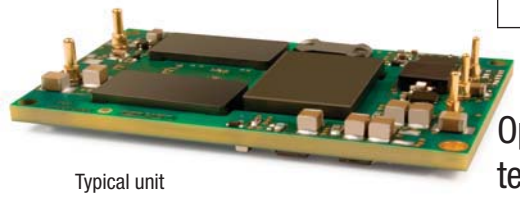
RBC-12/17-D48 Series

Quarter Brick, Regulated Bus Converters

Output (V)	Current (A)	Nominal Input (V)
12	17	48



Typical unit

Optimized for distributed power Regulated Intermediate Bus Architectures (RIBA), the RBC DC/DC bus converter series offer regulated outputs (±1.5%) in an industry-standard quarter brick open frame package.

FEATURES

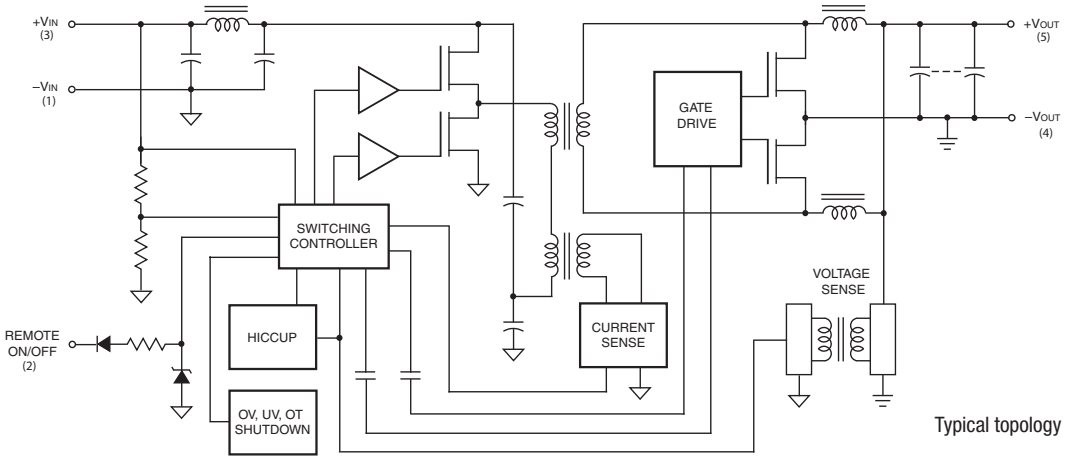
- Up to 210 Watts total output power
- Up to 93% ultra-high efficiency @ full load
- 48V Input (up to 36-75V range)
- 12V/17A Output for Regulated Intermediate Bus Architectures (RIBA) with POL converters
- Synchronous-rectifier topology
- 225kHz fixed switching frequency
- Fully isolated, 2250Vdc (BASIC)
- 2.3" x 1.45" x 0.42" quarter brick
- Stable no-load condition
- Thermal shutdown
- Fully I/O protected
- Certified to UL/IEC/EN 60950-1 and CSA C22.2 No.60950-1-07, 2nd edition

PRODUCT OVERVIEW

The present trend in distributed power architectures (DPA) requires both high efficiency and some regulation of the output voltage to reduce the risk of under voltage dropout. Earlier unregulated bus converters were simply ratiometric "DC transformers." The fully isolated (2250Vdc) RBC series accept a wide range 36 to 75 Volt DC input (48V nominal) and convert it to an output of 12Vdc. This output then drives point-of-load (PoL) converters such as our Okami, LSN, LEN, LSM or LQN series which feature precise load regulation. Applications include 48V-powered datacom and telecom installations, base stations, cellular telephone repeaters and embedded systems. Low overall height of 0.42" (10.7 mm) fits tight card cages.

The RBC's synchronous-rectifier topology and fixed frequency operation means excellent efficiencies. "No fan" or zero airflow applications may use the optional base plate for cold surface mounting or natural-convection heatsinks.

A wealth of electronic protection features include input undervoltage (UV) lockout, output current limit, short circuit hiccup, overtemperature shutdown and output overvoltage. Available options include positive or negative polarity remote On/Off control and the baseplate. Assembled using ISO-certified automated surface-mount techniques, the RBC series includes all UL and IEC emissions, safety and flammability certifications.



Typical topology is shown.

Figure 1. Simplified Block Diagram

RoHS COMPLIANT 2002/95/EC

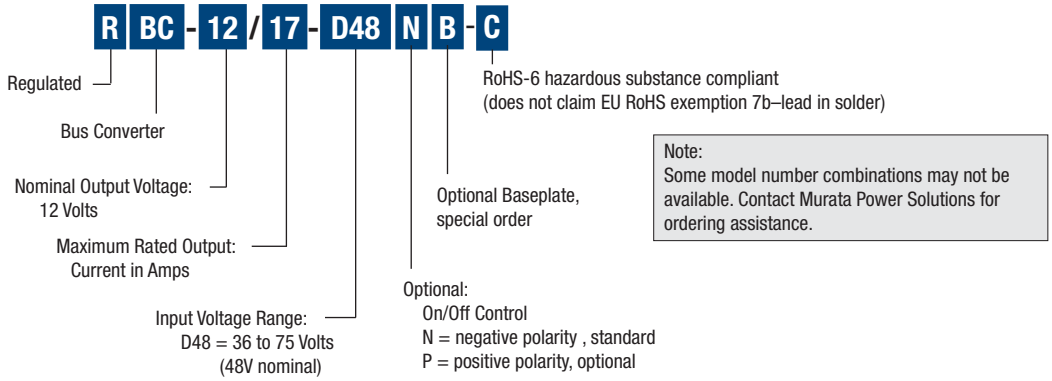
For full details go to www.murata-ps.com/rohs

ORDERING GUIDE SUMMARY

Root Model ①	V_{OUT}	I_{OUT} (Max.)	R/N (mV pk-pk)		Regulation (Max.)		V_{IN} (Nom.)	Range	Iin, no load	Iin, full load	Efficiency		Package	
	V	A	Typ.	Max.	Line	Load	V	V	mA	A	Min.	Typ.	Case	Pinout
RBC-12/17-D48N-C	12	17	50	75	±0.65%	±1.5%	48	36-75	165	4.59	90.5%	92.5%	C49	P65

① Please refer to the part number structure for complete model numbers

PART NUMBER STRUCTURE



CAUTION – This converter is not internally fused. To avoid danger to persons or equipment and to retain safety certification, the user must connect an external fast-blow input fuse as listed in the specifications. Be sure that the PC board pad area and etch size are adequate to provide enough current so that the fuse will blow with an overload.

Start-Up Considerations

When power is first applied to the DC/DC converter, there is some risk of start up difficulties if you do not have both low AC and DC impedance and adequate regulation of the input source. Make sure that your source supply does not allow the instantaneous input voltage to go below the minimum voltage at all times. Even if this voltage depression is very brief, this may interfere with the on-board controller and possibly cause a failed start.

Use a moderate size capacitor very close to the input terminals. You may need two parallel capacitors. A larger electrolytic or tantalum cap supplies the surge current and a smaller parallel low-ESR ceramic cap gives low AC impedance.

Remember that the input current is carried both by the wiring and the ground plane return. Make sure the ground plane uses adequate thickness copper. Run additional bus wire if necessary.

Performance/Functional Specifications

Typical at T_A = +25°C under nominal input voltage and full-load conditions unless noted.
Refer to required airflow and Derating curves for thermal specifications. [1]

Input	
Input Voltage Range	36-75 Volts
Recommended External Fuse	20 Amp fast blow
Start-up Threshold	35V
Undervoltage shutdown	33.5V
Overvoltage shutdown	None [note 12]
Input Current, nominal	See ording guide
Input Current, V_{IN} = V_{MIN}	6.00A
Input Current, shut-down mode	6.5mA max.
Inrush Transient	0.05A^2-seconds
Reflected Ripple Current [2]	15mAp-p
Internal Filter Type	L-C
Reverse Polarity Protection	None (see note 11), install external fuse
Remote On/Off Control [5]	
Positive Logic	On = Open or +3.5 to +13.5 V. Off = Gnd. Pin or 0 to +1V.
Negative Logic	On = Gnd. Pin or 0 to +1V. Off = Pin open or +3.5V to +13.5V.
Current	2mA max.

Output	
Total Output Power [3]	210W max. [15]
Setpoint Accuracy (50% load)	±3% of $V_{NOMINAL}$
Extreme Accuracy [14]	11.4V min. to 12.6V max.
Output Current [7]	See ordering guide
Minimum Load	No minimum load
Ripple and Noise (20MHz bandwidth)	See ordering guide
Line and Load Regulation [10]	See ordering guide
Efficiency	See ordering guide
Isolation Voltage (Input/output) (Input to baseplate) (Baseplate to output)	2250Vdc min. 1500Vdc min. 1500Vdc min.
Isolation Resistance	100MΩ
Isolation Capacitance	1500pF
Isolation Safety Rating	Basic
Current Limit Inception (98% of V_{OUT})	27A, after warm up
Short Circuit Current [6]	5 Amps (hiccup autorestart – remove short for recovery)
Short Circuit Duration (+V_{OUT} grounded)	Continuous, no damage
Overvoltage Protection	15Vdc max. via magnetic feedback
Max. Capacitive Loading (resistive load)	10,000µF, low ESR 0.02 Ohms
Temperature Coefficient	±0.02% per °C

Dynamic Characteristics	
Dynamic Load Response (to within 3% of V_{OUT})	75µsec, 50-75-50% load step 100µsec, 25-75-25% load step
Start Up Time (V_{IN} to V_{OUT} regulated) (Remote On to Vout regulated)	 60msec 60msec
Fixed Switching Frequency	225 ±25kHz

Environmental	
Calculated MTBF [4]	1,247,727 hours
Operating Case Temperature [13]	+110°C max.
Electronic Thermal Shutdown	+125°C min.
Operating Temperature Range (With Derating)	-40ºC to +85ºC, See Derating curves
Storage Temperature Range	–55 to +125°C
Flammability	UL94V-0
Relative Humidity	To 85% / +85°C
Safety Compliance	UL60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1
Electromagnetic Interference conducted or radiated	EN55022/CISPR22 (may require external filters)

Physical	
Pin Material	Copper alloy with gold plate over nickel underplate
Weight	1 ounce (28.4 grams)

Absolute Maximum Ratings

Input Voltage:	
Continuous	75 Volts
Transient (100msec max.)	100 Volts
Input Reverse-Polarity Protection	None, see notes. Install external fuse.
Output Current	Current limited. Devices can withstand an indefinite output short circuit without damage.
Storage Temperature	–55 to +125°C
Lead Temperature (soldering, 10 sec.)	+280°C

These are stress ratings. Exposure of devices to any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance/Functional Specifications Table is not implied.

(1) All models are tested and specified with external 1 || 10uF ceramic/tantalum output capacitors and external 22uF input capacitor. All capacitors are low ESR types. These capacitors are necessary to accommodate our test equipment and may not be required to achieve specified performance in your applications. All models are stable and regulate within spec under no-load conditions.
General conditions for Specifications are +25°C, VIN = nominal, VOUT = nominal, full load.

(2) Input Ripple Current is tested and specified over a 5 Hz to 20 MHz bandwidth. Input filtering is CIN = 33µF/100V tantalum, CBUS = 220µF/100V electrolytic, LBUS = 12µH.

(3) Note that Maximum Power Derating curves indicate an average current at nominal input voltage. At higher temperatures and/or lower airflow, the DC/DC converter will tolerate brief full current outputs if the total RMS current over time does not exceed the Derating curve. All Derating curves are presented at sea level altitude. Be aware of reduced power dissipation with increasing density altitude.

(4) Mean Time Before Failure is calculated using the Telcordia (Belcore) SR-332 Method 1, Case 3, ground fixed conditions, TPCBOARD = +25°C, full output load, natural air convection.

(5) The On/Off Control may be driven with external logic or by applying appropriate external voltages which are referenced to Input Common. The On/Off Control Input should use either an open collector/open drain transistor or logic gate which does not exceed +13.5V.

(6) Short circuit shutdown begins when the output voltage degrades approximately 2% from the selected setting.

(7) The outputs are not intended to sink appreciable reverse current.

(8) Output noise may be further reduced by adding an external filter. See I/O Filtering and Noise Reduction.

(9) All models are fully operational and meet published specifications, including "cold start" at –40°C.

(10) Regulation specifications describe the deviation as the line input voltage or output load current is varied from a nominal midpoint value to either extreme.

(11) If reverse polarity is accidentally applied to the input, a body diode will become forward biased and will accept considerable current. To ensure reverse input protection with full output load, always connect an external input fuse in series with the +VIN input. Use approximately twice the full input current rating with nominal input voltage.

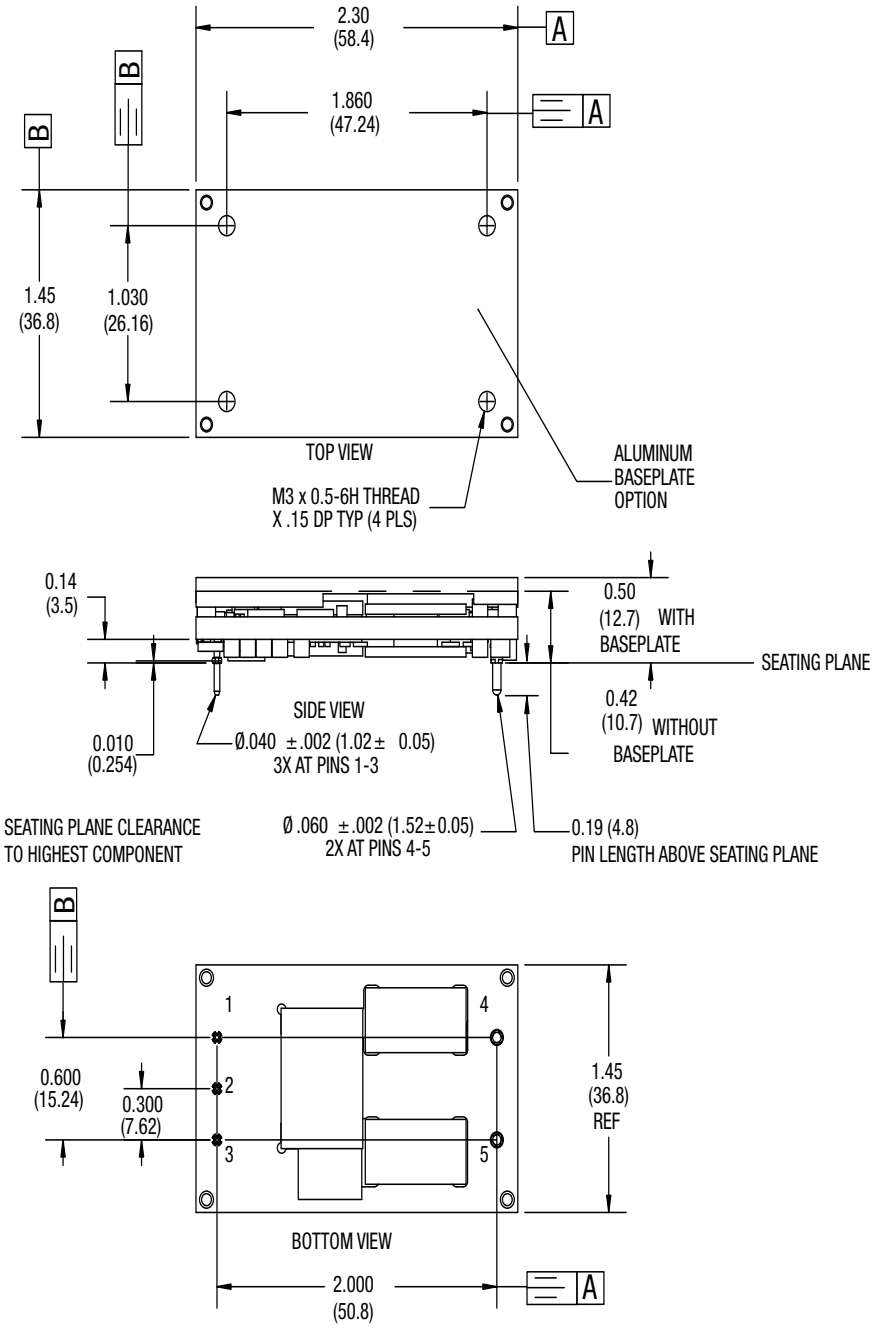
(12) Input overvoltage shutdown on 48V input models is normally deleted in order to comply with certain telecom reliability requirements. These requirements attempt continued operation despite significant input overvoltage.

(13) Note that the converter may operate up to +110°C PCB temperature with the baseplate installed. However, thermal self-protection occurs near +125°C and there is a temperature gradient from high power components. Therefore, +100°C baseplate temperature is recommended to avoid thermal shutdown.

(14) "Extreme accuracy" refers to all combinations of line and load regulation, output current, initial setpoint accuracy and temperature coefficient.

(15) Vo = (11.64V to 12.36V)
Power = (197.88W to 210.12W)

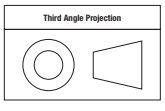
MECHANICAL SPECIFICATIONS



INPUT/OUTPUT CONNECTIONS	
Pin	Function P65
1	-Input*
2	Remote On/Off
3	+Input*
4	-Output
5	+Output

* These converters are pin-for-pin/plug-compatible to competitive units. Other units may use different pin numbering or alternate outline views. When laying out your PC board, follow the pin FUNCTION. DOSA designates Pin 1 as +Input and Pin 3 as -Input.

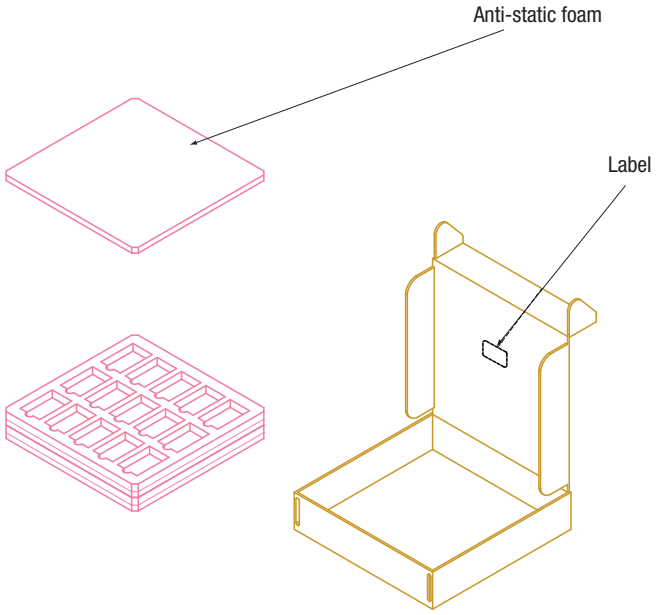
Dimensions are in inches (mm shown for ref. only).



Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2°

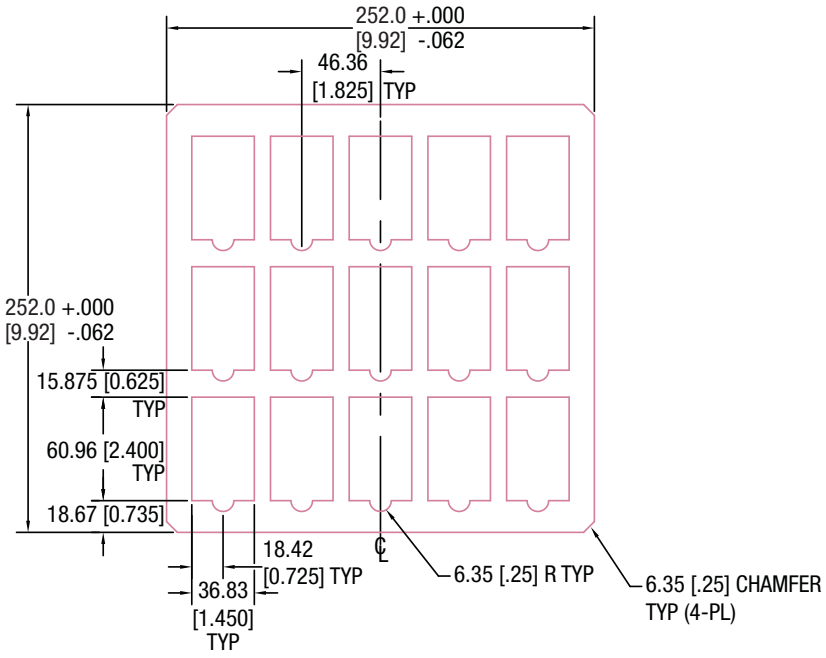
Components are shown for reference only.

SHIPPING TRAYS AND BOXES, THROUGH-HOLE MOUNT



SHIPPING TRAY DIMENSIONS

RBC modules are supplied in a 15-piece (5 x 3) shipping tray. The tray is an anti-static closed-cell polyethylene foam. Dimensions are shown below.

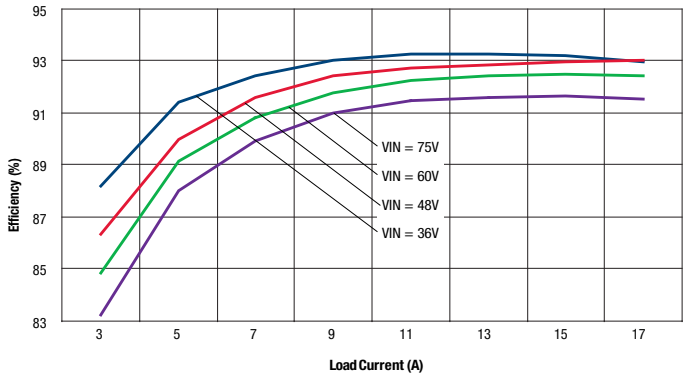


Notes:

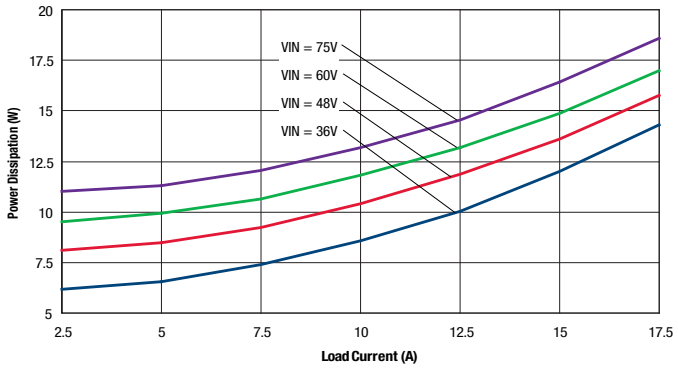
1. Material: Dow 220 antistat ethafoam (Density: 34-35 kg/m3)
2. Dimensions: 252 x 252 x 19.1 mm 5 x 3 array (15 per tray)
3. All dimensions in millimeters [inches]
4. Tolerances unless otherwise specified: +1/-0

PERFORMANCE DATA

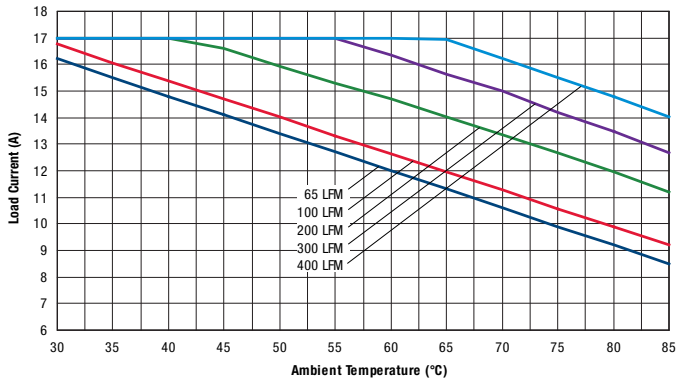
Efficiency vs. Line Voltage and Load Current @ Ta = +25°C



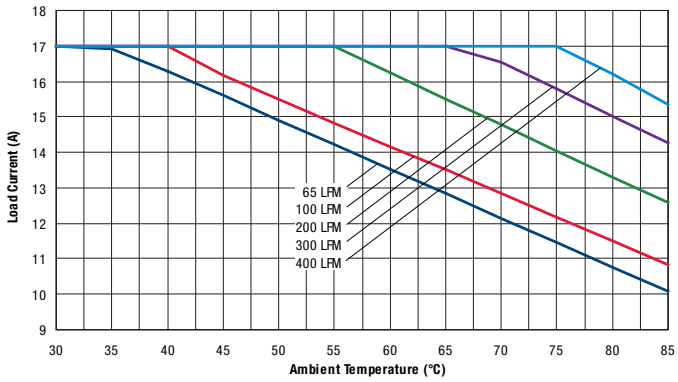
Power Dissipation vs. Load Current @ Ta = +25°C



Maximum Power Temperature Derating at Sea Level
Vin = 48 (air flow from Pin 1 to Pin 3 on PCB, no baseplate)

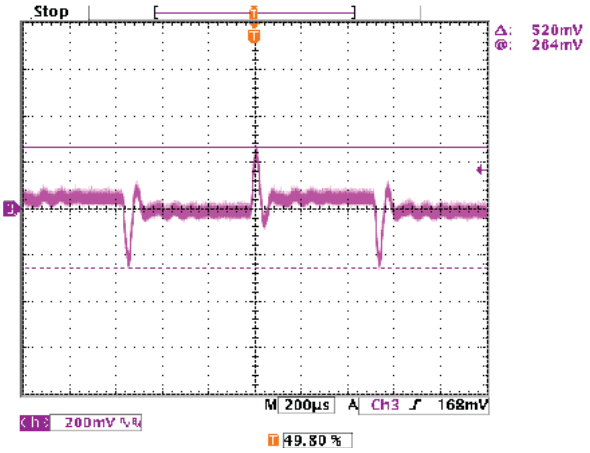


Maximum Power Temperature Derating at Sea Level
Vin = 48 (air flow from Pin 1 to Pin 3 on PCB, with baseplate)

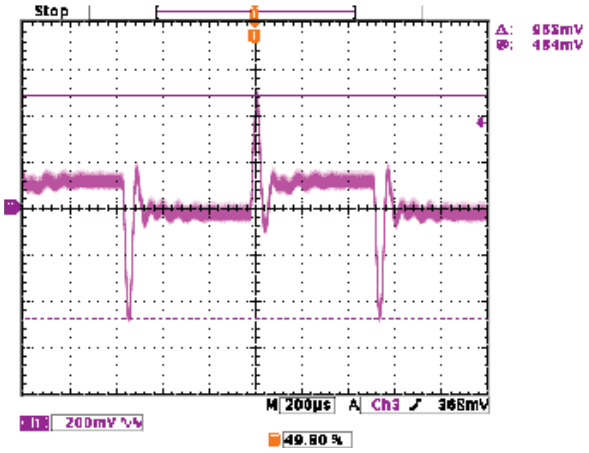


OSCILLOGRAMS

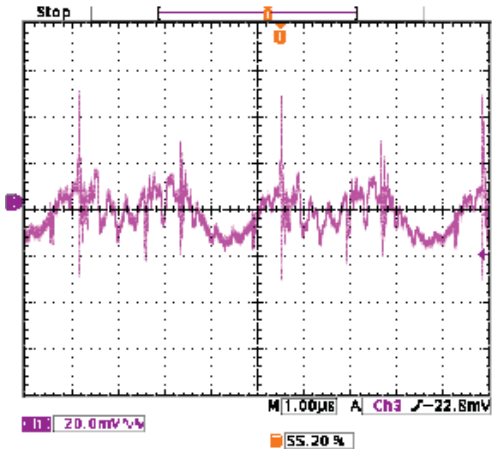
Stepload Transient Response (Vin=48V, Iout=50-75-50% of Imax, Cout=1 & 10uF, Ta=+25°C, Scope BW=20MHz)



Stepload Transient Response (Vin=48V, Iout=25-75-25% of Imax, Cout=1 & 10uF, Ta=+25°C, Scope BW=20MHz)



Output Ripple and Noice (Vin=48V, Iout=17A, Cout=1 & 10uF, Ta=+25°C, Scope BW=20MHz)



Technical Notes

I/O Filtering and Noise Reduction

The RBC is tested and specified with external output capacitors. These capacitors are necessary to accommodate our test equipment and may not be required to achieve desired performance in your application. The RBC is designed with high-quality, high-performance *internal* I/O caps, and will operate within spec in most applications with *no additional external components*.

In particular, the RBC input capacitors are specified for low ESR and are fully rated to handle the units' input ripple currents. Similarly, the internal output capacitors are specified for low ESR and full-range frequency response.

In critical applications, input/output ripple/noise may be further reduced using filtering techniques, the simplest being the installation of external I/O caps.

External input capacitors serve primarily as energy-storage devices. They minimize high-frequency variations in input voltage (usually caused by IR drops in conductors leading to the DC/DC) as the switching converter draws pulses of current. Input capacitors should be selected for bulk capacitance (at appropriate frequencies), low ESR, and high rms-ripple-current ratings. The switching nature of modern DC/DC's requires that the dc input voltage source have low ac impedance at the frequencies of interest. Highly inductive source impedances can greatly affect system stability. Your specific system configuration may necessitate additional considerations.

Input Fusing

Most applications and or safety agencies require the installation of fuses at the inputs of power conversion components. The RBC Series may have an optional input fuse. Therefore, if input fusing is mandatory, either a normal-blow or a fast-blow fuse with a value no greater than twice the maximum input current should be installed within the ungrounded input path to the converter.

Input Overvoltage and Reverse-Polarity Protection

The RBC does not incorporate input reverse-polarity protection. Input voltages in excess of the specified absolute maximum ratings and input polarity reversals of longer than "instantaneous" duration can cause permanent damage to these devices.

Start-Up Time

The V_{IN} to V_{OUT} Start-Up Time is the interval between the time at which a rising input voltage crosses the lower limit of the specified input voltage range and the fully loaded output voltage enters and remains within its specified regulation band. Actual measured times will vary with input source impedance, external input capacitance, and the slew rate and final value of the input voltage as it appears to the converter.

The On/Off to V_{OUT} Start-Up Time assumes the converter is turned off via the On/Off Control with the nominal input voltage already applied to the converter. The specification defines the interval between the time at which the converter is turned on and the fully loaded output voltage enters and remains within its specified regulation band.

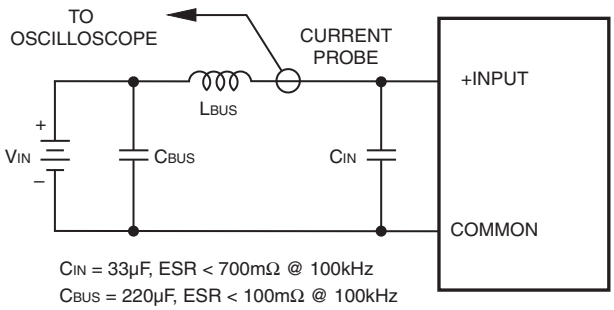


Figure 2. Measuring Input Ripple Current

Thermal Considerations and Thermal Protection

The typical output-current thermal-derating curves shown below enable designers to determine how much current they can reliably derive from each model of the RBC under known ambient-temperature and air-flow conditions. Similarly, the curves indicate how much air flow is required to reliably deliver a specific output current at known temperatures.

The highest temperatures in RBC's occur at their output inductor, whose heat is generated primarily by I^2R losses. The derating curves were developed using thermocouples to monitor the inductor temperature and varying the load to keep that temperature below +110°C under the assorted conditions of air flow and air temperature. Once the temperature exceeds +125°C (approx.), the thermal protection will disable the converter using the hiccup shutdown mode.

Undervoltage Shutdown

When the input voltage falls below the undervoltage threshold, the converter will terminate its output. However, this is not a latching shutdown mode. As soon as the input voltage rises above the Start-Up Threshold, the converter will restore normal operation. This small amount of hysteresis prevents most uncommanded power cycling. Since some input sources with higher output impedance will increase their output voltage greater than this hysteresis as soon as the load is removed, it is possible for this undervoltage shutdown to cycle indefinitely. To prevent this, be sure that the input supply always has adequate voltage at full load.

Thermal Shutdown

Extended operation at excessive temperature will initiate overtemperature shutdown triggered by a temperature sensor inside the PWM controller. This operates similarly to overcurrent and short circuit mode. The inception point of the overtemperature condition depends on the average power delivered, the ambient temperature and the extent of forced cooling airflow.

Remote On/Off Control

The RBC may be turned off or on using the external remote on/off control. This terminal consists of a digital input to the internal PWM controller through a protective resistor and diode.

The on/off input circuit should be CMOS logic referred to the –Input power terminal however TTL or TTL-LS logic will also work or a switch to ground. If preferred, you can even run this using a bipolar transistor in “open collector” configuration or an “open drain” FET transistor. You may also leave this input unconnected and the converter will run whenever input power is applied.

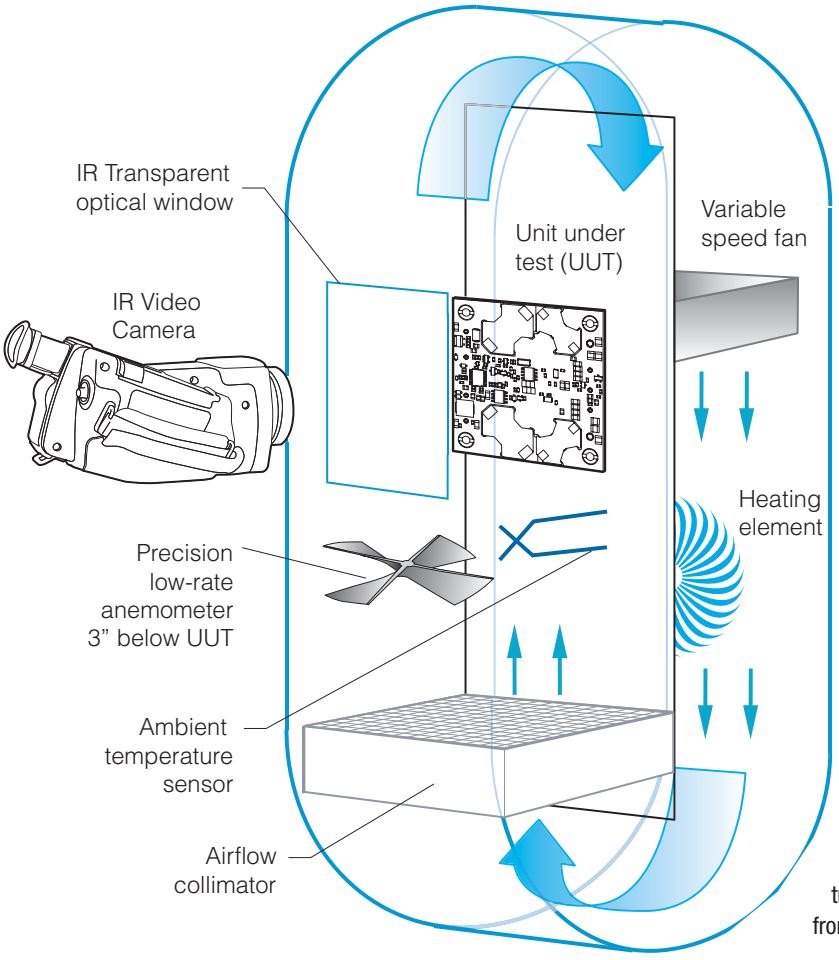


Figure 3. Vertical Wind Tunnel

Vertical Wind Tunnel

Murata Power Solutions employs a custom-designed enclosed vertical wind tunnel, infrared video camera system and test instrumentation for accurate airflow and heat dissipation analysis of power products. The system includes a precision low flow-rate anemometer, variable speed fan, power supply input and load controls, temperature gauges and adjustable heating element.

The IR camera can watch thermal characteristics of the Unit Under Test (UUT) with both dynamic loads and static steady-state conditions. A special optical port is used which is transparent to infrared wavelengths. The computer files from the IR camera can be studied for later analysis.

Both through-hole and surface mount converters are soldered down to a host carrier board for realistic heat absorption and spreading. Both longitudinal and transverse airflow studies are possible by rotation of this carrier board since there are often significant differences in the heat dissipation in the two airflow directions. The combination of both adjustable airflow, adjustable ambient heat and adjustable Input/Output currents and voltages mean that a very wide range of measurement conditions can be studied.

The airflow collimator mixes the heat from the heating element to make uniform temperature distribution. The collimator also reduces the amount of turbulence adjacent to the UUT by restoring laminar airflow. Such turbulence can change the effective heat transfer characteristics and give false readings. Excess turbulence removes more heat from some surfaces and less heat from others, possibly causing uneven overheating.

Both sides of the UUT are studied since there are different thermal gradients on each side. The adjustable heating element and fan, built-in temperature gauges and no-contact IR camera mean that power supplies are tested in real-world conditions.

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