

RPX-1.5Q

1.5 Amp QFN Package



Features

Power Module

- AEC-Q100 qualified buck regulator power module with integrated shielded inductor
- 36VDC input voltage, 1.5A output current
- SCP, OCP, OTP, and UVLO protection
- 3.0 x 5.0mm low profile QFN package
- Wettable flanks for optical inspection on request
- Enable, power good, soft start, and sync functions
- -40 to 125°C operating temperature

Description

The RPX-1.5Q is an automotive-grade buck converter with an integrated inductor in a compact 3mm x 5mm x 1.6mm thermally-enhanced QFN package (wetable flank version available on request). The input range is from 4 to 36VDC, allowing 5V, 12V, or 24V supply voltages to be used. The output voltage can be set with two resistors in the range from 0.8 up to 30VDC. The output current is up to 1.5A and is fully protected against continuous short-circuits, output overcurrent, or over-temperature faults.

Selection Guide

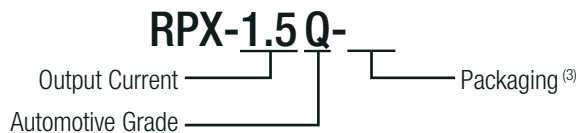
| Part Number | Input Voltage Range [VDC] | Output Voltage ⁽¹⁾ [VDC] | Output Current [mA] | Efficiency typ. ⁽²⁾ [%] |
|-------------|---------------------------|-------------------------------------|---------------------|------------------------------------|
| RPX-1.5Q | 4 - 36 | 0.8 - 30 | 1500 | 87 |

Notes:

Note1: Refer to **"SAFE OPERATING AREA"**

Note2: Efficiency tested at $V_{IN} = 12VDC$, full load, and $V_{OUT} = 3.3VDC$

Model Numbering



Notes:

Note3: Add suffix "-R" for tape and reel packaging

Add suffix "-CT" for bag packaging (refer to **"PACKAGING INFORMATION"**)

Specifications

ABSOLUTE MAXIMUM RATINGS (exceeding these ratings may damage the device)

| Parameter | Symbol | Min. | Typ. | Max. |
|--|---------------------------|---------|------|-------------------|
| Absolute Maximum Voltage | V_{IN} | -0.3VDC | | 40VDC |
| | V_{SW} | -0.3VDC | | $V_{IN} + 0.3VDC$ |
| | V_{OUT} | -0.3VDC | | $V_{IN} + 0.3VDC$ |
| | V_{BST} | | | $V_{SW} + 6VDC$ |
| | others | -0.3VDC | | 6VDC |
| Maximum Continuous Power Losses ⁽⁴⁾ | @ $T_{AMB} = 25^{\circ}C$ | | | 2.7W |
| Junction Temperature | T_J | | | 150°C |
| Lead Temperature | | | | 260°C |
| Storage Temperature | | -65°C | | +150°C |

Notes:

Note4: Maximum power losses = $(150 - T_{amb}) / 46$. Exceeding this value will activate thermal protection.



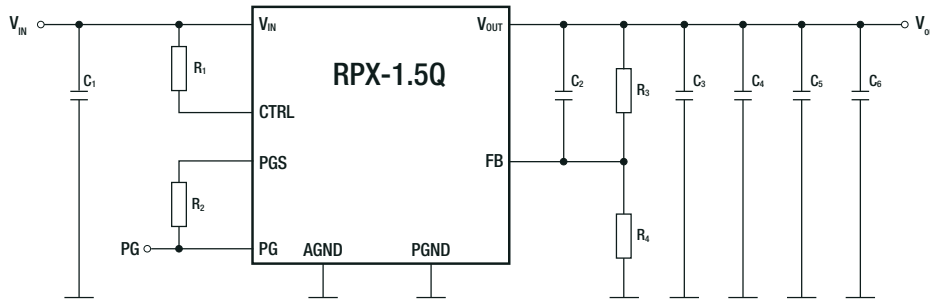
<https://www.recom-power.com/pdf/Eval-Boards/RPX-1.5Q-EVM-1.pdf>

Specifications

OPERATING CONDITIONS ($V_{IN}= 12VDC$, $T_J= -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted, typical values are at $T_J= +25^{\circ}C$)

| Parameter | Condition | Min. | Typ. | Max. |
|---|--|----------------|---------|----------------|
| Input Voltage Range | | 4VDC | | 36VDC |
| V_{IN} Under-voltage Lockout Threshold Rising | | 3VDC | 3.5VDC | 3.8VDC |
| V_{IN} Under-voltage Lockout Threshold Hysteresis | | | 330mV | |
| Output Voltage Range | refer to "SAFE OPERATING AREA" | 0.8VDC | | 30VDC |
| Standby Current | DC-DC OFF | | | 8 μ A |
| Quiescent Current | | | 0.6mA | |
| Switching Frequency | | 1800kHz | 2200kHz | 2600kHz |
| Feedback Voltage | $T_{AMB} = 25^{\circ}C$ $T_{AMB} = -40^{\circ}C$ to $+125^{\circ}C$ | 795mV 790mV | 807mV | 819mV 824mV |
| Feedback Current | $V_{FB}= 820mV$ | | 10nA | 50nA |
| Rise-time | internal soft start | | 1.7ms | |

Typical Application



| C1 (C_{IN}) | R1 | R2 | C2 (C_{FF}) ⁽⁵⁾ | R3 | R4 | C3 - C6 (C_{OUT}) |
|-----------------|---------------|---------------|--------------------------------|--------------|---|-----------------------|
| 10 μ F | 100k Ω | 100k Ω | $V_{out} < 2VDC$, 22pF | 75k Ω | Refer to "OUTPUT VOLTAGE TRIMMING" | 10 μ F |

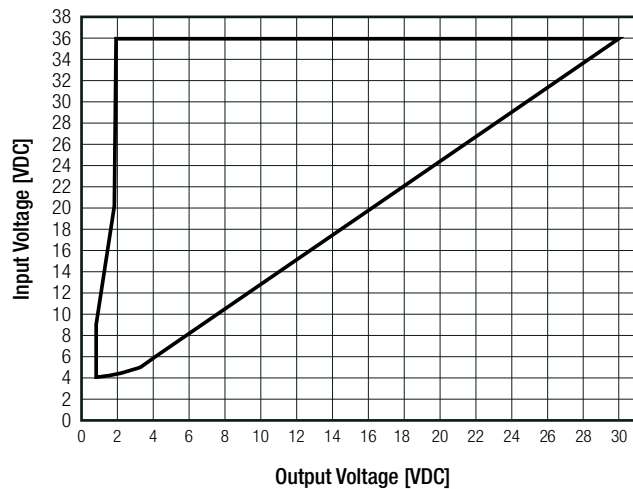
Notes:

Note5: C_2 (C_{FF}) is required for low output voltages (<2VDC)

The typical performance and circuit waveforms are shown in the Typical Performance Characteristics section.

For more device applications, please refer to the related evaluation board datasheet [RPX-1.5Q-EVM-1](#)

SAFE OPERATING AREA



POWER GOOD OPERATING CONDITIONS ($V_{IN}= 12VDC$, $T_J= -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted, typical values are at $T_J= +25^{\circ}C$)

| Parameter | Condition | Min. | Typ. | Max. |
|-------------------|-----------|---------------|---------------|---------------|
| Rising Threshold | | 0.83 V_{FB} | 0.88 V_{FB} | 0.93 V_{FB} |
| Falling Threshold | | 0.78 V_{FB} | 0.83 V_{FB} | 0.88 V_{FB} |

Specifications

CTRL AND SYNC OPERATING CONDITIONS ($V_{IN}= 12VDC$, $T_J= -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted, typical values are at $T_J= +25^{\circ}C$)

| Parameter | Condition | Min. | Typ. | Max. |
|------------------------|------------------|--------|-----------|------------|
| CTRL Rising Threshold | | 1.2VDC | 1.45VDC | 1.7VDC |
| CTRL Falling Threshold | | 0.8VDC | 1VDC | 1.3VDC |
| CTRL Input Current | $V_{CTRL}= 2VDC$ | | 5 μ A | 10 μ A |
| CTRL Turn-off Delay | | | 3 μ s | |
| CTRL Frequency Range | | 450kHz | | 2200kHz |

THERMAL OPERATING CONDITIONS ($V_{IN}= 12VDC$, $T_J= -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted, typical values are at $T_J= +25^{\circ}C$)

| Parameter | Condition | Min. | Typ. | Max. |
|--------------------------------|---------------------------------------|-----------------|-------|-------------------------------|
| Operating Junction Temperature | | -40 $^{\circ}C$ | | +125 $^{\circ}C$ |
| Thermal Impedance | case to ambient | | 46K/W | |
| | junction to case (refer to tc point) | | 10K/W | |
| Thermal Shutdown | Junction Temperature= 170 $^{\circ}C$ | | | auto recovery after cool down |

Notes:

Note6: Tested with RECOM evaluation module: [RPX-1.5Q-EVM-1](#)

OUTPUT VOLTAGE TRIMMING

The external resistor divider sets the output voltage (see *“Typical Application”*). The feedback resistor (R_4) sets the feedback loop bandwidth with the internal compensation capacitor. R_3 should be approximately 75k Ω when $V_{OUT} \geq 1V$. The values for trim resistors shown in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary. R_4 can then be calculated with below equation:

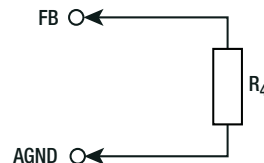
Calculation:

$$R_4 = \frac{R_3}{\frac{V_{OUT}}{0.807V} - 1}$$

Example:

$$R_4 = \frac{75k}{\frac{1.5V}{0.807V} - 1} = 87k33$$

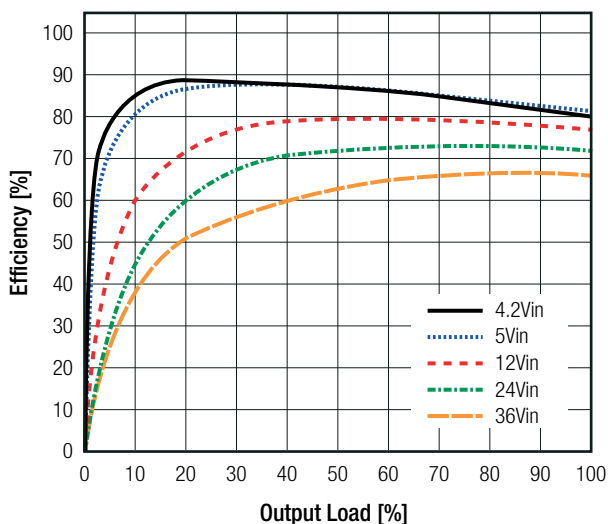
R_4 according to E96 \approx **86k6**



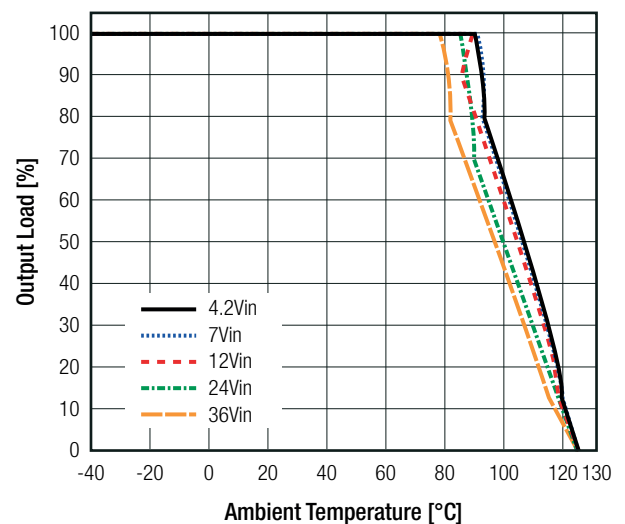
| V_{OUT} | 1.5 | 1.8 | 2.5 | 3.3 | 5 | 12 | 24 | [VDC] |
|-----------------------|------|------|------|------|------|------|------|--------------|
| R_4 (E96) \approx | 86k6 | 60k4 | 35k7 | 24k3 | 14k3 | 5k36 | 2k61 | [Ω] |

TYPICAL PERFORMANCE CHARACTERISTICS ($V_{OUT}= 1.8VDC$, $T_J= +25^{\circ}C$; tested with RECOM evaluation module: RPX-1.5Q-EVM-1)

Efficiency vs. Output current



Thermal Derating

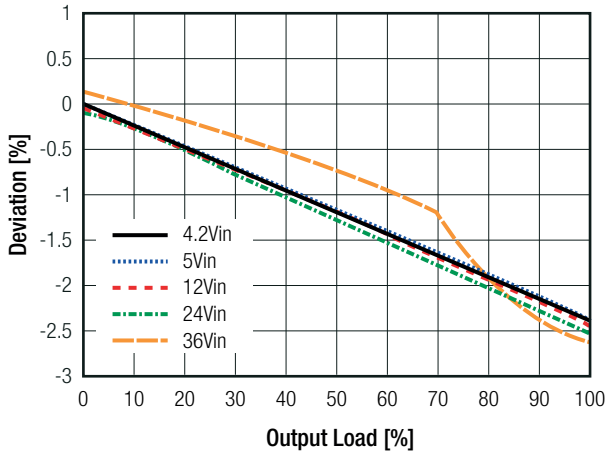


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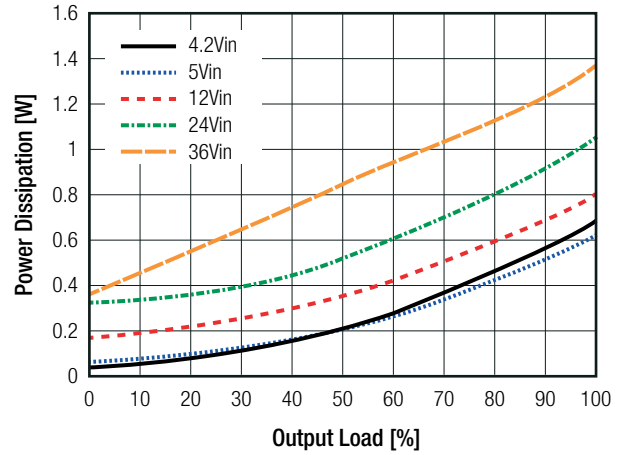
Specifications

TYPICAL PERFORMANCE CHARACTERISTICS ($V_{OUT} = 1.8VDC$, $T_J = +25^\circ C$; tested with RECOM evaluation module: RPX-1.5Q-EVM-1)

Deviation vs. Load

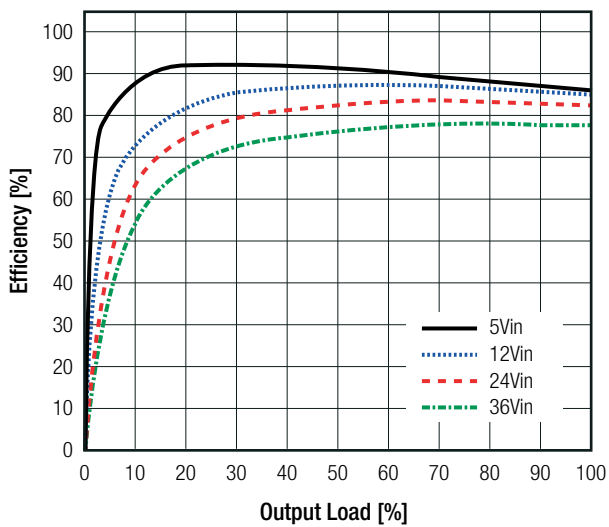


Power Dissipation

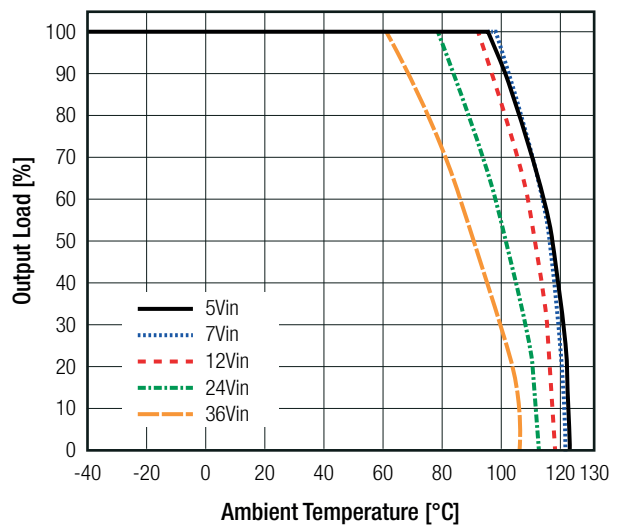


TYPICAL PERFORMANCE CHARACTERISTICS ($V_{OUT} = 3.3VDC$, $T_J = +25^\circ C$; tested with RECOM evaluation module: RPX-1.5Q-EVM-1)

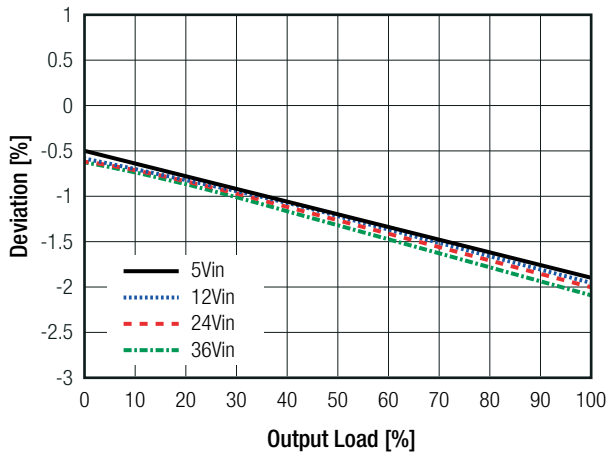
Efficiency vs. Output current



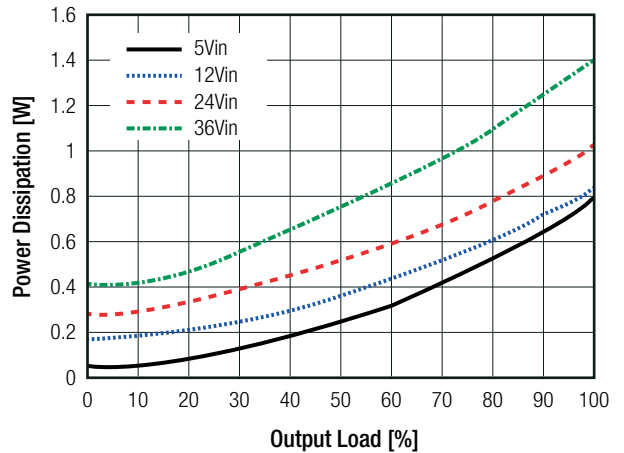
Thermal Derating



Deviation vs. Load



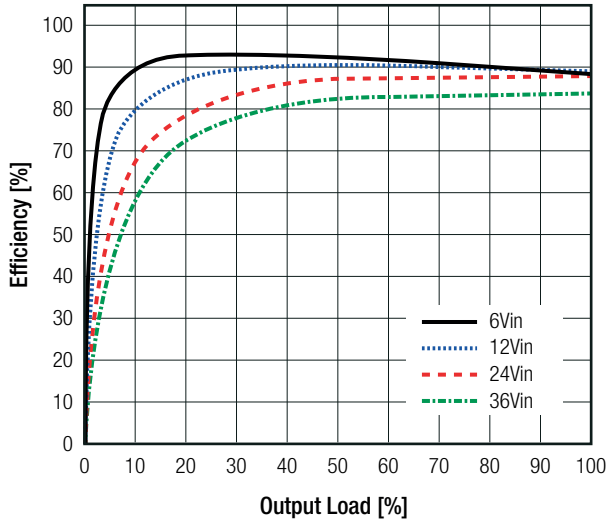
Power Dissipation



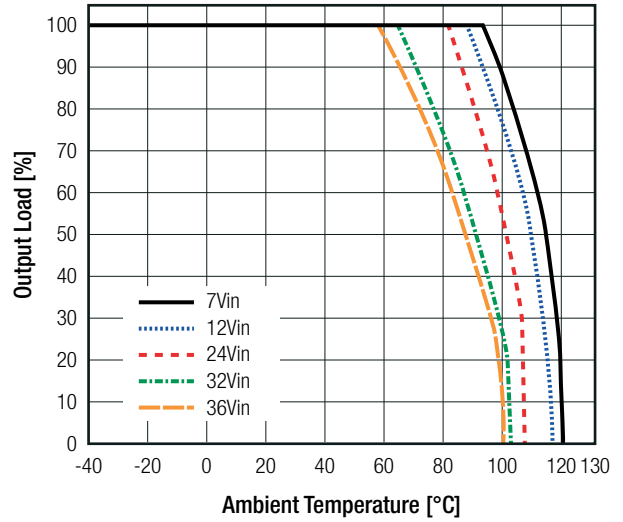
Specifications

TYPICAL PERFORMANCE CHARACTERISTICS ($V_{OUT}= 5VDC, T_J= +25^{\circ}C$; tested with RECOM evaluation module: RPX-1.5Q-EVM-1)

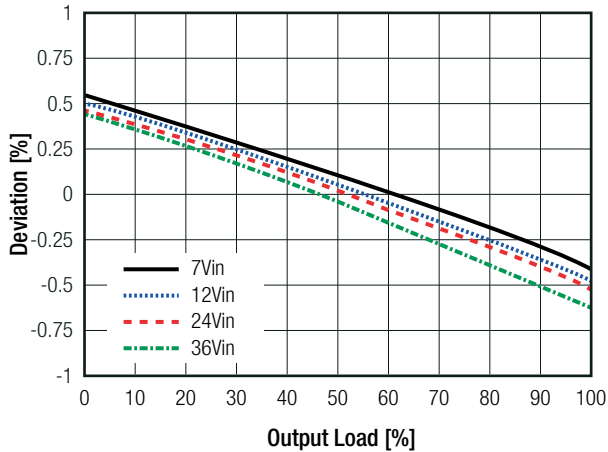
Efficiency vs. Output current



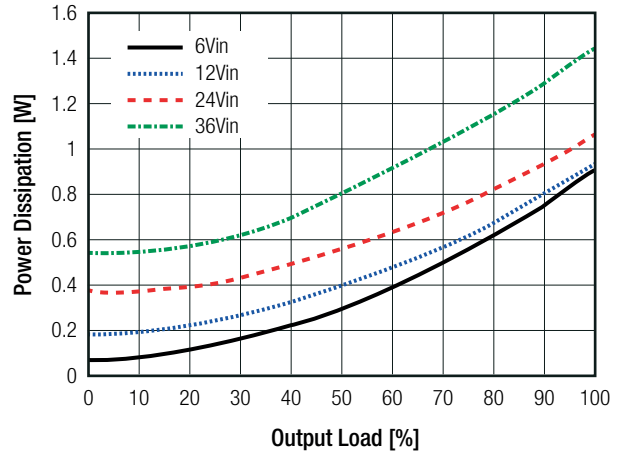
Thermal Derating



Deviation vs. Load

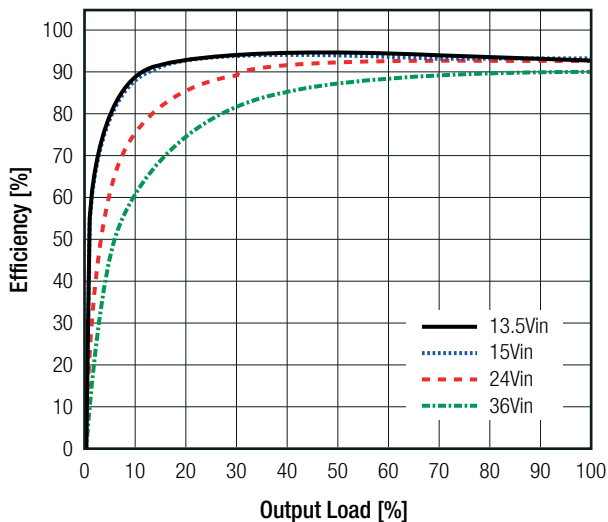


Power Dissipation

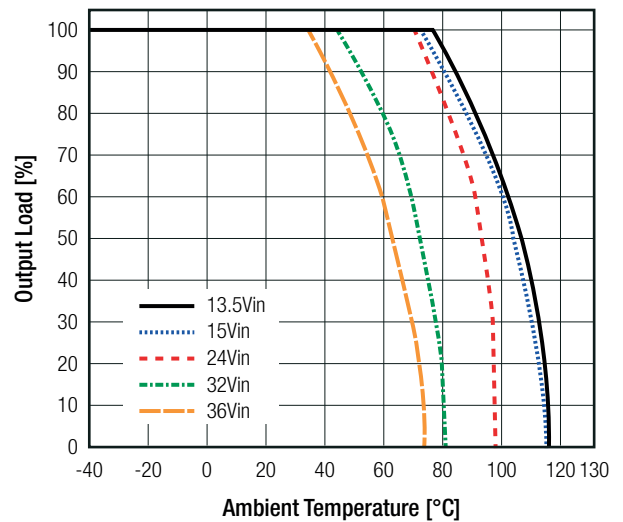


TYPICAL PERFORMANCE CHARACTERISTICS ($V_{OUT}= 12VDC, T_J= +25^{\circ}C$; tested with RECOM evaluation module: RPX-1.5Q-EVM-1)

Efficiency vs. Output current



Thermal Derating

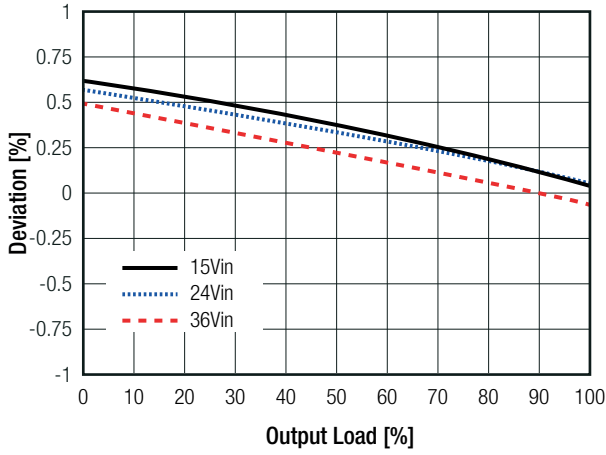


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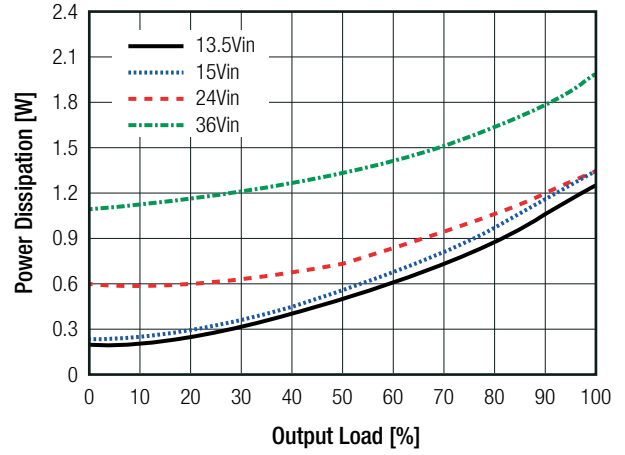
Specifications

TYPICAL PERFORMANCE CHARACTERISTICS ($V_{OUT}= 12VDC$, $T_J= +25^{\circ}C$; tested with RECOM evaluation module: RPX-1.5Q-EVM-1)

Deviation vs. Load

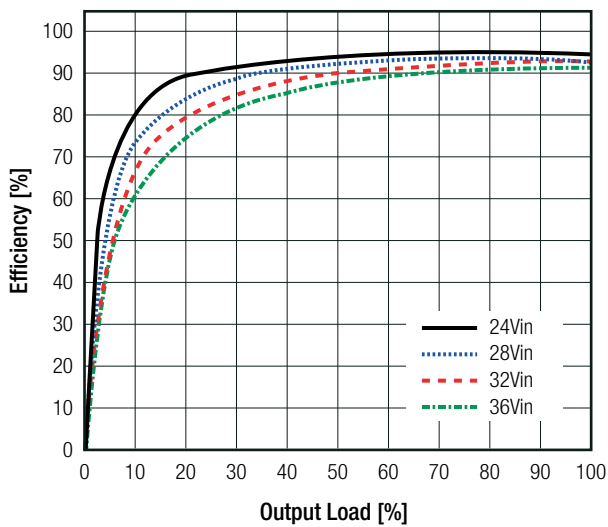


Power Dissipation

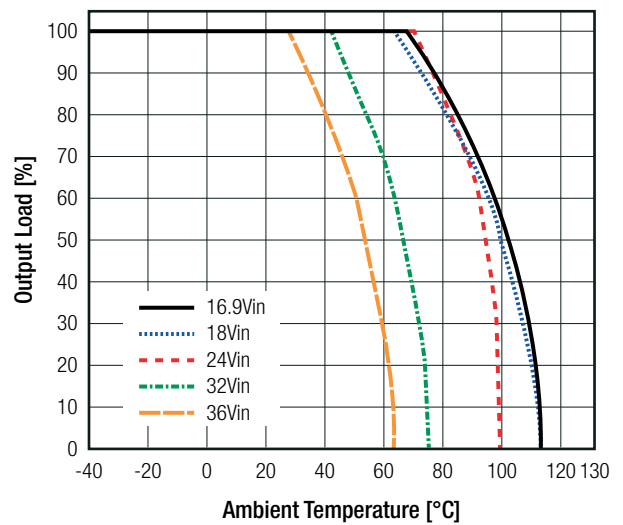


TYPICAL PERFORMANCE CHARACTERISTICS ($V_{OUT}= 15VDC$, $T_J= +25^{\circ}C$; tested with RECOM evaluation module: RPX-1.5Q-EVM-1)

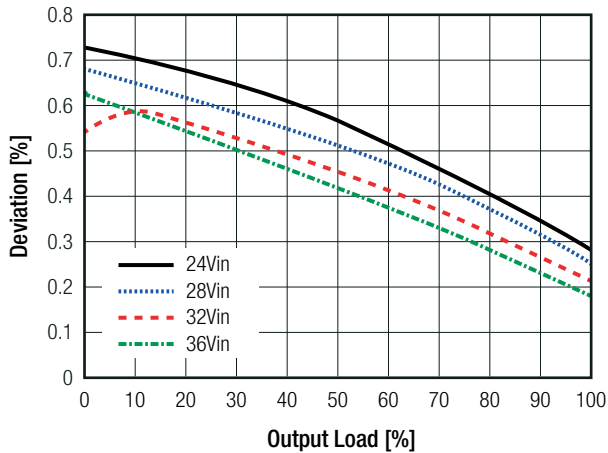
Efficiency vs. Output current



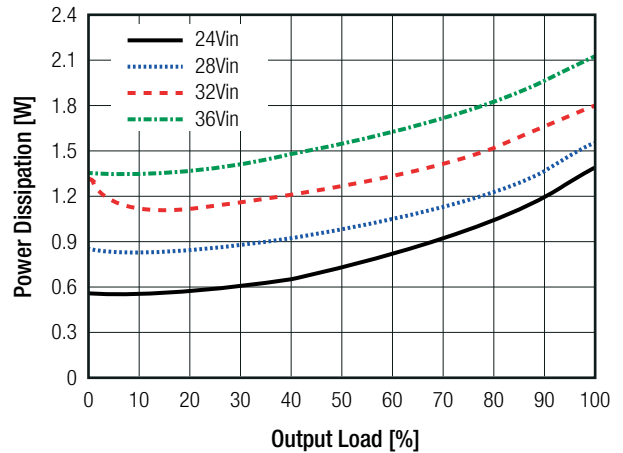
Thermal Derating



Deviation vs. Load

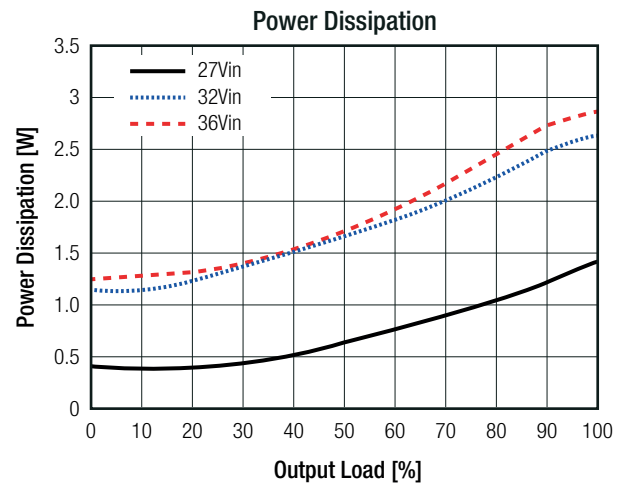
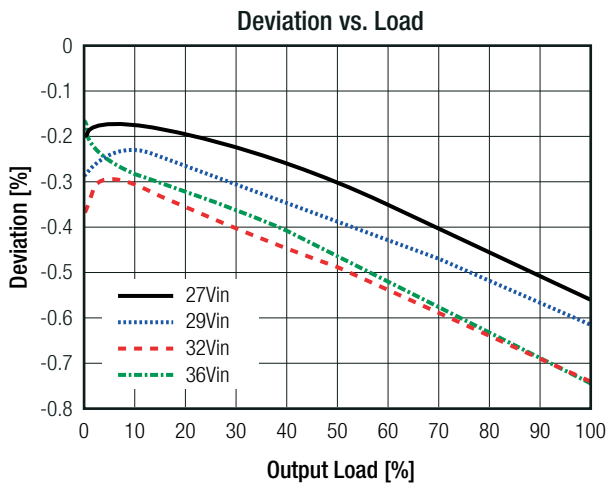
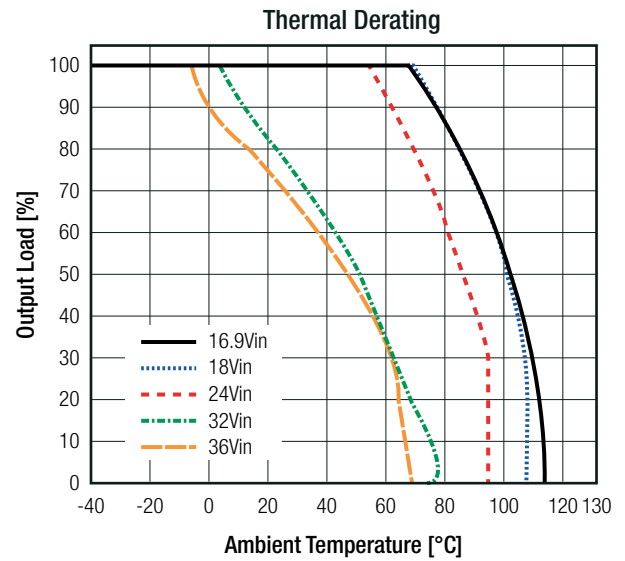
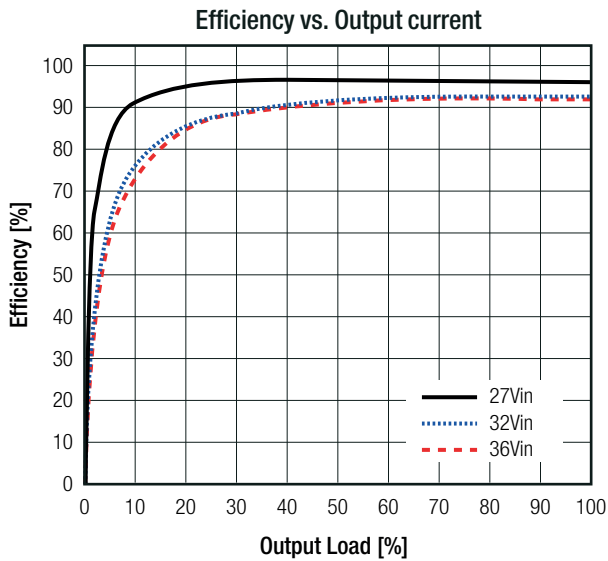


Power Dissipation



Specifications

TYPICAL PERFORMANCE CHARACTERISTICS ($V_{OUT}=24VDC$, $T_J=+25^{\circ}C$; tested with RECOM evaluation module: RPX-1.5Q-EVM-1)



ENVIRONMENTAL

| Parameter | Condition | Value |
|--------------------------|--|------------------------|
| ESD | human-body model (HBM), ANSI/ESDA/JEDEC JS-001 | ±2kV |
| | charged-device model (CDM), JEDEC JESD22-C101 | ±0.75kV |
| Moisture Sensitive Level | MSL peak temp. ⁽⁷⁾ | Level 3, 260°C, 168hrs |

Notes:

Note7: The Moisture Sensitivity Level rating is according to the JEDEC industry standard classifications and peak solder temperature

SAFETY AND CERTIFICATIONS

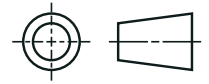
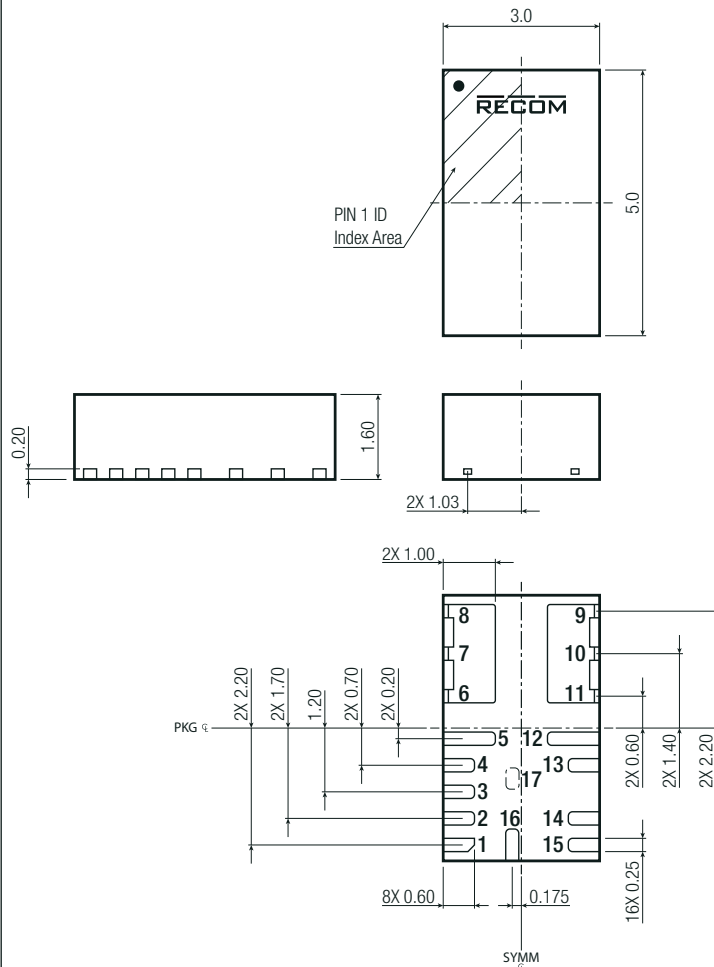
| Certificate Type (Safety) | Standard |
|---------------------------|-----------------------------|
| RoHS2 | RoHS 2011/65EU + AM2015/863 |

Specifications

DIMENSION AND PHYSICAL CHARACTERISTICS

| Parameter | Type | Value |
|-------------------|------|-------------------|
| Material | case | plastic |
| Dimension (LxWxH) | | 3.0 x 5.0 x 1.6mm |
| Weight | | 0.095g |

Dimension Drawing (mm)



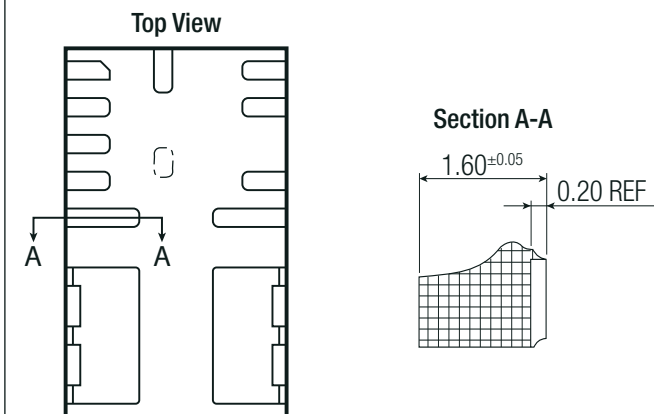
Pad Information

| Pad # | Function | Description |
|----------|---------------|---|
| 1 | PG | Output power good. High = Vout at set level, low = Vout below nominal regulation. Leave floating if not used |
| 2 | CTRL/ SYNC | Pull high to enable the RPX-1.5Q. Leave open or connect to ground to disable the device. Apply external clock to synchronize switching frequency. |
| 3 | FB | Feedback input. Used to set the output voltage between 0.8V and 30VDC. |
| 4 | PGS | Power good source |
| 5 | AGND | Analog ground. Reference ground of logic circuit. AGND is connected to PGND internally. |
| 6,7,8,12 | SW | Switch node. Connect 6, 7, and 8 to large copper pad for optimal heat dissipation. |
| 9,10,11 | Vout | Output Voltage. Connect external capacitor between this pin and GND as close to the pins as possible. |
| 13 | DNC | Do not connect. Must be soldered to an isolated pad. |
| 14,15 | PGND | Power Ground. Connect these pins to the power ground plane on the PCB |
| 16 | Vin | Input Voltage. Connect a low-ESR low-inductance external bypass capacitor between this pin and GND as close to the pins as possible |
| 17 | DNC | Do not connect. Leave Floating |

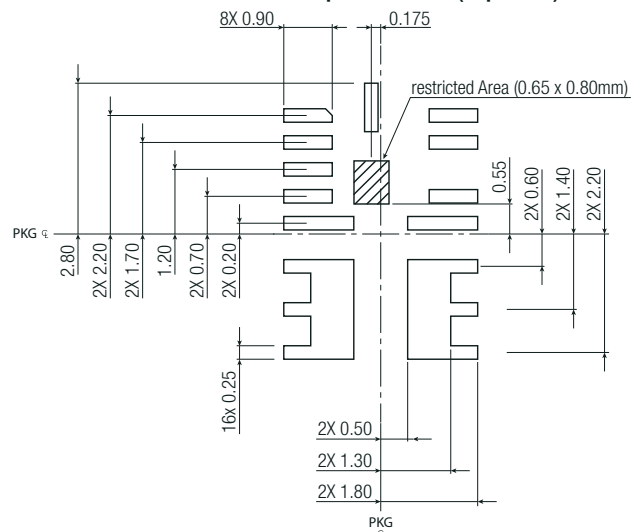
Tolerances: according to JEDEC MO-220

Lead side is wettable and coplanarity shall be 0.10mm max.

Wettable Flank version available on request, please contact RECOM



Recommended Footprint Details (Top View)



Specifications

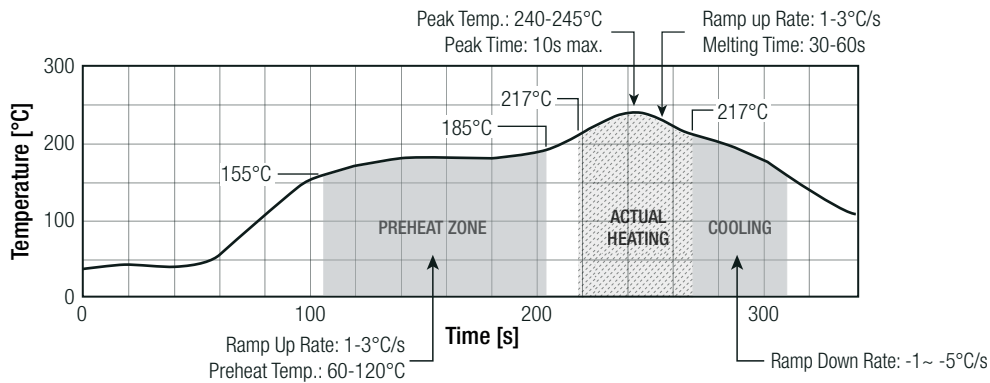
SOLDERING

Wave or Reflow etc.

| Profile Feature | PB-Free Assembly |
|---|------------------|
| Preheat | |
| minimum Temperature (TS_min) | 155°C |
| maximum Temperature (TS_max) | 245°C |
| Time (tS) | 100s-300s |
| Liquidus | |
| Temperature (TL) | 217°C |
| Time (tL) | 30-60s |
| Peak Temperature (TP) | |
| Time remaining around Peak Temperature | 10s |
| max Ramp Down Rate (from Ts_max to TP) | 5K/s |
| max Ramp Up Rate | 3K/s |
| max time from 25°C to Peak Temperature (TP) | 8min |

- 1 Pb-Free assembly is recommended according to JEDEC J-STD020.
- 2 Ensure that the peak reflow temperature does not exceed 240°C ±5°C as per JEDEC J-STD020
- 3 The reflow time period during peak temperature of 240°C ±5°C should not exceed 30 seconds.
- 4 Reflow time above liquids (217°C) should not exceed 150 seconds.
- 5 For solder paste use a standard SAC Alloy such as SAC 305, type 3 or higher.
- 6 Other soldering methods (e.g. vapor-phase) are not verified and have to validate by the customer on his own risk.

Soldering temp. graph



PCB LAYOUT SUGGESTION

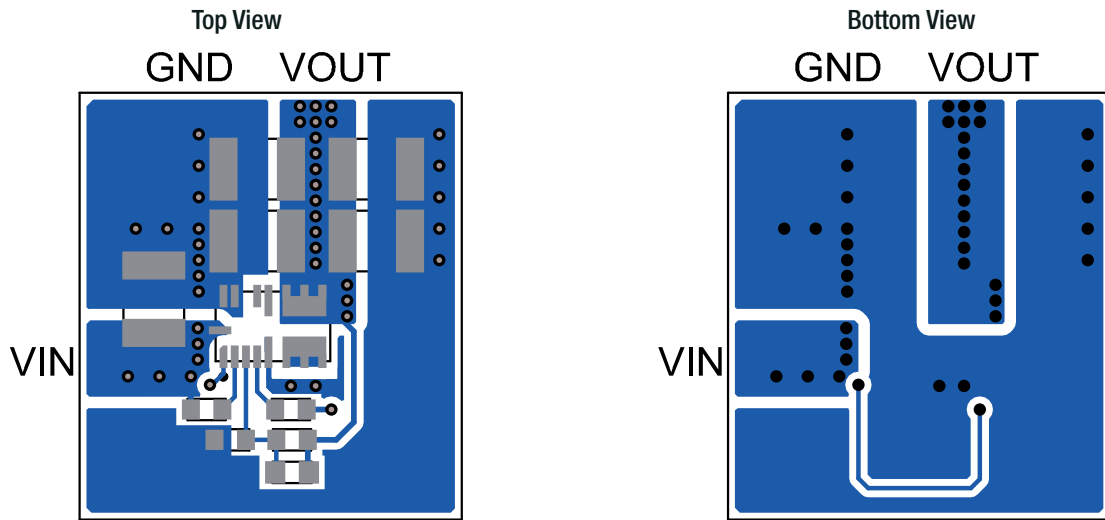
Efficient PCB layout, especially of the input capacitor placement, is critical for stable operation. For best results, refer to Figure 6, and follow the guidelines below.

1. Connect a large ground plane to PGND pins 14 and 15 directly. If the bottom layer is a ground plane, add vias near GND.
2. Ensure that the high-current paths at GND and VIN have short, direct, and wide traces.
3. Place the ceramic input capacitor close to VIN and GND.
4. Keep the connection of the input capacitor and VIN as short and wide as possible.
5. Place the external feedback resistors next to FB and AGND.
6. Feedback and switch node should be placed as far away from one another as possible.

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Specifications

PCB LAYOUT SUGGESTION



PACKAGING INFORMATION

| Parameter | Type | Value |
|-----------------------------|------------------------------|------------------------|
| Packaging Dimension (LxWxH) | reel (diameter + width) | Ø177.8 x 12.4mm |
| | tape and reel (carton) | 260.0 x 240.0 x 60.0mm |
| | moisture barrier bag ("-CT") | 100.0 x 100.0 x 30mm |
| Packaging Quantity | tape and reel | 500pcs |
| | moisture barrier bag ("-CT") | 10pcs |
| Tape Width | | 12mm |
| Storage Temperature Range | | -65°C to +150°C |

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