

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

RECOM
Evaluation Module

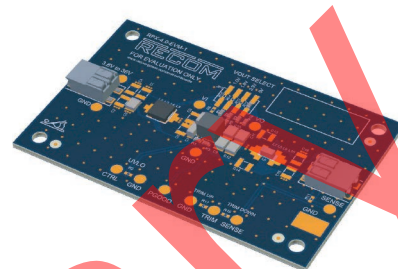
RPX-4.0-EVM-1

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 ⁽¹⁾ [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 P₁ to power supply (observe correct polarity)
2. Connect P₂ to the load (no load operation is allowed. For 5V_{OUT}, please refer to safe operating area in the RPX-4.0 datasheet)
3. The evaluation module is preset to 5V_{OUT}. 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_{IN} pin. The device is disabled when the internal voltage is under 3.55VDC(typ.). When a higher UVLO threshold is required, assemble resistor R₂. Refer to the [RPX-4.0](#) module datasheet for R₂ values.
5. CTRL
The device is preset as normally on. It can be disabled by pulling the CTRL pin to GND. Short R₂ to disable the device.

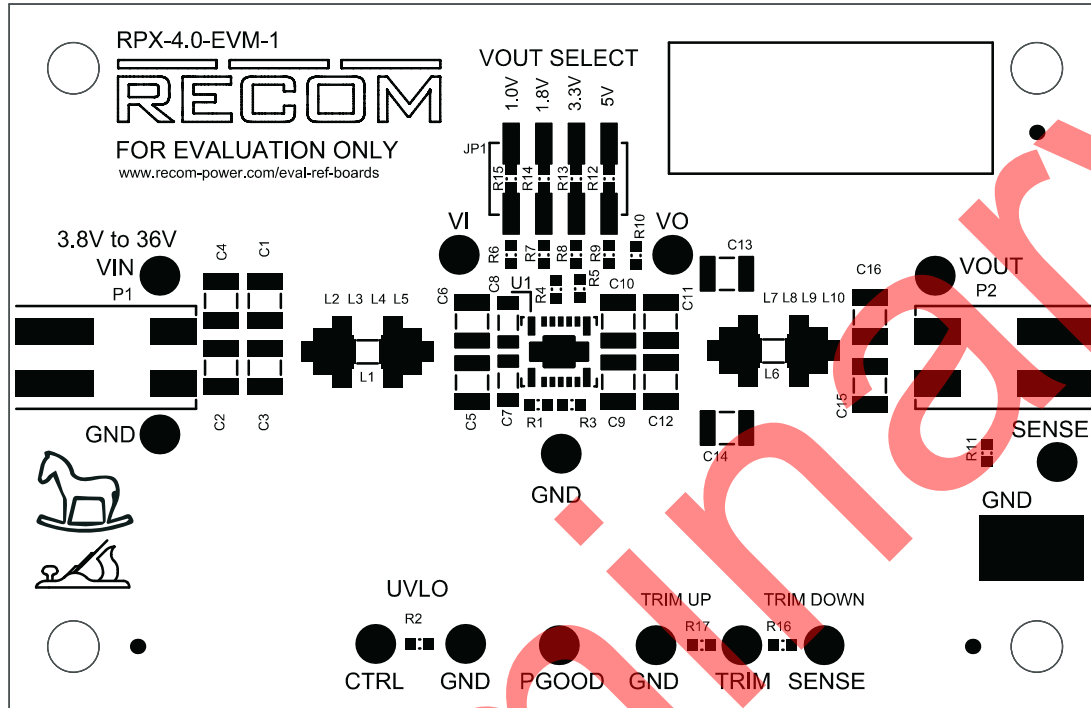


Caution:

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

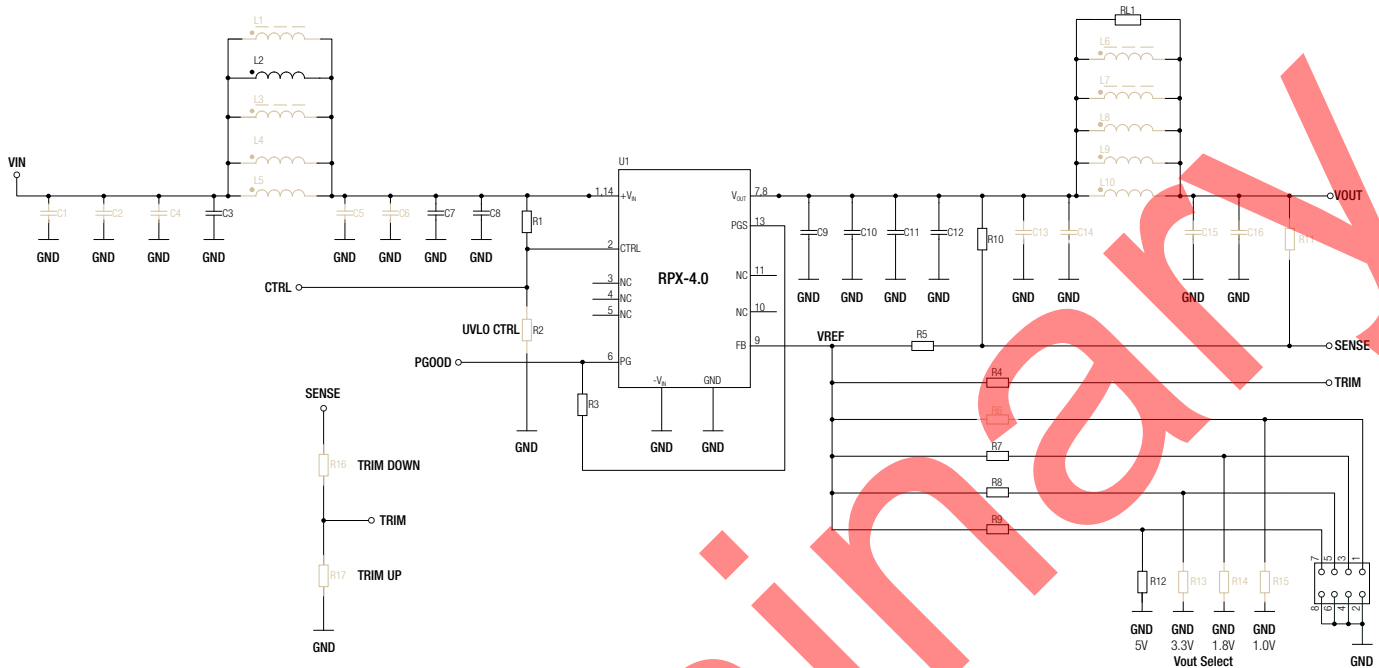
| Pin | Name | Description |
|-----|------|-------------------------|
| 1 | GND | Common GND |
| 2 | VOUT | Positive Output Voltage |

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 @ $T_a = 25^\circ\text{C}$, full load and after warm-up unless otherwise stated)

Schematic



Notes:

Note2: Grey colored components are not mounted

Description

U₁: RPX-4.0 power module.

C₁, C₂, C₃, C₄, L₁, L₂, L₃, L₄, L₅, C₅, C₆, C₇, C₈: allow placement of various sized components to test input filter design. The populated filter is designed to meet EN55022 class B.

C₉, C₁₀, C₁₁, C₁₂, C₁₃, C₁₄, L₆, L₇, L₈, L₉, L₁₀, C₁₅, C₁₆, RL₂: allow placement of various sized components to test output filter design. The populated filter is designed to meet EN55022 class B.

R₁, R₂: configure CTRL and UVLO. R₁ is populated to enable the RPX-4.0. Short R₂ in order to disable the RPX-4.0 or populate R₂ in order to set UVLO threshold. Refer to **"UNDERVOLTAGE LOCKOUT"**

R₁₀: 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 R₁₀, and connect sense to the new measurement point.

R₁₁: sense point for output voltage after the filter. To set sense point here, remove R₁₀, and solder a zero ohm resistor at R₁₁.

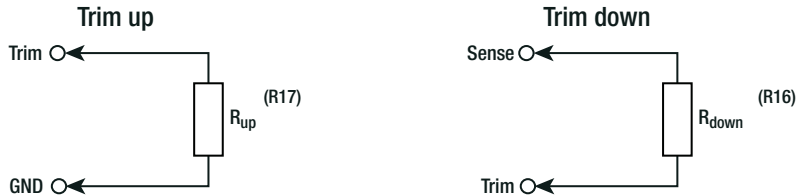
V_{OUT} Selection: the output voltage can be selected with values of 1VDC, 1.8VDC, 3.3VDC, and 5VDC by shorting a zero ohm resistor to the respective places as seen in the board silkscreen. Instead of R₁₂-R₁₅ resistors, the JP₁ (SMT 2-row pin header) can be assembled and output voltage can be quickly set with jumper. Remove any resistor from positions R₁₂-R₁₅ before installing SMT header JP₁.

R₁₆, R₁₇: 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_{FB1} 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_{OUT} range.



Calculation:

V_{out_{nom}} = nominal output voltage [VDC]

V_{out_{set}} = trimmed output voltage [VDC]

R_{up} = trim up resistor [kΩ]

R_{down} = trim down resistor [kΩ]

R_{FB1}, R_{FB2} = 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 _{out_{nom}} | R _{FB1} [kΩ] | R _{FB2} [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_{out_{nom}} = 3.3VDC, V_{out_{set}} = 3.6VDC

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

R_{up} according to E96 ≈ 32.4kΩ

Practical Example RPX-4.0, trim down:

V_{out_{nom}} = 3.3VDC, V_{out_{set}} = 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_{down} according to E96 ≈ 105kΩ

V_{out_{set}} = 1.8VDC

Trim up

| | | | | | | | |
|----------------------------------|------|------|------|------|------|------|-------|
| V _{out_{set}} = | 1.85 | 1.90 | 2.0 | 2.1 | 2.3 | 2.5 | [VDC] |
| R _{up} (E96) ≈ | 200k | 100k | 48k7 | 32k4 | 19k1 | 13k3 | [Ω] |

Trim down

| | | | | |
|----------------------------------|------|------|------|-------|
| V _{out_{set}} = | 1.75 | 1.72 | 1.7 | [VDC] |
| R _{down} (E96) ≈ | 150k | 88k7 | 69k8 | [Ω] |

V_{out_{set}} = 3.3VDC

Trim up

| | | | | | | | |
|----------------------------------|------|------|------|------|------|-----|-------|
| V _{out_{set}} = | 3.4 | 3.5 | 3.6 | 3.8 | 4.0 | 4.2 | [VDC] |
| R _{up} (E96) ≈ | 100k | 48k7 | 32k4 | 19k1 | 13k3 | 10k | [Ω] |

Trim down

| | | | | |
|----------------------------------|------|------|------|-------|
| V _{out_{set}} = | 3.2 | 3.1 | 3.0 | [VDC] |
| R _{down} (E96) ≈ | 221k | 105k | 66k5 | [Ω] |

V_{out_{set}} = 5VDC

Trim up

| | | | | | | | | |
|----------------------------------|------|-----|------|------|------|------|------|-------|
| V _{out_{set}} = | 5.1 | 5.2 | 5.3 | 5.5 | 6.0 | 6.5 | 7.0 | [VDC] |
| R _{up} (E96) ≈ | 100k | 48k | 32k4 | 19k1 | 9k09 | 5k62 | 4k02 | [Ω] |

Trim down

| | | | | | |
|----------------------------------|------|------|------|------|-------|
| V _{out_{set}} = | 4.9 | 4.8 | 4.7 | 4.5 | [VDC] |
| R _{down} (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.

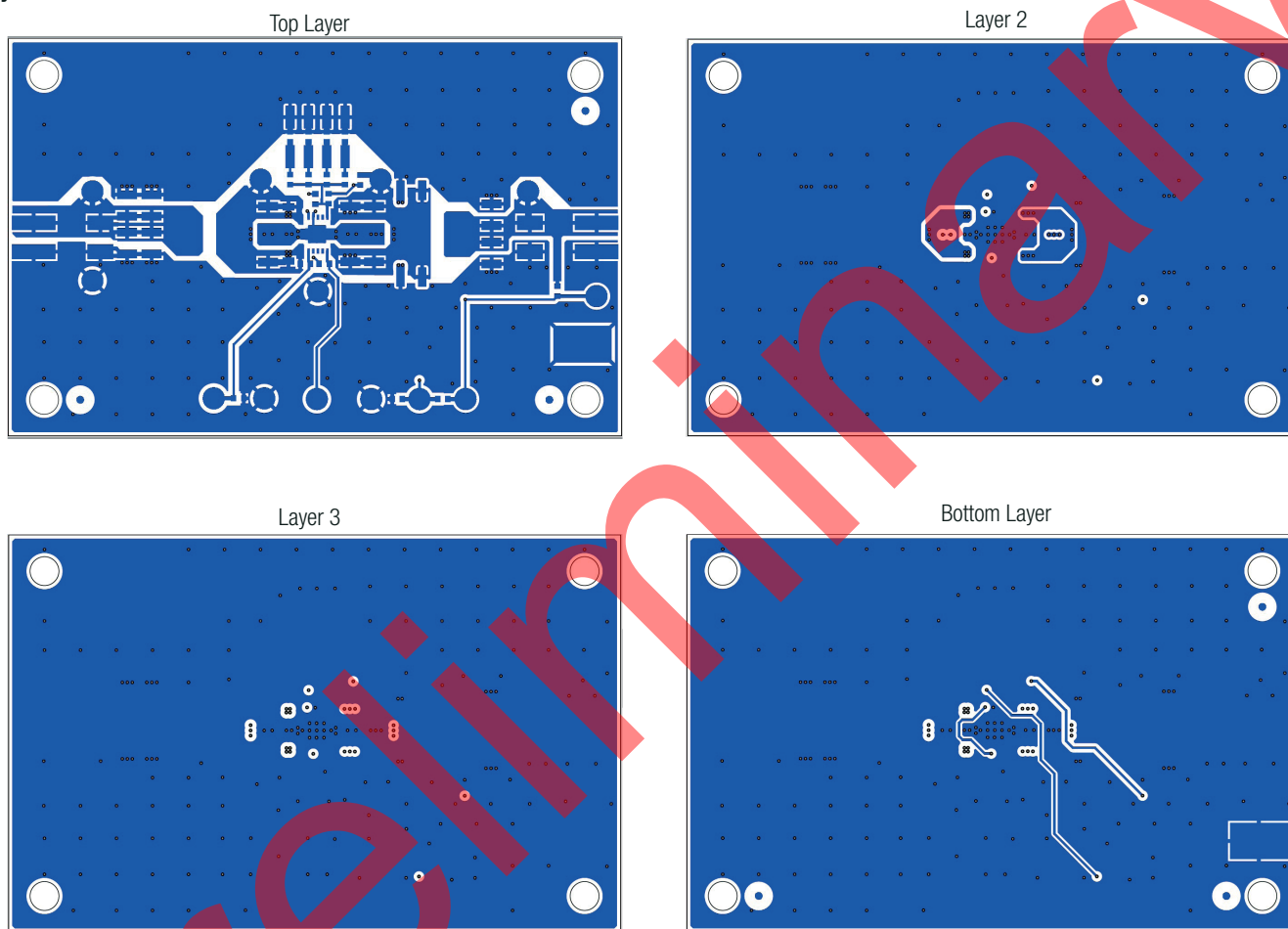
| | | | | | | | |
|--------------------------------|------|------|------|------|------|------|-------|
| V _{IN} UVLO threshold | 6.5 | 10 | 15 | 20 | 25 | 30 | [VDC] |
| R ₂ (E96) ≈ | 23k7 | 14k3 | 9k09 | 6k65 | 5k23 | 4k32 | [Ω] |

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 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 | 100kΩ 0.1W 0603 | RC0603FR-07100KL | YAGEO | |
| R2, R6, R11, R13, R14, R15, R16, R17 | RES 0603 | | | not mounted |
| R4 | 1kΩ 0.1W 0603 | RC0603FR-071KL | YAGEO | |
| R5 | 10kΩ 0.1W 0603 | RC0603FR-0710KL | YAGEO | |
| R7 | 12.4kΩ 0.1W 0603 | RC0603FR-0712K4L | YAGEO | |
| R8 | 4.32kΩ 0.1W 0603 | RC0603FR-074K32L | YAGEO | |
| R9 | 2.49kΩ 0.1W 0603 | RC0603FR-072K49L | YAGEO | |
| R10, R12 | 0Ω 0.1W 0603 | RC0603JR-070RL | YAGEO | |
| RL1 | 0Ω 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