

Features

Evaluation Module

- Evaluation platform for RPX-1.5Q Buck Regulator Module
- Thermal design considerations included
- EMI Class B filter
- Easy evaluation of output voltage selection, control and sensing functions

RECOM
Evaluation Module

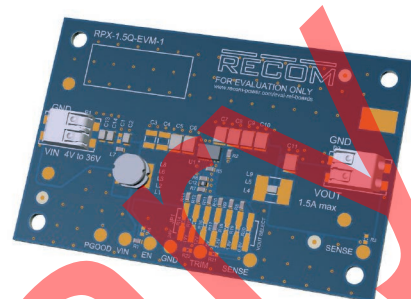
RPX-1.5Q-EVM-1

Description

The RPX-1.5Q-EVM-1 generates a constant output voltage selectable from 0.8VDC, 1.8VDC, 3.3VDC, 5VDC, 12VDC, 15VDC or 24VDC from a DC input in the range of 4 – 36VDC. It has a maximum continuous output current of 1.5A.

All the functions of the RPX-1.5Q such as output voltage selection, control, power good, trim and output sense can be readily evaluated. Also the behavior in overload or over-temperature can be evaluated easily before it 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-1.5Q-EVM-1 | 4 - 36 | 0.8, 1.8, 3.3, 5, 12, 15, 24 | 1.5 |

Notes:

Note1: refer to [SAFE OPERATING AREA](#) of RPX-1.5Q datasheet

Quick Start Guide

1. Connect P₁ to power supply (observe correct polarity)
2. Connect P₂ to the load (no load operation is allowed. Refer to [safe operating area](#) in the [RPX-1.5Q](#) datasheet)
3. The evaluation module is preset to 5V_{OUT}. The output voltage can be selected for values of 0.8VDC, 1.8VDC, 3.3VDC, 5VDC, 12VDC, 15VDC and 24VDC by shorting a 0Ω resistor to the respective places as seen in the board silkscreen. For 0.8V_{OUT}, please refer to safe operating area in the [RPX-1.5Q](#) datasheet.
4. The sense pin is connected to the RPX output pin, so the preset voltage is very accurate at the output of the RPX. To compensate any losses of the filter, remove the resistor at R₂, and solder a 0Ω resistor at R₃.
5. The device is preset as normally on. It can be disabled by pulling the CTRL pad to GND. Short R₄ to disable the device.

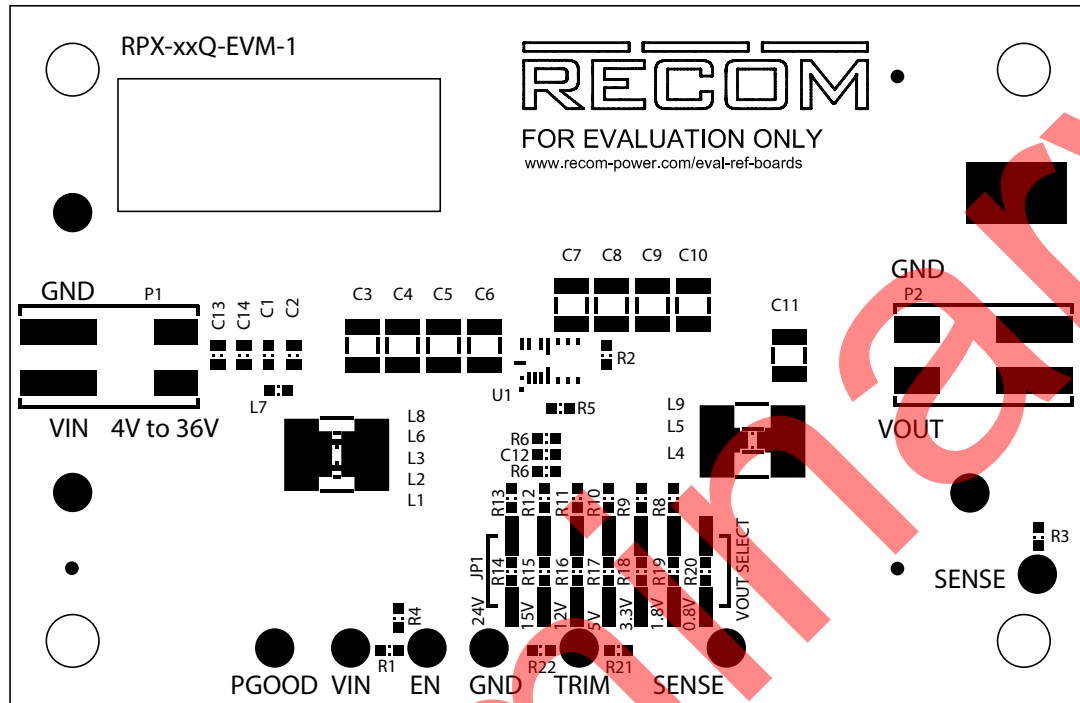


Caution:

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 |
|-----|------|--|
| 1-2 | GND | Common GND |
| 3-4 | VIN | Positive Input Voltage (observe correct polarity!) |

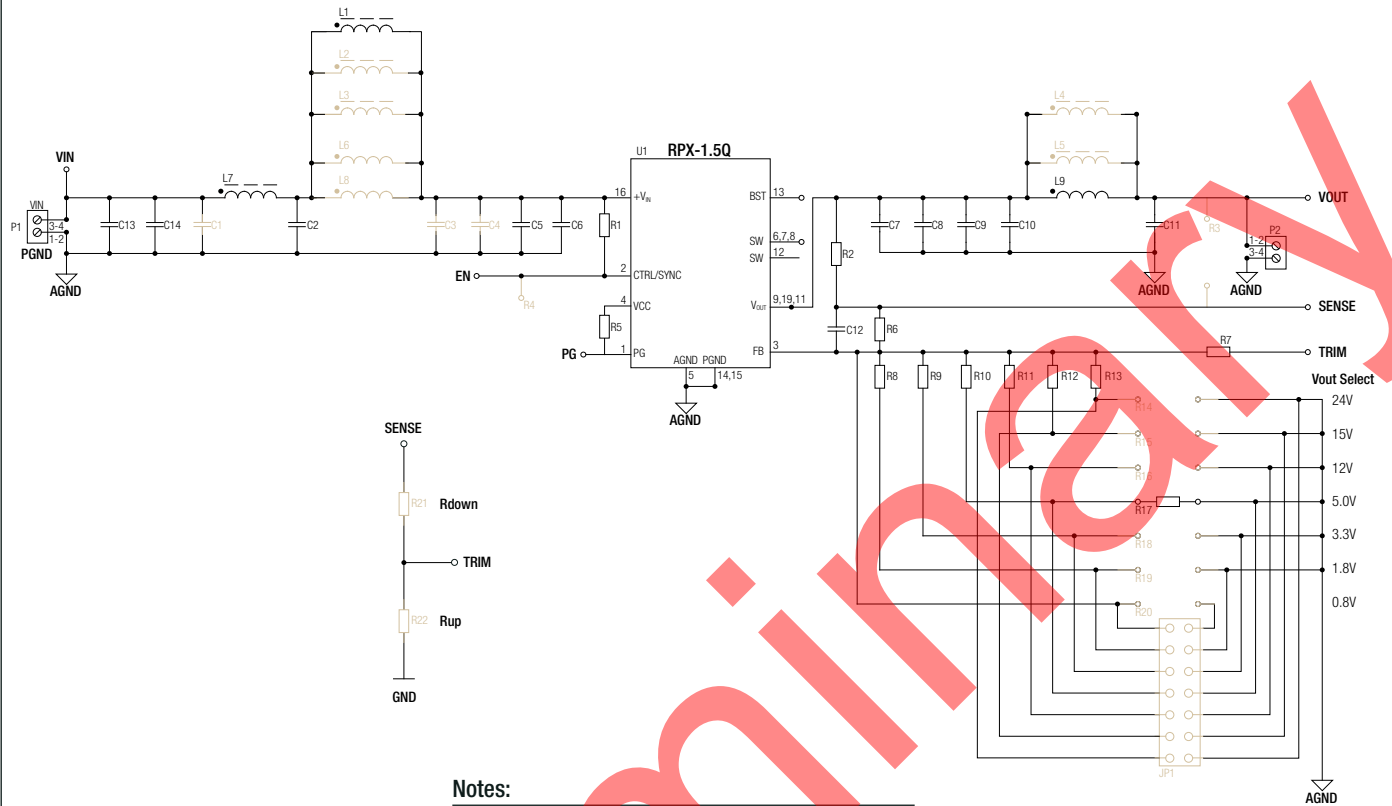
P2

| Pin | Name | Description |
|-----|------|-------------------------|
| 3-4 | GND | Common GND |
| 1-2 | VOUT | Positive Output Voltage |

Pads Direct Connection

| Name | Description |
|-------|---|
| GND | Negative Input Voltage (GND) |
| VIN | Positive Input Voltage |
| PGOOD | Power Good Signal |
| EN | EN Pad (leave open if not used) |
| TRIM | TRIM Pad (leave open if not used) |
| SENSE | Output Voltage Sense Pin (leave open if not used) |
| VOUT | Positive Output Voltage |

Schematic



Notes:

Note2: Grey colored components are not mounted

Description

U₁: RPX-1.5Q power module.

C₁, C₂, L₁, L₂, L₃, L₆, L₇, L₈, C₃, C₄, C₅, C₆, C₁₃, C₁₄: allow placement of various sized components to test input filter design. The populated filter is designed to meet EN55022 class B.

C₇, C₈, C₉, C₁₀, L₄, L₅, L₉, C₁₁: allow placement of various sized components to test output filter design. The populated filter is designed to meet EN55022 class B.

R₁ and R₄: configure CTRL. R₁ is populated to enable the RPX-1.5Q. Short R₄ in order to disable the RPX-1.5Q.

R₂: populated 0Ω 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 R₂, and connect sense to the new measurement point.

R₃: sense point for output voltage after the filter. To set sense point here, remove R₂ and solder a 0Ω resistor at R₃.

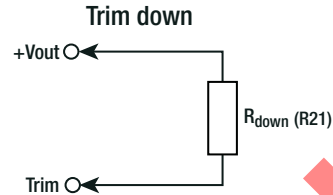
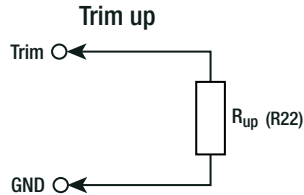
V_{OUT} Selection: the output voltage can be selected with values of 0.8VDC, 1.8VDC, 3.3VDC, 5VDC, 12VDC, 15VDC, and 24V by shorting a 0Ω resistor to the respective places as seen in the board silkscreen. Instead of R₁₄-R₂₀ resistors, the JP₁ (SMT 2-row pin header) can be assembled and output voltage can be quickly set with jumper. Remove any resistor from positions R₁₄-R₂₀ before installing SMT header JP₁.

Note: For 0.8VDC output voltage the placement of 0Ω resistor or the jumper is not required since the feedback is internally disconnected in the board. See the connection of R₂₀ in the schematic.

R₂₁, R₂₂: trim the output voltage. Refer to "OUTPUT VOLTAGE TRIMMING"

OUTPUT VOLTAGE TRIMMING

The RPX-1.5Q-EVM-1 offers the feature of trimming the output voltage by using external trim resistors. 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]
 V_{ref} = reference voltage [VDC]
 R_{up} = trim up resistor [kΩ]
 R_{down} = trim down resistor [kΩ]
 R_{FB1} (R_L), R_{FB2} (R_H) = feedback resistors [kΩ]

$$R_{up} = \frac{R_H \times R_L \times V_{REF}}{R_L \times (V_{out_{set}} - V_{REF}) - R_H \times V_{REF}} \quad [k\Omega]$$

$$R_{down} = \frac{R_H \times R_L \times (V_{out_{set}} - V_{REF})}{V_{REF} \times (R_H + R_L) - V_{out_{set}} \times R_L} \quad [k\Omega]$$

| Vout _{nom} | R _L /R _{FB1} [kΩ] | R _H /R _{FB2} [kΩ] | Vref [VDC] |
|---------------------|---------------------------------------|---------------------------------------|------------|
| 1.8VDC | 60k4 | 75k | 0.8 |
| 3.3VDC | 24k3 | 75k | 0.8 |
| 5VDC | 14k3 | 75k | 0.8 |
| 12VDC | 5k36 | 75k | 0.8 |
| 15VDC | 4k22 | 75k | 0.8 |
| 24VDC | 2k61 | 75k | 0.8 |

Practical Example RPX-1.5Q, trim up:

V_{out_{set}} = 5.1VDC

$$R_{up} = \frac{75 \times 14.3 \times 0.8}{14.3 \times (5.1 - 0.8) - 75 \times 0.8} = \underline{\underline{575.838\Omega}}$$

R_{up} according to E96 ≈ 576kΩ

Practical Example RPX-1.5Q, trim down:

V_{out_{set}} = 4VDC

$$R_{down} = \frac{75 \times 14.3 \times (4 - 0.8)}{0.8 \times (75 + 14.3) - 4 \times 14.3} = \underline{\underline{241.011\Omega}}$$

R_{down} according to E96 ≈ 243kΩ

V_{out_{set}} = 1.8VDC

Trim up

| | | | | | |
|-------------------------|------|------|------|------|-------|
| Vout _{set} = | 1.82 | 1.88 | 1.9 | 2.0 | [VDC] |
| R _{up} (E96) ≈ | 2M26 | 698k | 562k | 287k | [Ω] |

Trim down

| | | | | | |
|---------------------------|------|------|------|------|-------|
| Vout _{set} = | 1.7 | 1.6 | 1.5 | 1.4 | [VDC] |
| R _{down} (E96) ≈ | 715k | 309k | 178k | 115k | [Ω] |

V_{out_{set}} = 3.3VDC

Trim up

| | | | | | |
|-------------------------|------|------|------|------|-------|
| Vout _{set} = | 3.4 | 3.5 | 3.6 | 3.8 | [VDC] |
| R _{up} (E96) ≈ | 453k | 255k | 182k | 113k | [Ω] |

Trim down

| | | | | | |
|---------------------------|------|------|------|------|-------|
| Vout _{set} = | 3.1 | 3.0 | 2.8 | 2.6 | [VDC] |
| R _{down} (E96) ≈ | 1M02 | 604k | 316k | 200k | [Ω] |

V_{out_{set}} = 5VDC

Trim up

| | | | | | |
|-------------------------|------|------|------|------|-------|
| Vout _{set} = | 5.1 | 5.2 | 5.3 | 6.0 | [VDC] |
| R _{up} (E96) ≈ | 576k | 294k | 196k | 59k0 | [Ω] |

Trim down

| | | | | | |
|---------------------------|------|------|------|------|-------|
| Vout _{set} = | 4.7 | 4.5 | 4.3 | 4.0 | [VDC] |
| R _{down} (E96) ≈ | 976k | 549k | 374k | 237k | [Ω] |

V_{out_{set}} = 12VDC

Trim up

| | | | | | |
|-------------------------|------|------|------|------|-------|
| Vout _{set} = | 12.4 | 12.6 | 13.0 | 13.2 | [VDC] |
| R _{up} (E96) ≈ | 147k | 100k | 59k | 49k9 | [Ω] |

Trim down

| | | | | | |
|---------------------------|------|------|------|------|-------|
| Vout _{set} = | 11 | 10.6 | 10 | 9.6 | [VDC] |
| R _{down} (E96) ≈ | 768k | 523k | 348k | 247k | [Ω] |

continued on next page

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

OUTPUT VOLTAGE TRIMMING

V_{outset} = 15VDC

Trim up

| | | | | | |
|-------------------------|------|------|------|------|-------|
| V _{outset} = | 15.5 | 16 | 16.3 | 16.5 | [VDC] |
| R _{up} (E96) ≈ | 124k | 60k4 | 46k4 | 40k2 | [Ω] |

Trim down

| | | | | | |
|---------------------------|------|------|------|------|-------|
| V _{outset} = | 14.5 | 14.0 | 13.5 | 13.0 | [VDC] |
| R _{down} (E96) ≈ | 2M05 | 976k | 634k | 453k | [Ω] |

V_{outset} = 24VDC

Trim up

| | | | | | |
|-------------------------|------|------|------|------|-------|
| V _{outset} = | 25 | 25.5 | 26 | 26.4 | [VDC] |
| R _{up} (E96) ≈ | 49k9 | 34k8 | 27k4 | 22k6 | [Ω] |

Trim down

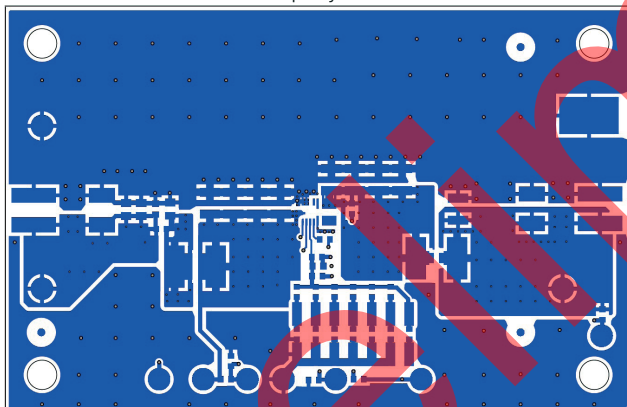
| | | | | | |
|---------------------------|------|------|------|------|-------|
| V _{outset} = | 23.0 | 22.0 | 20.0 | 19.2 | [VDC] |
| R _{down} (E96) ≈ | 2M05 | 887k | 383k | 301k | [Ω] |

DIMENSION AND PHYSICAL CHARACTERISTICS

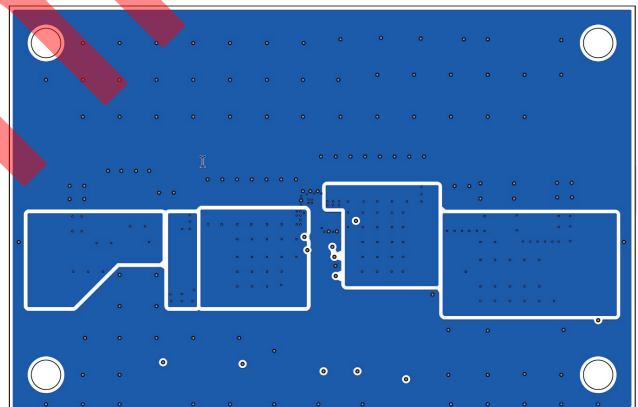
| Parameter | Type | Value |
|-------------------|------|---------------------|
| Dimension (LxWxH) | | 85.0 x 55.0 x 6.5mm |
| Weight | | 22g |

Layout

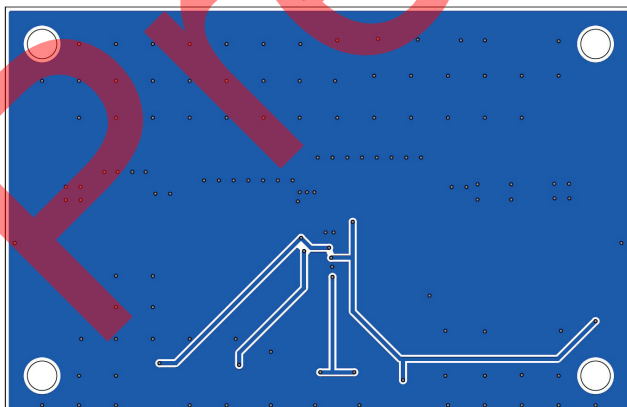
Top Layer



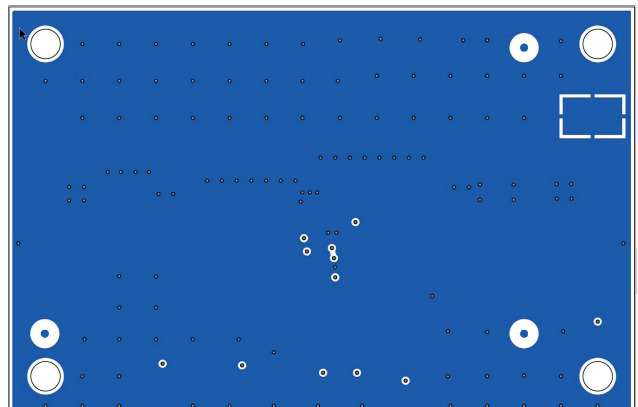
Layer 2



Layer 3



Bottom Layer



Notes:

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

BOM

| Comp. | Description | Manufacturer Part Number | Manufacturer | Remarks |
|--|---------------------------|--------------------------|---------------------------|-------------|
| C1 | CAP 0603 | | | not mounted |
| C2 | 1uF 50V X7R 0805 | CL21B105KBFNNNF | Samsung Electro-Mechanics | |
| C3, C4 | CAP 1210 | | | not mounted |
| C5, C6, C7, C8, C9, C10, C11 | 10uF 50V X7R 1210 | CL32B106KBJNNWE | Samsung Electro-Mechanics | |
| C12 | 33pF 50V C0G 0603 | CL10C330JB8NNNC | Samsung Electro-Mechanics | |
| C13, C14 | 4.7uF 50V X7R 0805 | CGA4J1X7R1H475K125AE | TDK | |
| L1 | IND 18uH 1.89A | RLS-186 | RECOM | |
| L2, L3, L4, L5, L6, L8 | FERRITE BEAD | | | not mounted |
| L7 | FERRITE BEAD 33 OHM 0603 | BLM18PG330SN1D | MURATA | |
| L9 | FERRITE BEAD 600 OHM 0805 | 742792040 | WURTH | |
| P1, P2 | CONNECTOR | 2060-452/998-404 | WAGO | |
| R1 | 301kΩ 0.1W 0603 | RC0603FR-07301KL | YAGEO | |
| R2, R17 | 0Ω 0.1W 0603 | RC0603JR-070RL | YAGEO | |
| R3, R4, R14, R15, R16, R18, R19, R20, R21, R22 | RES 0603 | | | not mounted |
| R5 | 100kΩ 0.1W 0603 | RC0603FR-07100KL | YAGEO | |
| R6 | 75kΩ 0.1W 0603 | RC0603FR-0775KL | YAGEO | |
| R7 | 1kΩ 0.1W 0603 | RC0603FR-071KL | YAGEO | |
| R8 | 60.4kΩ 0.1W 0603 | RC0603FR-0760K4L | YAGEO | |
| R9 | 24.3kΩ 0.1W 0603 | RC0603FR-0724K3L | YAGEO | |
| R10 | 14.3kΩ 0.1W 0603 | RC0603FR-0714K3L | YAGEO | |
| R11 | 5.36kΩ 0.1W 0603 | RC0603FR-075K36L | YAGEO | |
| R12 | 4.22kΩ 0.1W 0603 | RC0603FR-074K22L | YAGEO | |
| R13 | 2.61kΩ 0.1W 0603 | RC0603FR-072K61L | YAGEO | |
| U1 | RPX-1.5Q MODULE | RPX-1.5Q | RECOM | |

PACKAGING INFORMATION

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

Contents

- RPX-1.5Q-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.