

# Features

# Evaluation Module

- Evaluation platform for RBB10 buck/boost regulators
- Input voltage can be lower, higher or the same as output voltage
- Class B EMC filter layout
- Built-in thermal management
- Easy evaluation of modes, trimming, enable and sensing function of the RBB10 modules

## RBB10-2.0-EVM-1

### Description

The RBB10-2.0-EVM-1 evaluation board generates a regulated output voltage with a current up to 4A from an external DC supply which can be higher, lower or the same as the set output voltage. The output voltage is preset to 3.3V or 5V but can be adjusted between 1.0V and 5.5V using on-board resistors. All of the functions of the RBB10-2.0 regulator such as the different operating modes, output trim, enable, and the sense input can be easily evaluated using the break out connectors.

Typical applications that can be evaluated include:

**USB voltage converter/regenerator:** 3.3V or 5V output from a 3.3V (+60%/-30%) or from a 5V (+10%/-50%) supply. A stable output voltage can be regenerated even if the input voltage is outside of the USB voltage specification.

With a regulated supply voltage, the following continuous output current limits apply:

nom. Input Voltage <sup>(1)</sup>	Output Voltage	Output Current
3.3V	1.8V	4A max
3.3V	3.3V	2.8A max
3.3V	5V	2.2A max
5V	1.8V	4A max
5V	3.3V	4A max
5V	5V	3.2A max

#### Notes:

Note1: For detail information please refer to "Safe Operating Area" graph on page P-2

**Battery stabiliser:** the output can be set to deliver a stable 5V or 3.3V from a nominal 3V, 3.7V or 4.2V Lithium Ion or 3V/4.5V alkaline battery pack. In standby, the board consumes only 5µA.

**Supercapacitor booster:** the output can be set to deliver a stable 5V or 3.3V from a single supercapacitor (2.3V – 2.7V) or from two supercapacitors wired in series (2.3V – 5.4V).

Low voltage regulator with sense: 1V, 1.2V, 1.8V or 2.5V output with up to 4A current.



### Selection Guide

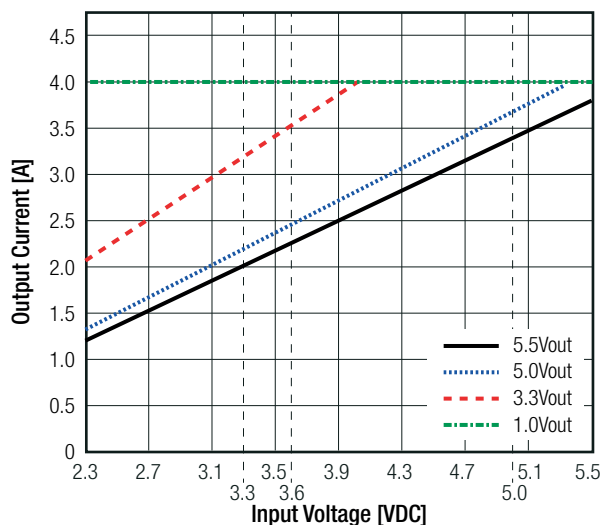
Part Number	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [A]
RBB10-2.0-EVM-1	2.3 - 5.5	1.0 - 5.5 (5VDC preset)	2.0 (4.0 buck mode)

**Specifications** (measured @ Ta= 25°C, full load after warm up unless otherwise stated)

**Quick Start Guide**

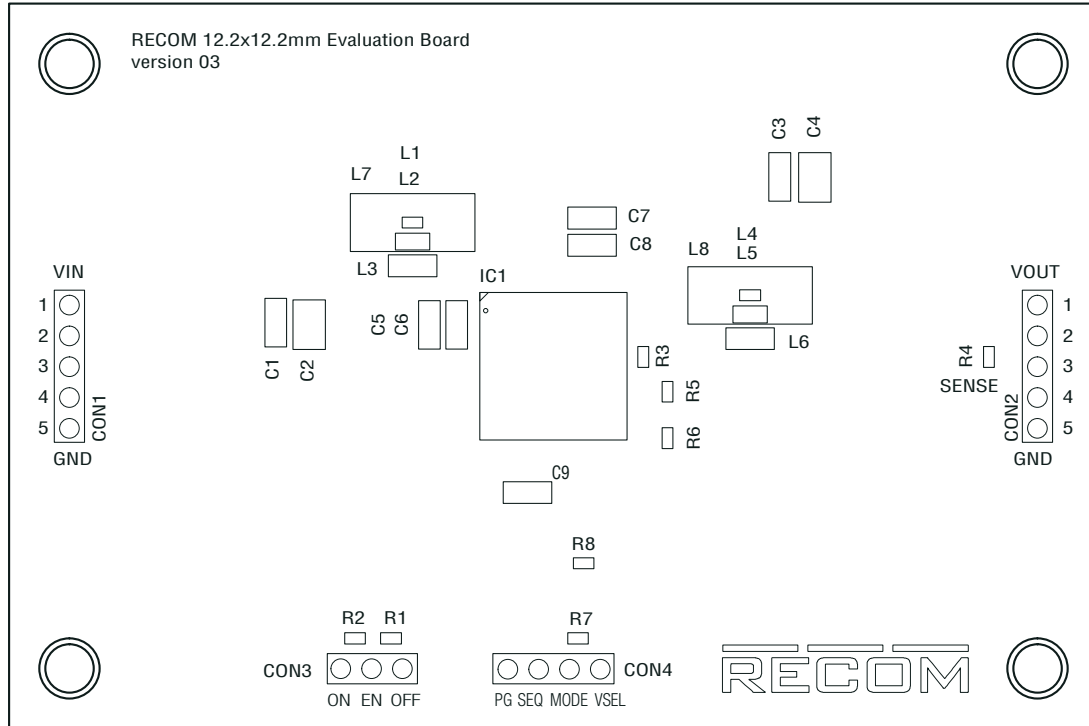
- 1) Connect Sense to the required potential.  
The Sense input is via R3 directly at the power module output. To compensate for ohmic losses of the filter, desolder the R3 resistor and move it to the position of R4.  
If you want to sense directly on the load, desolder R3 and connect the middle pin of Con 2 to the positive potential of the load with a separate connection.
- 2) If a different output voltage is required, fit R5 or R6.
- 3) Connect Con1 to a DC power supply and check output voltage.
- 4) Connect Con2 to the load.
- 5) Enable the device on Con3.  
The converter is normally on. You can disable the converter by pulling the Enable pin to GND with a switch, open collector driver or logic input. R1 or R2 can be used to change the default function from normally on to normally off.
- 6) Modes:  
The RBB10-2.0 has the possibility to work in two regulation modes:
  - 6.1) 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.
  - 6.2) 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 pin on Con4 to GND or solder a 0Ω resistor a position R7 to enter this mode.

**Safe Operating Area**



Specifications (measured @ Ta= 25°C, full load after warm up unless otherwise stated)

## Component Placement



## Connector Description

### Con1

Pin	Name	Description
1,2	Vin	Positive Input Voltage (observe correct polarity!)
3	NC	Not connected
4,5	GND	Negative Input Voltage (Common GND)

### Con2

Pin	Name	Description
1,2	Vout	Positive Output Voltage
3	SENSE	Output Voltage Sense Pin (leave open if not used)
4,5	GND	Negative Output Voltage (Common GND)

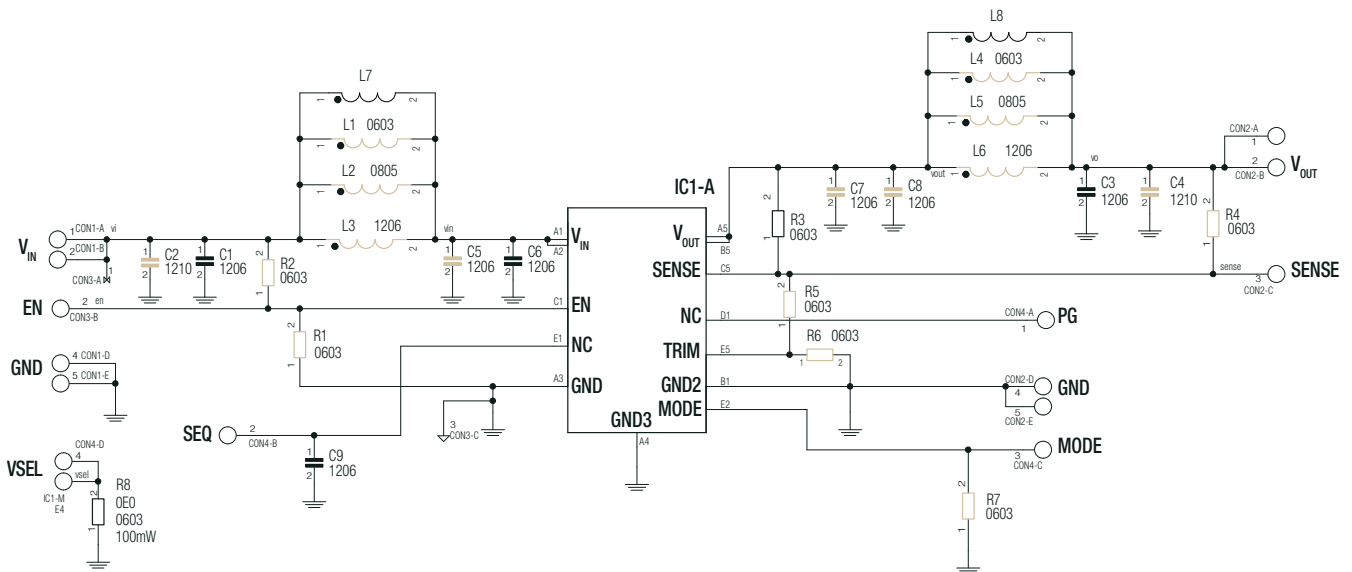
### Con3

Pin	Name	Description
1	ON	Connect to Vin
2	EN	Enable Pin (leave open if not used)
3	OFF	Connected to GND

### Con4

Pin	Name	Description
1	PG	Not used
2	SEQ	Not used
3	MODE	Regulation mode (leave open if not used)
4	VSEL	Not used

### Schematic



### Description

IC1 is the RBB10-2.0 power module.

C1,C2,L1,L2,L3,L7,C5,C6 give the possibility to try different input EMC filters. The populated filter is designed to meet EN55032 class B has C1, L7 and C6 fitted.

C7,C8,L4,L5,L6,L8,C3,C4 give the possibility to try different output EMC filters. The populated filter is designed to meet EN55032 class B has L8 and C3 fitted.

R1 and R2 give the possibility to preset the Enable pin in other configurations. These resistors are not populated. The default for IC1 is always on.

If R2 is fitted, then the enable is normally on, pull down to ground to turn off. If R1 is fitted, the enable is normally off, pull up to Vin to turn on. Refer to the datasheet of IC1 for more information.

C9 is not populated on this board.

R3 is a populated 0Ω resistor for output voltage sensing directly at the module output. If the output sense input is required at the point of load, unsolder R3 and connect the Sense pin to the load.

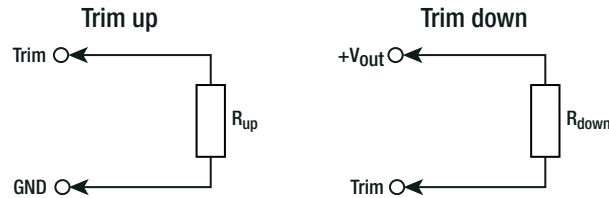
R4 gives the possibility to compensate the output voltage for any voltage drop through the EMC filter by unsoldering R3 and soldering it at the position of R4.

R7 and R8 are not populated on this Board.

R5 and R6 give the possibility to trim the output voltage between 1.0V and 5.5V (see calculations and trim table below). Fit only R5 or R6.

### 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 [ $\Omega$ ]  
 $R_{down}$  = trim down resistor [ $\Omega$ ]  
 $R_1, R_2, R_3$  = internal resistors [ $\Omega$ ]

$V_{out\_nom}$	$R_1$	$R_2$	$R_3$	$V_{ref}$
5VDC	629k $\Omega$	1k $\Omega$	788k $\Omega$	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:

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

$$R_{up} \text{ according to E96} \approx \underline{\underline{1M27\Omega}}$$

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

$$R_{down} \text{ according to E96} \approx \underline{\underline{2M55\Omega}}$$

#### 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	[ $\Omega$ ]

##### Trim down

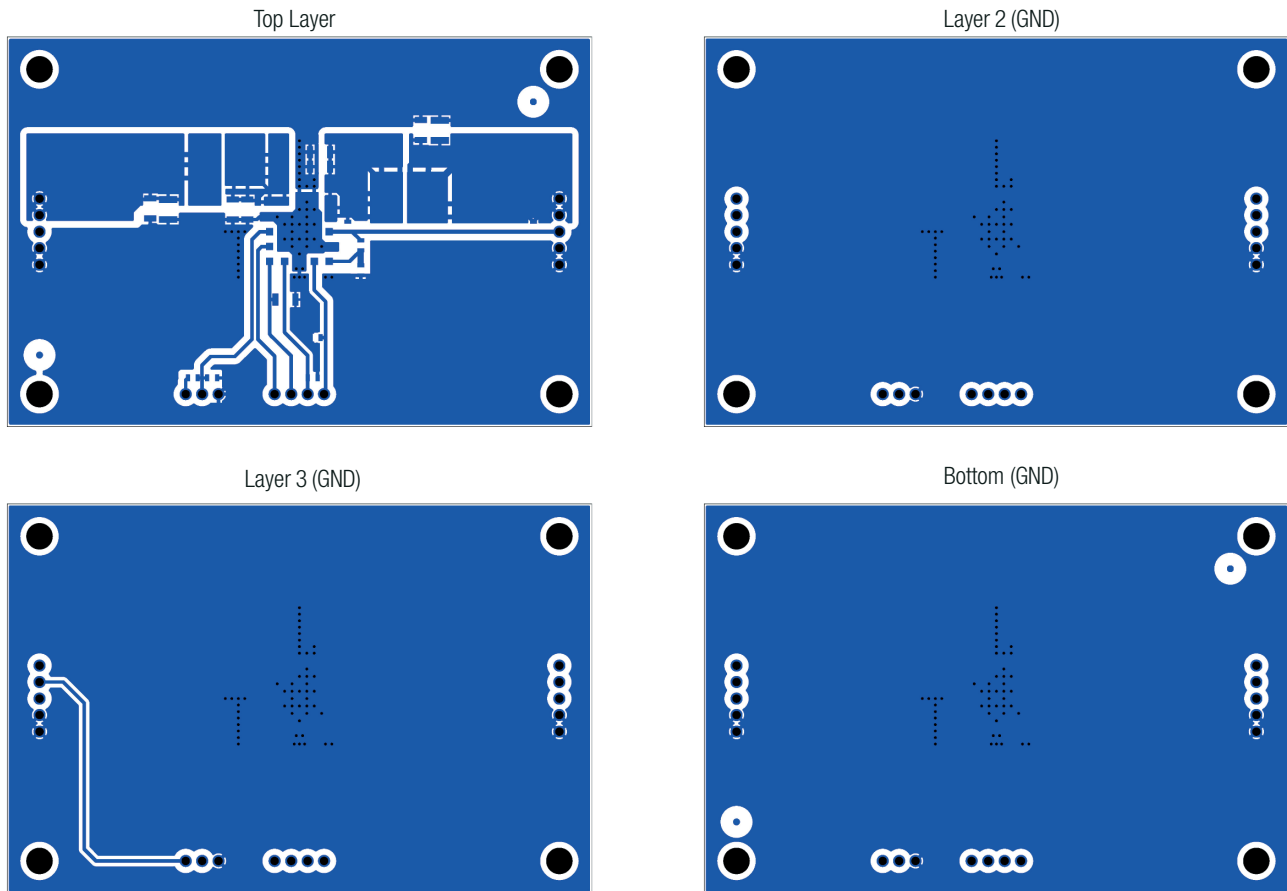
$V_{out\_set}$ =	4.5	4.0	3.5	3.3	3.0	2.5	2.0	1.8	1.5	1.0	[VDC]
$R_{down}$ (E96) $\approx$	5M90	2M55	1M43	1M15	866k	536k	316k	243k	158k	38k3	[ $\Omega$ ]

### DIMENSION AND PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Dimension (LxWxH)		90.0 x 60.0 x 26.0mm
Weight		23.3g typ.

**Specifications** (measured @ Ta= 25°C, full load after warm up unless otherwise stated)

**Layout**



**Notes:**

Note2: Visit [www.recom-power.com/eval-ref-boards](http://www.recom-power.com/eval-ref-boards) to download the Gerber files

**BOM**

Comp.	Description	Manufacturer Part Number	Manufacturer	Remarks
C1	22µF 10V X7R 1206	CL31B226MPHNNNE	Samsung	
C2	10µF ±10% 63V X7R MLCC 1210	GRM32ER71J106KA12L	Murata	not mounted
C3	10µF 35V X7R 1206	GMK316AB7106KL-TR	Taiyo Yuden	
C4	10µF ±10% 63V X7R MLCC 1210	GRM32ER71J106KA12L	Murata	not mounted
C5	22µF 10V 1206	CL31B226MPHNNNE	Samsung	
C6	22µF 10V X7R 1206	CL31B226MPHNNNE	Samsung	
C7	10µF 35V X7R 1206	GMK316AB7106KL-TR	Taiyo Yuden	not mounted
C8	10µF 35V X7R 1206	GMK316AB7106KL-TR	Taiyo Yuden	not mounted
C9	CAP CER 100nF 50V X7R 1206	CL31B104KBCNNNC	Samsung	not mounted
CON1	RS Pro Header 2.54mm 5	W81105T3825RC	RS	
CON2	RS Pro Header 2.54mm 5	W81105T3825RC	RS	
CON3	RS Pro Header 2.54mm 3	W81103T3825RC	RS	
CON4	RS Pro Header 2.54mm 4	W81104T3825RC	RS	
L1	FERRITE BEAD 600 OHM 0603 1LN	742792651	Würth	not mounted
L2	FERRITE BEAD 330 OHM 0805 1LN	FBMH2012HM331-T	Taiyo Yuden	not mounted

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