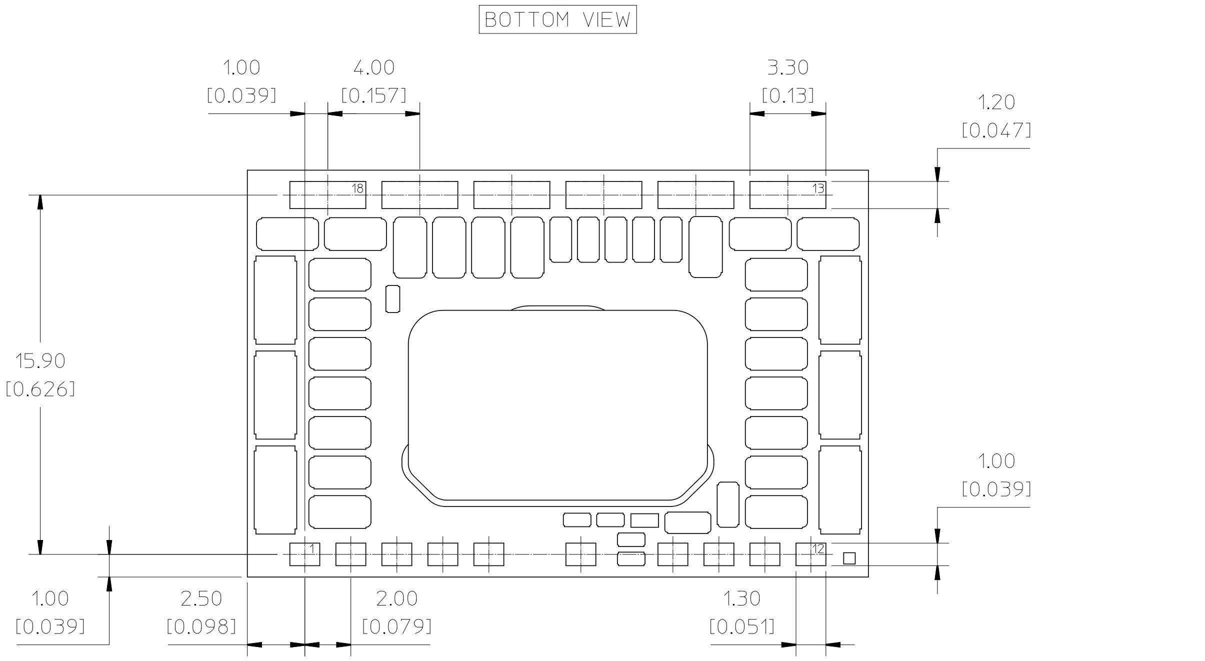
C1-C3, C6-C8 2.2uF 10% 1206 100V X7R, capacitor
C4-C5 10uF 100VDC X7R 10%, capacitor
L1 2.2uH 20% 26A DC, Inductor

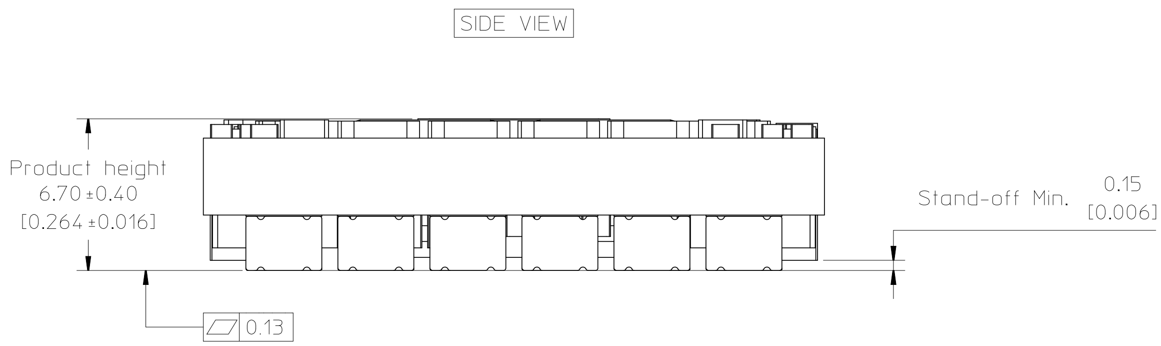
Layout recommendations

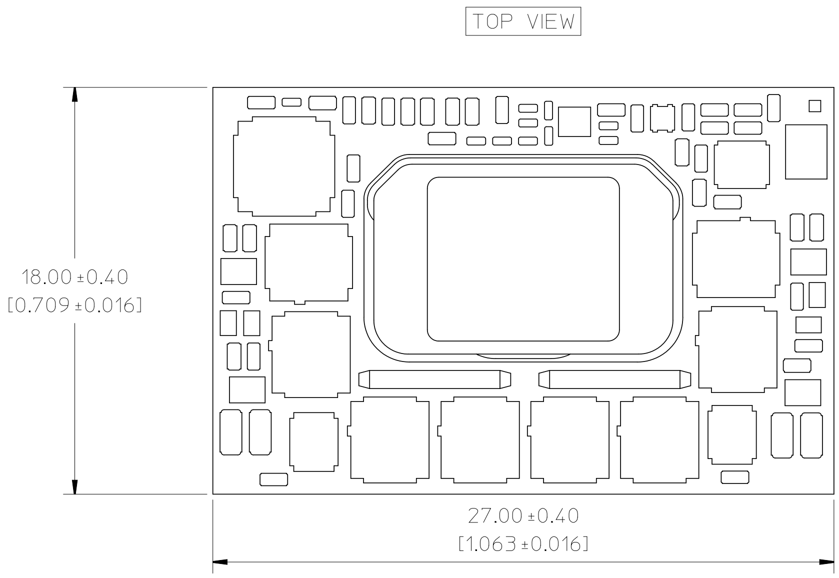
The radiated EMI performance of the product will depend on the PCB layout and ground layer design. It is also important to consider the stand-off of the product. If a ground layer is used, it should be connected to the output of the product and the equipment ground or chassis. A ground layer will increase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

Part 3: Mechanical information

BMR323 1000/xxx: surface mounted







NOTES:

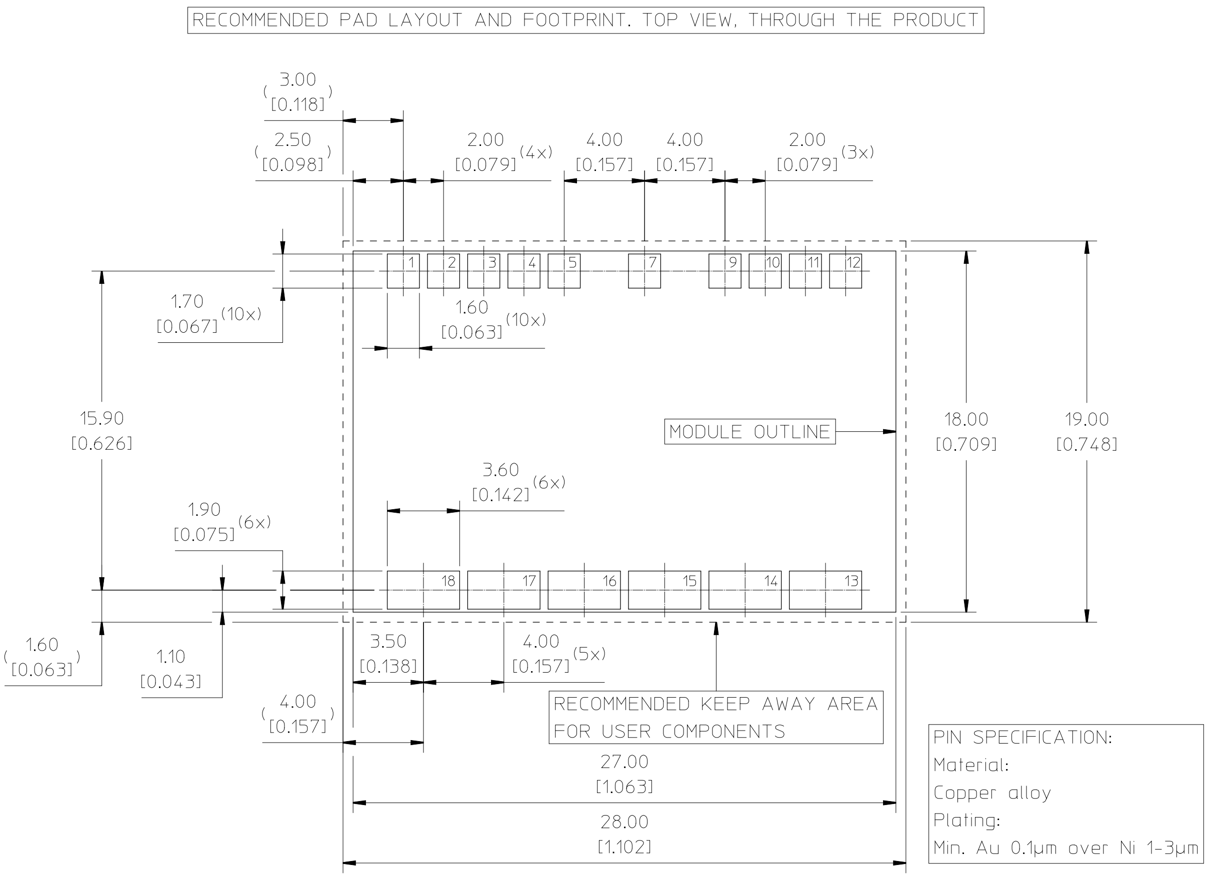
WEIGHT
Typical: 10.6 g

All dimensions in mm and [inch].
Tolerances unless specified:
x.x mm ±0.50 mm, [x.xx in. ±0.02 in.]
x.xx mm ±0.25 mm, [x.xxx in. ±0.010 in.]
(Not applied on footprint and typical values)

3D MODELS
3D .stp models are available on request.

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.

TOP VIEW - Pin-out description and pin positions



Pin	Designation	Type	Function
1	NC		
2	SCL	Input/Output	PMBus clock
3	SDA	Input/Output	PMBus data
4	GND	Power	Power ground
5	ADDR	Input	PMBus address pin strap
6	Not mounted		
7	VIN	Power	Input voltage
8	Not mounted		
9	VCC	Power	Auxiliary supply
10	NC		
11	EN	Input	Enable, active high
12	PG	Open Drain	Power good, active high
13, 15, 17	VOUT	Power	Output voltage
14, 16, 18	GND	Power	Power ground

Part 4: Thermal considerations

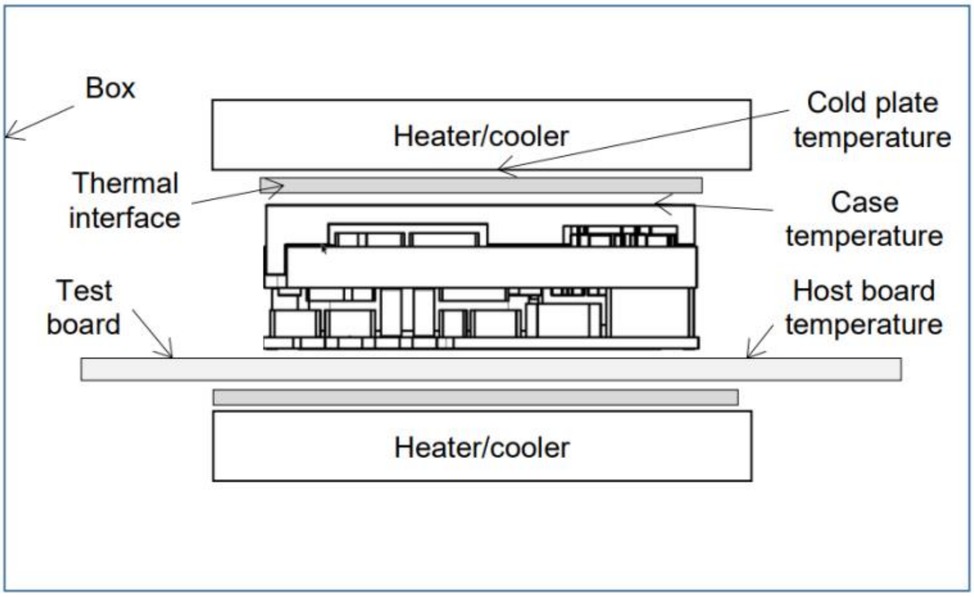
Thermal considerations

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

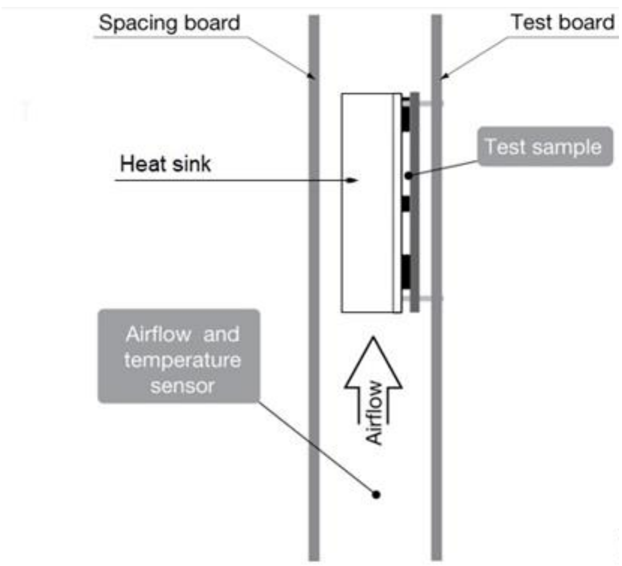
Test Setup – Heatsink

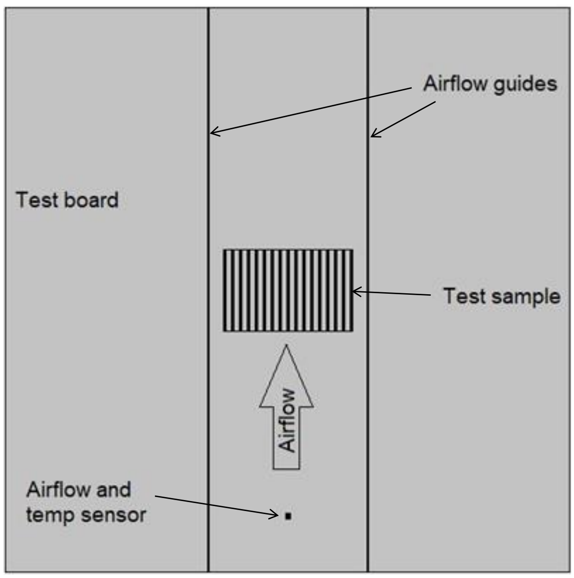
For products mounted on a PCB with a heatsink attached, cooling is achieved both by conduction, from the pins to the host board, and through the heatsink mounted on top of the device. The wind speed and temperature are measured in a point upstream to the device. The output current derating graphs found later in this section provide the available output current vs. ambient air temperature and air velocity at V_{in} = 54 V.

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

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

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

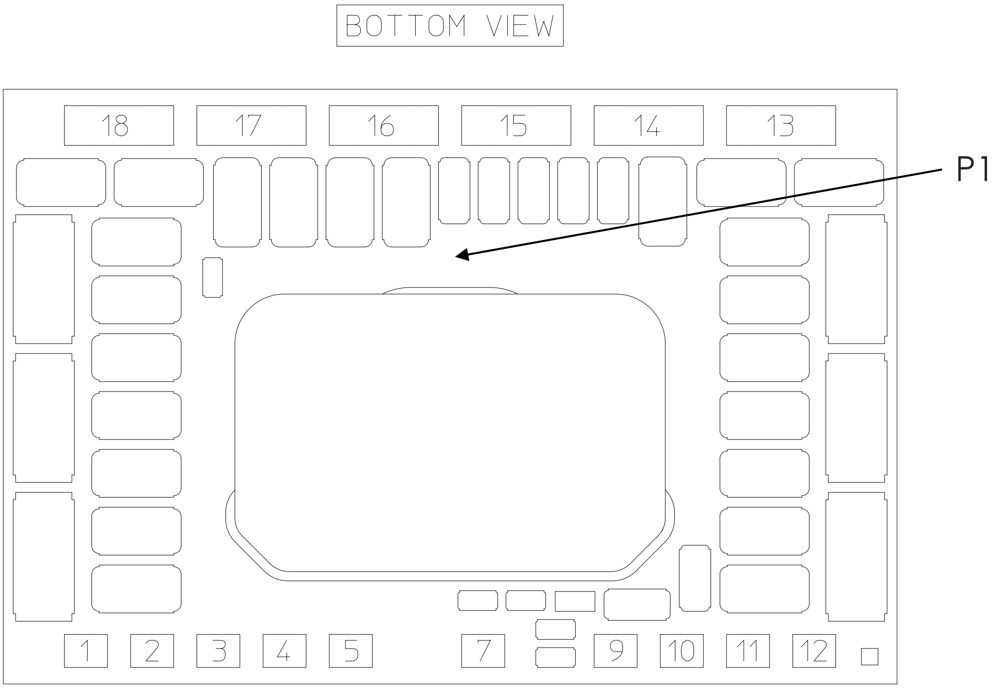




Definition of product operating temperature

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	PCB Bottom side	T_{P1}= 125 °C



Thermal graphs

Output Power derating

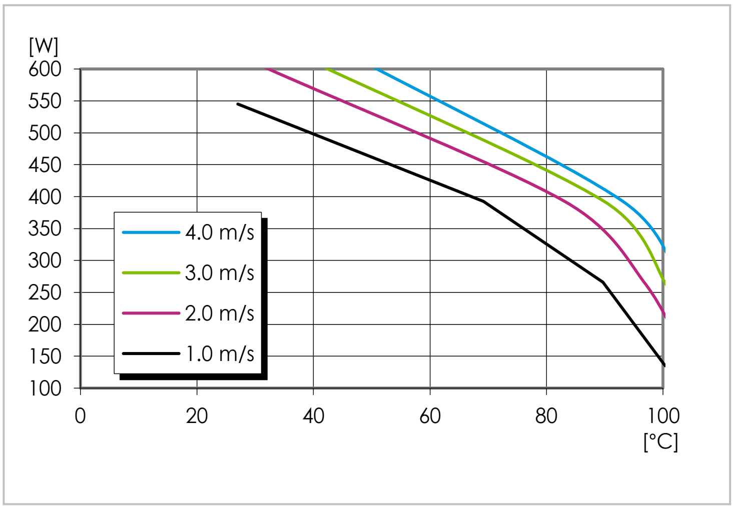


Figure 15: Max average output power vs. windspeed. Using ICK S 32 x 32 x 10 from Fischer.

Output Power derating

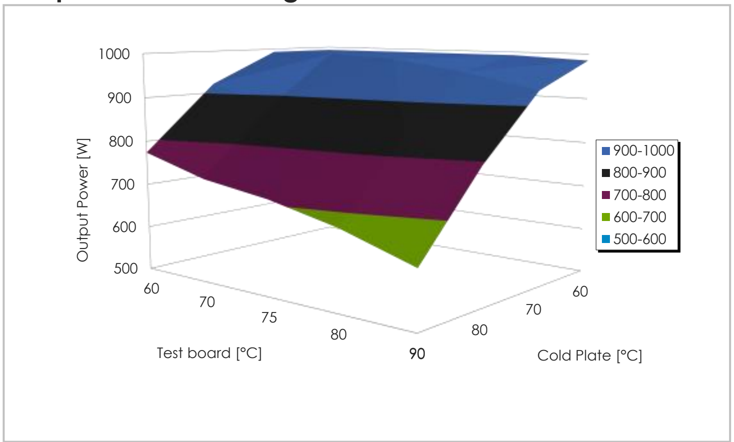


Figure 16: Max output power vs. cold plate temperature and host board temperature. Thermal interface material top 2.0 mm, 8 W/Mk, bottom 1.0 mm, 8 W/mK.

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

Peak Power

Peak power capability

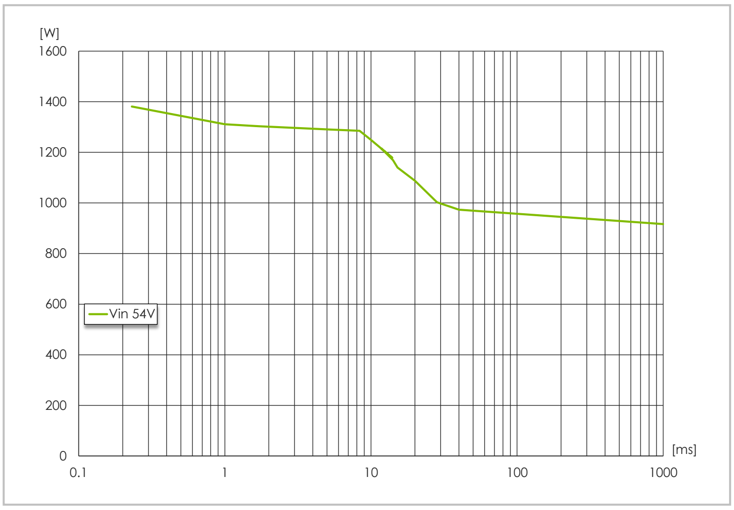


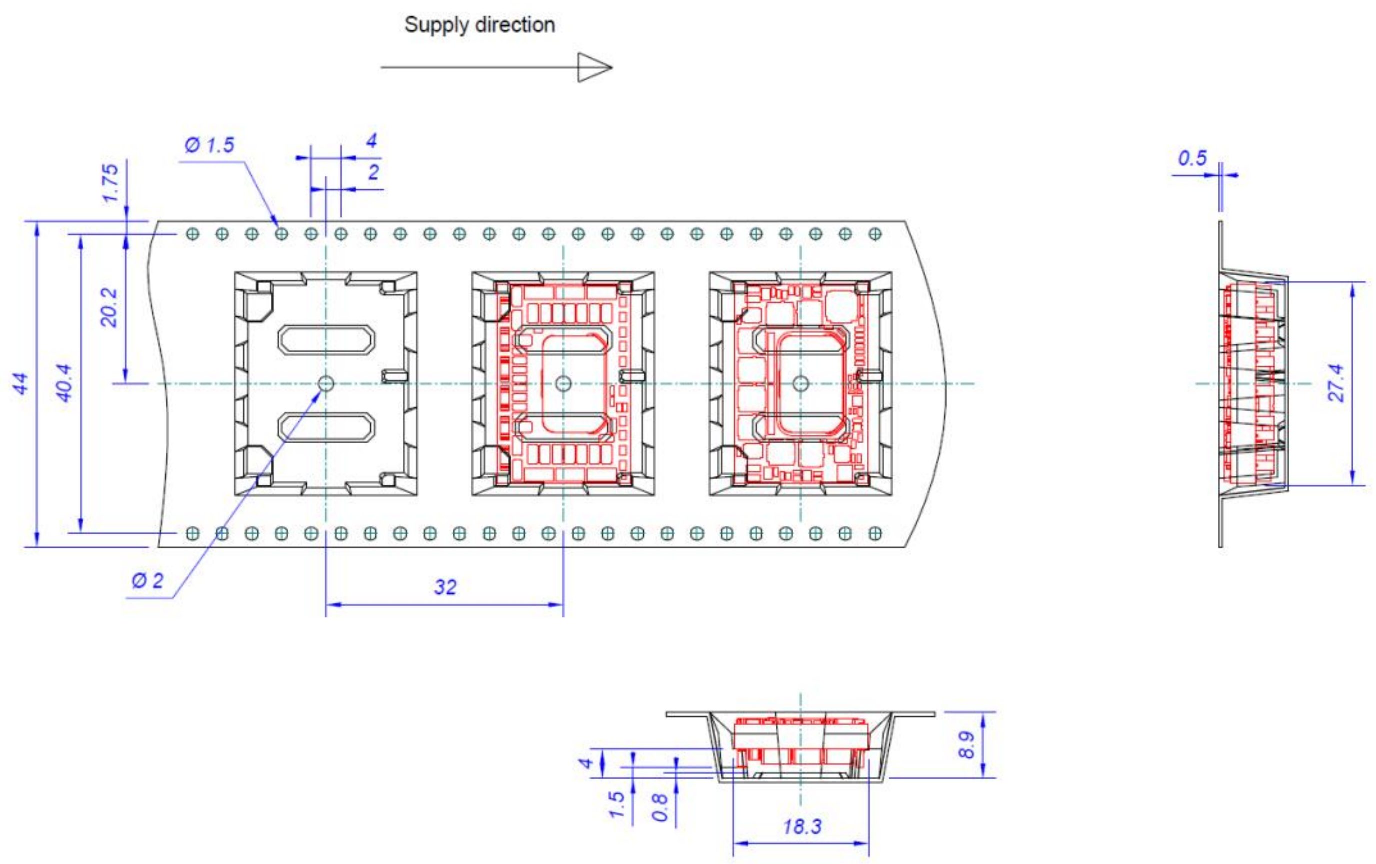
Figure 16: Max peak output current vs pulse duration and PMBus monitored temperature when pulse starts. Initial I_{out} = 90 A. Limit given by max internal junction temperature (150 °C) of hotspot component.

Part 5: Packaging

Packaging information

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

Carrier Tape Specifications	
Material	Antistatic PS
Surface resistance	10^7 < ohm/square
Bakabilty	Tape cannot be baked
Tape width, W	44 mm [1.73 inch]
Pocket pitch, P1	32 mm [1.26 inch]
Pocket depth, K0	8.9 mm [0.35 inch]
Reel diameter	330 mm [13 inch]
Reel capacity	150 products/reel
Reel weight	2.2kg/full reel



Part 6: Revision history

Revision table

Revision number	revision change	date	revisor
Rev. A	First release.	2025-04-XX	Karmjoh
Rev. B	Updated picture of product.	2025-04-22	Karjnils
Rev. C	Fixing typo.	2025-04-23	Karjnils
Rev. D	Adding order number example on page 2.	2025-04-24	Karjnils
Rev. E	Added Liquid cooling thermal graphs and the Liquid Cooling Setup, pages 12, 13, 15.	2025-04-29	Karjlind

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.