

Features

Power Module

- 10W buck/boost converter with up to 4A output
- Input voltage can be higher, lower or same as output voltage
- >90% efficiency from 100mA – 3000mA load
- 7µA standby power consumption
- Low profile, thermally enhanced 25pad LGA package

RECOM
DC/DC Converter

RBB10-2.0

**2 Amp
Single
Output**



EN55032 compliant

Description

The RBB10-2.0 series is a 4A non-isolated buck/boost regulator power module where the input voltage can be higher, lower or same as output voltage. Transition from buck to boost mode is smooth without any interruption to the output. The compact DOSA-compatible footprint module has a low profile of only 3.9mm, but with an efficiency of up to 95%, the RBB10-2.0 can operate at full load in ambient temperatures as high as 85°C without forced air cooling. The package has 6-sided shielding for optimal EMC performance and excellent thermal management. Typical applications include USB voltage regenerators, 3.3V<->5V converters and supercapacitor or Li-Ion battery regulators.

Selection Guide

| Part Number | Input Voltage Range [VDC] | Nom. Output Voltage [VDC] | Output Current max. [A] | Efficiency typ. [%] | Max. Capacitive Load ⁽¹⁾ [µF] |
|-------------|---------------------------|---------------------------|-------------------------|---------------------|--|
| RBB10-2.0 | 2.3 - 5.5 | 5 (1.0 - 5.5) | 2 - 4 | 96 | 42000 |

Notes:

Note1: Max. Cap Load is tested at nominal input and full resistive load

Model Numbering

RBB10-2.0

nom. Output Current

Specifications (measured @ Ta= 25°C, 5Vin, 5Vout, 2A and after warm-up unless otherwise stated)

BASIC CHARACTERISTICS

| Parameter | Condition | Min. | Typ. | Max. |
|--|------------------------------|--------------------------|----------------|--------------|
| Internal Input Filter | | | | capacitor |
| Input Voltage Range ⁽²⁾ | | 2.3VDC | 5VDC | 5.5VDC |
| Absolute Maximum Input Voltage | | | | 7VDC |
| Undervoltage Lockout Threshold | | 1.6VDC | 1.75VDC | 2.0VDC |
| Undervoltage Lockout Hysteresis | | | 65mV | |
| Input Current | Vin= 5VDC Vin= 3.6VDC | | 2.3A 3.4A | |
| Quiescent Current | Vin= 5VDC | | 40µA | 90µA |
| Internal Power Dissipation | Vin= 5VDC Vin= 3.6VDC | | | 0.9W 1.8W |
| Output Current Range | refer to safe operating area | 0A | 2A | 4A |
| Output Voltage Trimming ⁽³⁾ | see table or calculation | 1.0VDC | 5.0VDC | 5.5VDC |
| Minimum Load | | 0% | | |
| Start-up time | power up 2A | Vin= 5VDC Vin= 3.6VDC | 1.4ms 1.8ms | |
| | BUCK BOOST | Vin= 5VDC Vin= 3.6VDC | 700µs 450µs | |

continued on next page



www.recom-power.com/eval-ref-boards

Specifications (measured @ $T_a = 25^\circ\text{C}$, 5Vin, 5Vout, 2A and after warm-up unless otherwise stated)

| Parameter | Condition | | Min. | Typ. | Max. |
|--|--|---------------------------------|--|-------------------|---------------------|
| Rise Time | | | | 400 μs | |
| ON/OFF CTRL | nom. Vin= 5VDC | DC-DC ON DC-DC OFF | Open or $1.2\text{V} < V_{\text{CTRL}} < V_{\text{in}}$ Short or $-0.3\text{V} < V_{\text{CTRL}} < 0.4\text{VDC}$ | | |
| Input Current of CTRL Pad | nom. Vin= 5VDC | CTRL voltage = 0V | | 5 μA | |
| Standby Current | nom. Vin= 5VDC | CTRL voltage = 0V | | 5.1 μA | 7 μA |
| Internal Operating Frequency | | | | 2.55MHz | |
| Output Ripple and Noise ⁽⁴⁾ | 20MHz BW - 98 Ω @ 100MHz + 22 μF | | | 15mVp-p | |
| Absolute Maximum Capacitive Load | <1 second start up | $C_{\text{ss}} = 3700\text{nF}$ | | | 42000 μF |
| | <1 second start up | no C_{ss} | | | 800 μF |

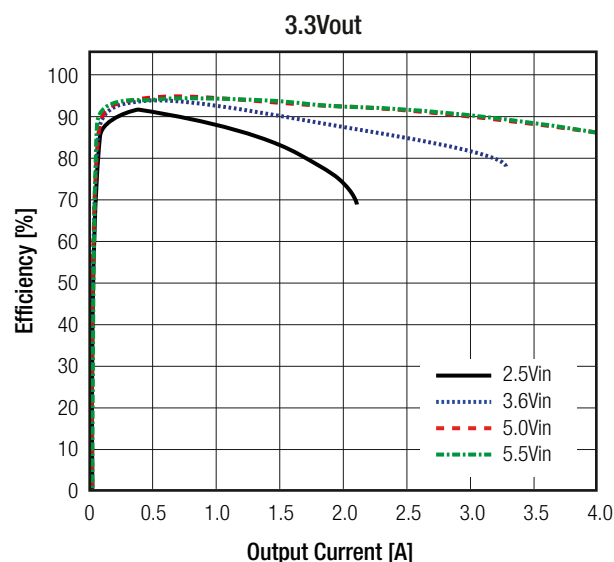
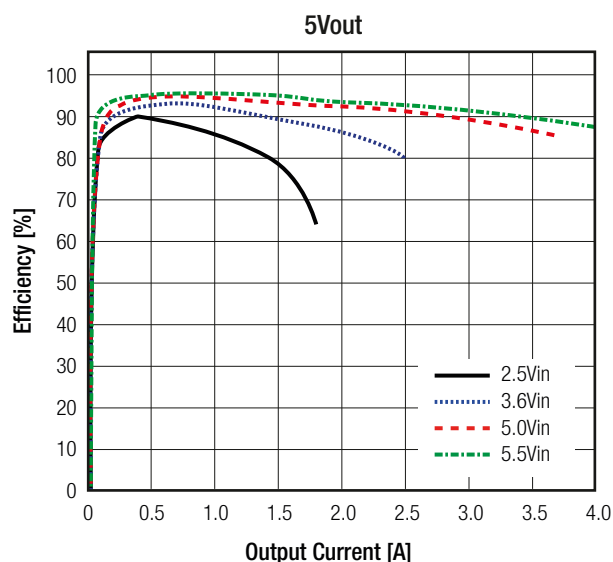
Notes:

Note2: For detail information please refer to "Safe Operating Area" graph below

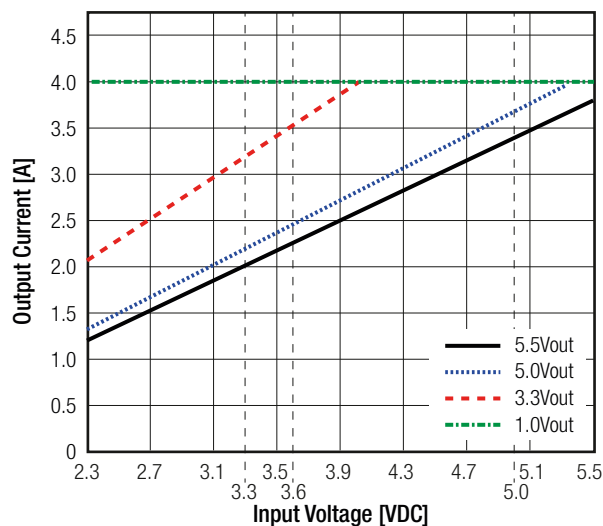
Note3: For detail information please refer to trim table or calculation on page RBB-3

Note4: Measurements are made with a 22 μF MLCC across output (low ESR)

Efficiency vs. Load



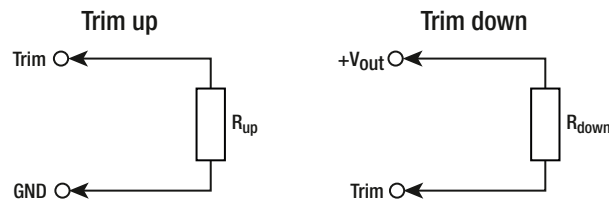
Safe Operating Area



Specifications (measured @ Ta= 25°C, 5Vin, 5Vout, 2A and after warm-up unless otherwise stated)

OUTPUT VOLTAGE TRIMMING

The RBB10-2.0 series offers the feature of trimming the output voltage over a range between 1.0V and 5.5V by using external trim resistors. The values for trim resistors shown in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary.



V_{out_nom} = nominal output voltage [VDC]
 V_{out_set} = trimmed output voltage [VDC]
 V_{ref} = reference voltage [VDC]
 R_{up} = trim up resistor [Ω]
 R_{down} = trim down resistor [Ω]
 R_1, R_2, R_3 = internal resistors [Ω]

| V_{out_nom} | R_1 | R_2 | R_3 | V_{ref} |
|----------------|---------------|-------------|---------------|-----------|
| 5VDC | 629k Ω | 1k Ω | 788k Ω | 0.805 |

Calculation:

$$R_{up} = \left[\frac{R_1}{V_{out_set} - V_{nom}} \right] - R_2$$

$$R_{down} = \left[\frac{(V_{out_set} - V_{ref}) \times R_3}{V_{out_nom} - V_{out_set}} \right]$$

Practical Example RBB10-2.0:

$$R_{up} = \left[\frac{629k}{5.5 - 5.0} \right] - 1k = \underline{\underline{1M26\Omega}}$$

R_{up} according to E96 \approx 1M27 Ω

$$R_{down} = \left[\frac{(4.0 - 0.805) \times 788k}{5.0 - 4.0} \right] = \underline{\underline{2M52\Omega}}$$

R_{down} according to E96 \approx 2M55 Ω

RBB10-2.0

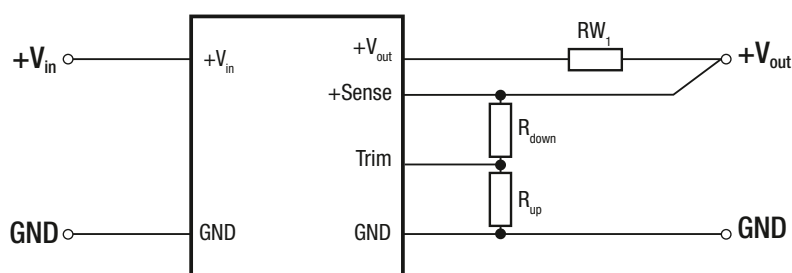
Trim up

| | | | | | | |
|--------------------------|------|------|------|------|------|--------------|
| $V_{out_set} =$ | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | [VDC] |
| R_{up} (E96) \approx | 6M34 | 3M16 | 2M10 | 1M58 | 1M27 | [Ω] |

Trim down

| | | | | | | | | | | | |
|----------------------------|------|------|------|------|------|------|------|------|------|------|--------------|
| $V_{out_set} =$ | 4.5 | 4.0 | 3.5 | 3.3 | 3.0 | 2.5 | 2.0 | 1.8 | 1.5 | 1.0 | [VDC] |
| R_{down} (E96) \approx | 5M90 | 2M55 | 1M43 | 1M15 | 866k | 536k | 316k | 243k | 158k | 38k3 | [Ω] |

REMOTE SENSE



The output voltage can be adjusted via the trim and sense functions.

The maximum output voltage from Trim and Sense function combined is 5.5VDC. Derating may be required when using Trim and/or sense functions.

RW_1 ... wire losses +
 R_{up} ... trim up resistor
 R_{down} ... trim down resistor

Specifications (measured @ Ta= 25°C, 5Vin, 5Vout, 2A and after warm-up unless otherwise stated)

REGULATIONS

| Parameter | Condition | | Value |
|--------------------|--------------------------------------|----------------------------------|--------------------------|
| Output Accuracy | | | ±3.0% max. |
| Line Regulation | low line to high line, full load | | 1.0% typ. / ±3.0% max. |
| Load Regulation | 0% to 100% load | PWM mode selected ⁽⁵⁾ | 0.5% max. |
| Transient Response | 100% - 0% load step recovery time | | 200mV max. 500µs typ. |

Notes:

Note5: The RBB10 has the possibility to work in two regulation modes:

Powersave Mode (standard): This mode is the best for use at low loads to reduce power consumption and extend battery life. In this mode the internal power consumption is reduced by using burst mode for loads under 350mA and PWM for loads above 350mA. The drawback is a 1-3 % higher output voltage at low load than full load.

Fixed PWM mode: In PWM mode the device accurately regulates the output voltage independently of the load current. The drawback is a higher internal power consumption and shorter battery life at lower loads. Pull down the Mode pad to GND to enter this mode.

PROTECTIONS

| Parameter | Condition | | Value |
|-----------------------------------|--|-----------------------|---|
| Short Circuit Protection (SCP) | 50mΩ | | constant current limit |
| Short Circuit Input Current | nom. Vin= 2.3VDC | | 700mA typ. |
| Over Current Protection (OCP) | refer to safe operating area | | 220% - 240%, constant current mode |
| Over Temperature Protection (OTP) | case temperature (measured on tc point) | DC-DC OFF DC-DC ON | 110°C, auto restart after cool down 100°C typ. |

ENVIRONMENTAL

| Parameter | Condition | | Value |
|--|--|--------------------------------|---|
| Operating Temperature Range ⁽⁶⁾ | @ natural convection 0.1m/s (refer to derating graph) | up to 4A load up to 2A load | -40°C to +85°C -40°C to +100°C |
| Maximum Case Temperature | | | +110°C |
| Temperature Coefficient | @ +65°C Tamb | | 0.02%/K |
| Thermal Impedance | 0.1m/s, horizontal (Tcase to Tamb) | | 8K/W |
| Operating Altitude | with derating @ natural convection 0.1m/s (refer to altitude vs. load graph) | | 5000m |
| Operating Humidity | non-condensing | | 5% - 95% RH max. |
| Shock | MIL-STD-810G, Method 516.6, Procedure I | | 40g, 11ms, saw-tooth, 3 shocks ± per axis 3 axis; unit is operating |
| | MIL-STD-810G, Method 516.6, Procedure IV | | drop on 50mm plywood on concrete 26 times from 1 meter |
| Temperature Cycling | MIL-STD-883F, Method 1010, Condition A | | powered -50°C to +85°C, 300 cycles |
| Random Vibration | MIL-STD-810G, Method 514.6, Procedure I, Category 24 | | Category 24 - Figure 514.6E-1 - power spectral density = 0.04g ² /Hz at 20Hz -1000Hz, -6dB/Octave at 1000Hz - 2000Hz, 60 minutes x 3 axis; unit is operating during tests |
| MTBF | according to MIL-HDBK-217F, G.B. | +25°C +85°C | 2200 x 10 ³ hours 400 x 10 ³ hours |

Notes:

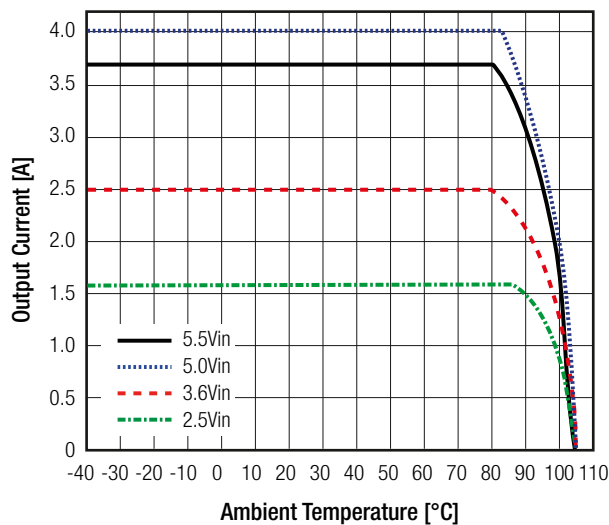
Note6: tested with a eurocard 160x100mm 70µm copper, 4 layer

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Specifications (measured @ $T_a = 25^\circ\text{C}$, 5Vin, 5Vout, 2A and after warm-up unless otherwise stated)

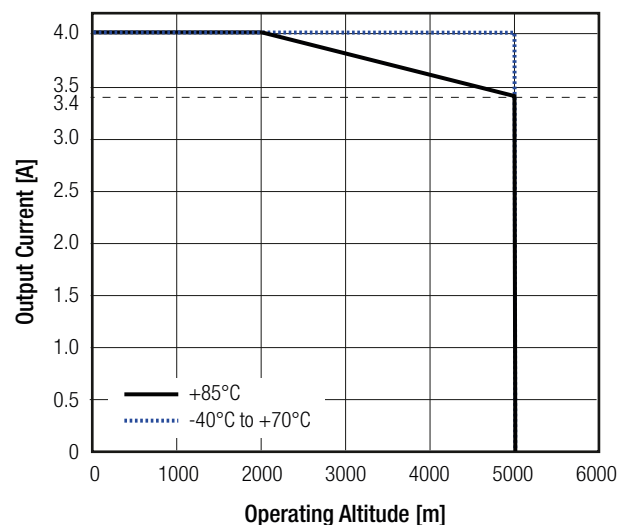
Derating Graph ⁽⁶⁾

(@ chamber and natural convection 0.1m/s)



Operating Altitude vs Load

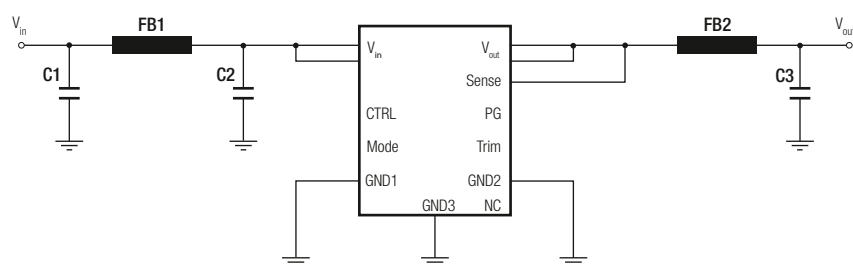
(@ chamber and natural convection 0.1m/s)



SAFETY AND CERTIFICATIONS

| Certificate Type (Safety) | Report / File Number | Standard |
|---|--------------------------|----------------------|
| RoHS 2 | | RoHS 2011/65/EU |
| EMC Compliance | Condition | Standard / Criterion |
| Electromagnetic compatibility of multimedia equipment - Emission requirements | with external components | EN55032, Class B |
| Information technology equipment - Immunity characteristics - Limits and methods of measurement | | EN55024:2010+A1:2015 |

EMC Filtering Suggestions according to EN55032



Component List Class B

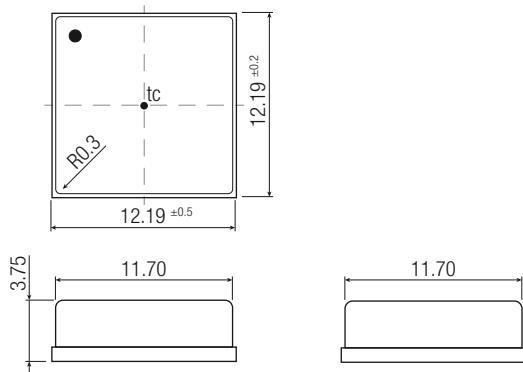
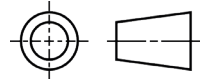
| C1 | C2 | FB1 | FB2 | C3 |
|--------------------|--------------------|-----------------------|---------------------|--------------------|
| 10 μ F 25V X7R | 10 μ F 25V X7R | WE ref.: 742792510 | WE ref.: 7427932 | 22 μ F 10V 7XR |

Specifications (measured @ Ta= 25°C, 5Vin, 5Vout, 2A and after warm-up unless otherwise stated)

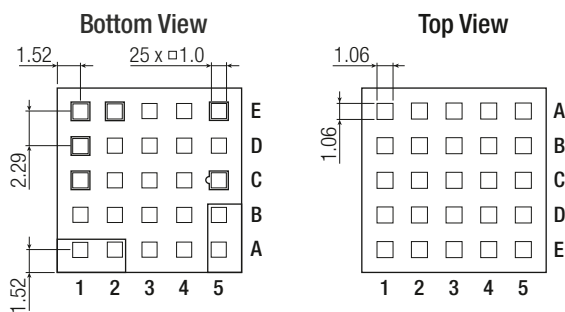
DIMENSION AND PHYSICAL CHARACTERISTICS

| Parameter | Type | Value |
|-------------------|----------------------------|--|
| Material | case PCB solder pads | metal FR4, (UL94 V-0) copper with electrolytic nickel-gold |
| Dimension (LxWxH) | | 12.19 x 12.19 x 3.75mm |
| Weight | | 1.1g typ. |

Dimension Drawing (mm)



Recommended Footprint Details



Pinning information

| Pad # | Function | Description |
|---|----------|--|
| A1, A2 | Vin | Positive input voltage with respect to GND. Connect to a Vin plane for enhanced thermal performance |
| C1 | CTRL | High active; pull to GND to disable the device. Pull high or leave open to enable the device |
| A5, B5 | Vout | Positive output voltage. Connect to a Vout plane for enhanced thermal performance |
| C5 | Sense | Connect this pad to the load or directly to Vout. This pad must not be left floating |
| E5 | Trim | Used to set the output voltage between 0.9V and 6V |
| E1 | NC | Not connected |
| E2 | Mode | Refer to note 5 on page RBB-4 |
| D1 | PGood | Output power good. High = Vout at set level, low = Vout outside of specification. Maximum sink current is 2mA. |
| A3, A4, B1, B2, B3, B4, C2, C3, C4, D2, D3, D4, D5, E3, E4 | GND | Negative input voltage. Connect to GND plane(s) for enhanced thermal performance |

tc = case temperature measuring point
Tolerance: xx.xx= ±0.05mm

PACKAGING INFORMATION

| Parameter | Type | Value |
|-----------------------------|---|--|
| Packaging Dimension (LxWxH) | tape and reel tape and reel (carton) | 330.2 x 330.2 x 30.4mm 355.0 x 350.0 x 50.0mm |
| Packaging Quantity | tape and reel | 500pcs |
| Tape Width | | 24mm |
| Storage Temperature Range | | -55°C to +125°C |
| Storage Humidity | non-condensing | 95% RH max. |

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