

## Features

## Evaluation Module

- Evaluation platform for RPX-4.0 buck regulator module
- Thermal design considerations included
- EMI class B filter
- Easy evaluation of output voltage selection, control, and sensing functions

### Description

The RPX-4.0-EVM-1 generates a constant output voltage selectable from 1.0VDC to 7VDC from a DC input in the range of 4 – 36VDC. It has a maximum continuous output current of 4.0A.

All the functions of the RPX-4.0 such as output voltage selection, control, power good, trim, and output sense can be readily evaluated. The behavior in overload or over-temperature can be evaluated easily before the module is designed in.

The evaluation board also contains the filter components to meet EMC class B levels. Alternate component positions are included to allow experimentation to optimize the EMC performance depending on operating conditions and budget.

### Selection Guide

Part Number	Input Voltage Range [VDC]	Output Voltage <sup>(1)</sup> [VDC]	Output Current max. [A]
RPX-4.0-EVM-1	4 - 36	1.0, 1.8, 3.3, 5	4.0

**Notes:**

Note1: refer to [SAFE OPERATING AREA](#) of RPX-4.0 datasheet

#### Quick Start Guide

1. Connect P<sub>1</sub> to power supply (observe correct polarity)
2. Connect P<sub>2</sub> to the load (no load operation is allowed. For 5V<sub>OUT</sub>, please refer to safe operating area in the RPX-4.0 datasheet)
3. The evaluation module is preset to 5V<sub>OUT</sub>.  
The output voltage can be selected for values of 1.0VDC, 1.8VDC, 3.3VDC, and 5VDC by shorting a 0Ω resistor to the respective places as seen in the board silkscreen. Please refer to safe operating area in the [RPX-4.0](#) module datasheet.
4. UVLO (Undervoltage Lockout) circuitry implements internal UVLO on the V<sub>IN</sub> pin. The device is disabled when the internal voltage is under 3.55VDC(typ.). When a higher UVLO threshold is required, assemble resistor R<sub>2</sub>. Refer to the [RPX-4.0](#) module datasheet for R<sub>2</sub> values.
5. CTRL  
The device is preset as normally on. It can be disabled by pulling the CTRL pin to GND. Short R<sub>2</sub> to disable the device.

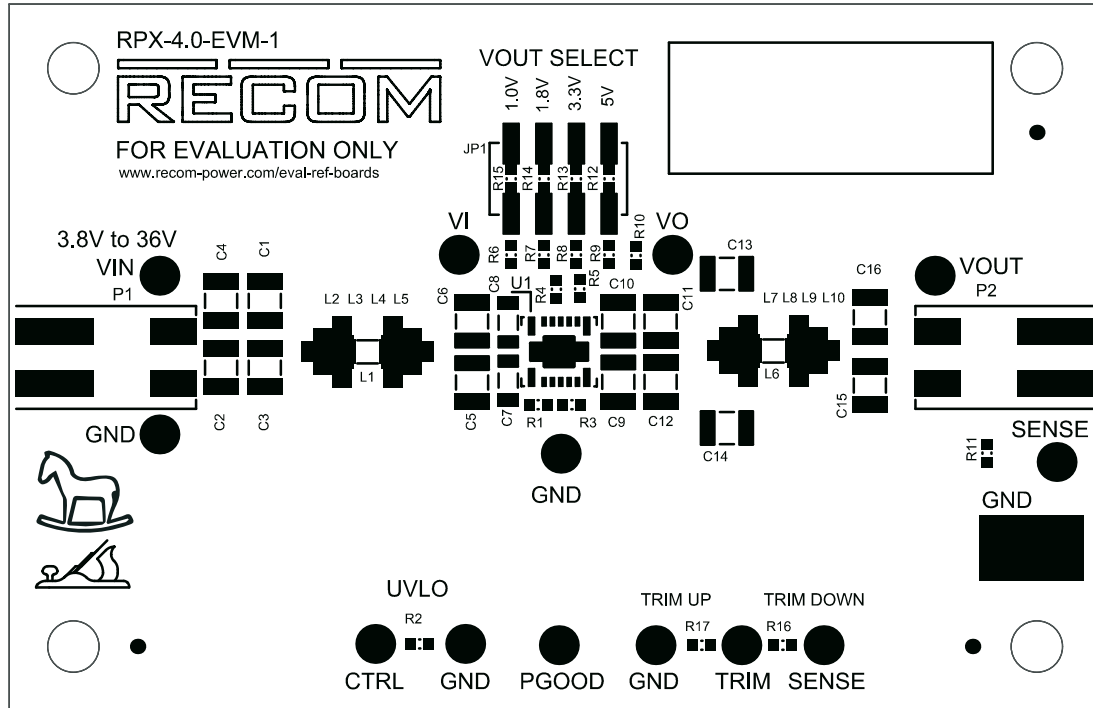


**Caution:**

ESD sensitive. Always follow ESD preventative procedures when handling the product!

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

## Component Placement



## Connector Description

### P1

Pin	Name	Description
1	VIN	Positive Input Voltage (observe correct polarity!)
2	GND	Common GND

### P2

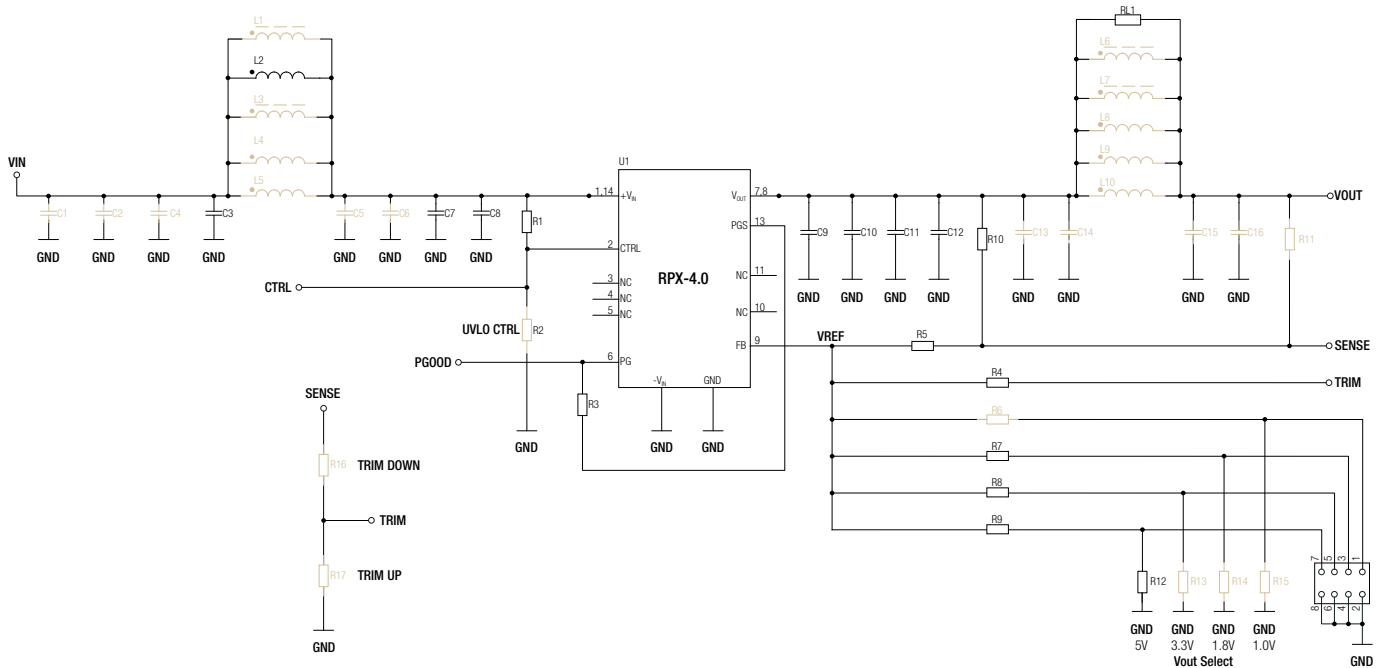
Pin	Name	Description
1	GND	Common GND
2	VOUT	Positive Output Voltage

## Pads Direct Connection

Pin	Name	Description
1	VIN	Positive Input Voltage
2	GND	Negative Input Voltage (GND)
3	CTRL	CTRL Pad (leave open if not used) or UVLO setting
4	GND	Negative Input Voltage (GND)
5	PGOOD	Power Good Signal
6	GND	Negative Input Voltage (GND)
7	TRIM	TRIM Pad (leave open if not used)
8, 9	SENSE	Output Voltage Sense Pin (leave open if not used)
10	VOUT	Positive Output Voltage
11	GND	Negative Output Voltage (GND)

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

### Schematic



### Notes:

Note2: Grey colored components are not mounted

### Description

U<sub>1</sub>: RPX-4.0 power module.

C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, L<sub>1</sub>, L<sub>2</sub>, L<sub>3</sub>, L<sub>4</sub>, L<sub>5</sub>, C<sub>5</sub>, C<sub>6</sub>, C<sub>7</sub>, C<sub>8</sub>: allow placement of various sized components to test input filter design. The populated filter is designed to meet EN55022 class B.

C<sub>9</sub>, C<sub>10</sub>, C<sub>11</sub>, C<sub>12</sub>, C<sub>13</sub>, C<sub>14</sub>, L<sub>6</sub>, L<sub>7</sub>, L<sub>8</sub>, L<sub>9</sub>, L<sub>10</sub>, C<sub>15</sub>, C<sub>16</sub>, RL<sub>2</sub>: allow placement of various sized components to test output filter design. The populated filter is designed to meet EN55022 class B.

R<sub>1</sub>, R<sub>2</sub>: configure CTRL and UVLO. R<sub>1</sub> is populated to enable the RPX-4.0. Short R<sub>2</sub> in order to disable the RPX-4.0 or populate R<sub>2</sub> in order to set UVLO threshold. Refer to **“UNDERVOLTAGE LOCKOUT”**

R<sub>10</sub>: populated zero ohm resistor for direct output voltage measurement. If sense is desired at a different location, for example after the filter or directly at the load), unsolder R<sub>10</sub>, and connect sense to the new measurement point.

R<sub>11</sub>: sense point for output voltage after the filter. To set sense point here, remove R<sub>10</sub>, and solder a zero ohm resistor at R<sub>11</sub>.

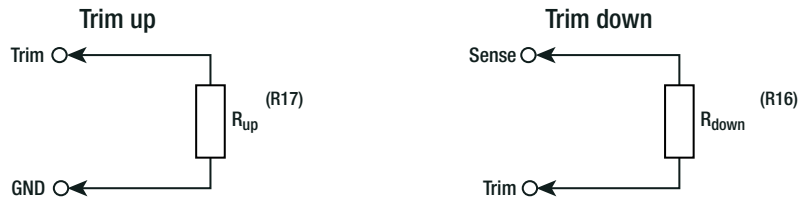
V<sub>OUT</sub> Selection: the output voltage can be selected with values of 1VDC, 1.8VDC, 3.3VDC, and 5VDC by shorting a zero ohm resistor to the respective places as seen in the board silkscreen. Instead of R<sub>12</sub>-R<sub>15</sub> resistors, the JP<sub>1</sub> (SMT 2-row pin header) can be assembled and output voltage can be quickly set with jumper. Remove any resistor from positions R<sub>12</sub>-R<sub>15</sub> before installing SMT header JP<sub>1</sub>.

R<sub>16</sub>, R<sub>17</sub>: trim the output voltage. Refer to **“OUTPUT VOLTAGE TRIMMING”**

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

#### OUTPUT VOLTAGE TRIMMING

The RPX-4.0-EVM-1 offers the feature of trimming the output voltage in range 1.0VDC to 7VDC by using external trim resistors. The recommended value of R<sub>FB1</sub> is 10kΩ, so margin of trimming down is limited. The values for trim resistors are shown in trim tables below according to E96 values; therefore, the specified voltage may slightly vary. Refer to “*Selection Guide*” for applicable V<sub>OUT</sub> range.



#### Calculation:

V<sub>out\_nom</sub> = nominal output voltage [VDC]

V<sub>out\_set</sub> = trimmed output voltage [VDC]

R<sub>up</sub> = trim up resistor [kΩ]

R<sub>down</sub> = trim down resistor [kΩ]

R<sub>FB1</sub>, R<sub>FB2</sub> = feedback resistors [kΩ]

$$R_{up} = \frac{R_{FB1} + (V_{out_{nom}} - V_{out_{set}})}{(V_{out_{set}} - V_{out_{nom}})}$$

$$R_{down} = \frac{R_{FB1}^2 + R_{FB2} \times (R_{FB1} + 1) \times (V_{out_{set}} - V_{out_{nom}})}{R_{FB2} \times (V_{out_{nom}} - V_{out_{set}})}$$

V <sub>out_nom</sub>	R <sub>FB1</sub> [kΩ]	R <sub>FB2</sub> [kΩ]
1.0VDC	10k	- (open)
1.8VDC	10k	12k4
3.3VDC	10k	4k32
5.0VDC	10k	2k49

#### Practical Example RPX-4.0, trim up:

V<sub>out\_nom</sub>=3.3VDC, V<sub>out\_set</sub>=3.6VDC

$$R_{up} = \frac{10 + (3.3 - 3.6)}{(3.6 - 3.3)} = \underline{\underline{32.3k\Omega}}$$

R<sub>up</sub> according to E96 ≈ 32.4kΩ

#### Practical Example RPX-4.0, trim down:

V<sub>out\_nom</sub>=3.3VDC, V<sub>out\_set</sub>=3.1VDC

$$R_{down} = \frac{10^2 + 4.32 \times (10 + 1) \times (3.1 - 3.3)}{4.32 \times (3.3 - 3.1)} = \underline{\underline{104.740k\Omega}}$$

R<sub>down</sub> according to E96 ≈ 105kΩ

#### V<sub>out\_set</sub> = 1.8VDC

##### Trim up

V <sub>out_set</sub> =	1.85	1.90	2.0	2.1	2.3	2.5	[VDC]
R <sub>up</sub> (E96) ≈	200k	100k	48k7	32k4	19k1	13k3	[Ω]

##### Trim down

V <sub>out_set</sub> =	1.75	1.72	1.7	[VDC]
R <sub>down</sub> (E96) ≈	150k	88k7	69k8	[Ω]

#### V<sub>out\_set</sub> = 3.3VDC

##### Trim up

V <sub>out_set</sub> =	3.4	3.5	3.6	3.8	4.0	4.2	[VDC]
R <sub>up</sub> (E96) ≈	100k	48k7	32k4	19k1	13k3	10k	[Ω]

##### Trim down

V <sub>out_set</sub> =	3.2	3.1	3.0	[VDC]
R <sub>down</sub> (E96) ≈	221k	105k	66k5	[Ω]

#### V<sub>out\_set</sub> = 5VDC

##### Trim up

V <sub>out_set</sub> =	5.1	5.2	5.3	5.5	6.0	6.5	7.0	[VDC]
R <sub>up</sub> (E96) ≈	100k	48k	32k4	19k1	9k09	5k62	4k02	[Ω]

##### Trim down

V <sub>out_set</sub> =	4.9	4.8	4.7	4.5	[VDC]
R <sub>down</sub> (E96) ≈	392k	191k	124k	69k8	[Ω]

#### UNDERVOLTAGE LOCKOUT

The RPX-4.0-EVM-1 offers the feature of setting UVLO threshold. The values for UVLO resistor value are shown in UVLO table below according to E96 values; therefore, the specified voltage may slightly vary.

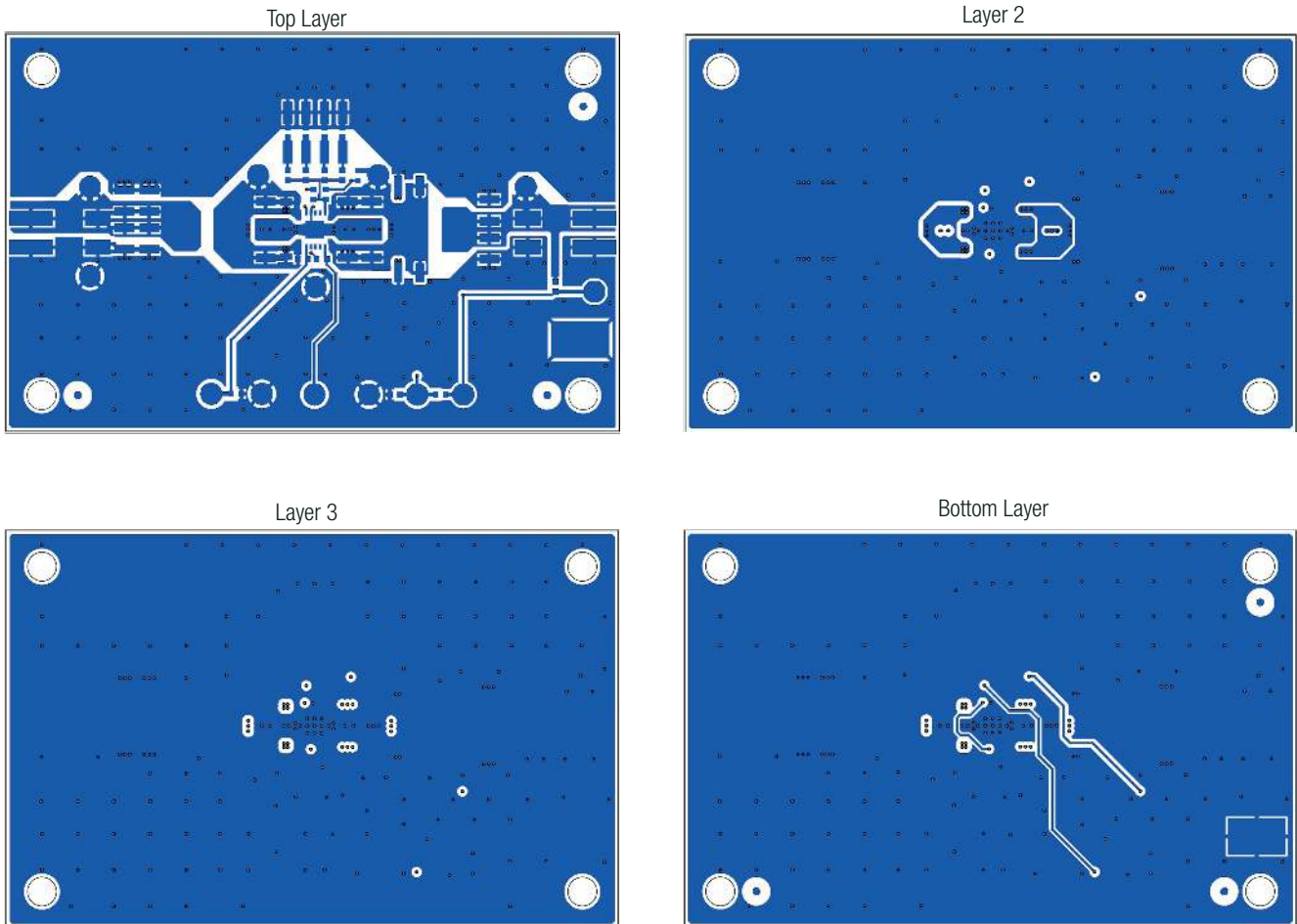
V <sub>IN</sub> UVLO threshold	6.5	10	15	20	25	30	[VDC]
R <sub>2</sub> (E96) ≈	23k7	14k3	9k09	6k65	5k23	4k32	[Ω]

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

**DIMENSION AND PHYSICAL CHARACTERISTICS**

Parameter	Type	Value
Dimension (LxWxH)		85.0 x 55.0 x 6.5mm
Weight		21g typ.

**Layout**



**Notes:**

Note3: 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, C2, C4, C5, C6, C13, C14, C15, C16	CAP 1210			not mounted
C3, C7, C8	10uF 50V X7R 1206	CL32B106KBJNNNE	Samsung Electro-Mechanics	
C9, C10	47uF 10V X7R 1210	GRM32ER71A476KE15L	MURATA	
C11, C12	22uF 25V X7R 1210	CL32B226KAJNFNE	Samsung Electro-Mechanics	
L1, L3, L4, L5, L6, L7, L8, L9, L10	FERRITE BEAD			not mounted
L2	IND 2.2uH 5.8A 29mΩ 0530	0530CDMCCDS-2R2MC	SUMIDA	

continued on next page

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

Comp.	Description	Manufacturer Part Number	Manufacturer	Remarks
P1, P2	CONNECTOR	2060-452_998-404	WAGO	
JP1	PIN HEADER			not mounted
R1, R3	100k $\Omega$ 0.1W 0603	RC0603FR-07100KL	YAGEO	
R2, R6, R11, R13, R14, R15, R16, R17	RES 0603			not mounted
R4	1k $\Omega$ 0.1W 0603	RC0603FR-071KL	YAGEO	
R5	10k $\Omega$ 0.1W 0603	RC0603FR-0710KL	YAGEO	
R7	12.4k $\Omega$ 0.1W 0603	RC0603FR-0712K4L	YAGEO	
R8	4.32k $\Omega$ 0.1W 0603	RC0603FR-074K32L	YAGEO	
R9	2.49k $\Omega$ 0.1W 0603	RC0603FR-072K49L	YAGEO	
R10, R12	0 $\Omega$ 0.1W 0603	RC0603JR-070RL	YAGEO	
RL1	0 $\Omega$ 0.25W 1206	CRCW12060000Z0EAC	VISHAY	
U1	RPX-4.0 MODULE	RPX-4.0	RECOM	

**PACKAGING INFORMATION**

Parameter	Type	Value
Packaging Dimension (LxWxH)		114.0 x 60.0 x 28.0mm
Packaging Quantity		1pc

**Contents**

- RPX-4.0-EVM-1 Evaluation Module
- Terms and Conditions

The product information and specifications may be subject to changes even without prior written notice. The product has been designed for various applications; its suitability lies in the responsibility of each customer. The products are not authorized for use in safety-critical applications without RECOM's explicit written consent. A safety-critical application is an application where a failure may reasonably be expected to endanger or cause loss of life, inflict bodily harm or damage property. The applicant shall indemnify and hold harmless RECOM, its affiliated companies and its representatives against any damage claims in connection with the unauthorized use of RECOM products in such safety-critical applications.