

RPZ-6.0 Series / Power Module

6.0 Amp / 2.75-7.0VDC / 24 Pad QFN Package

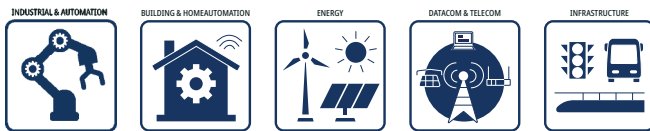
FEATURES

- Buck regulator power module with integrated shielded inductor
- 7V maximum input voltage
- Programmable 0.6 - 6.65V output voltage
- 6A maximum output current
- SCP, OCP, OTP, and UVLO protection
- 4mm x 6mm x 1.6mm QFN package
- Flip-Chip technology for improved thermal management
- Efficiency up to 90%



Dimensions (LxWxH): 4.0 x 6.0 x 1.6mm (0.157 x 0.236 x 0.063inch)
0.1g (0.0002lbs)

APPLICATIONS



SAFETY & EMC



DESCRIPTION

The RPZ-6.0 series is a cutting-edge non-isolated step-down power module meticulously crafted for electronic designs across a diverse spectrum of applications. This versatile module is poised to empower microcontrollers, sensors, embedded systems, portable electronics, IoT devices, consumer electronics, and medical devices with efficient and reliable power. The RPZ-6.0 is a buck regulator power module featuring an integrated shielded inductor, ensuring optimal performance and ease of use in various scenarios. With a maximum input voltage of 7V, this module strikes the perfect balance between adaptability and efficiency, providing a stable and reliable power source for a wide array of applications. Designed for flexibility, the RPZ-6.0 allows for programmable output voltages ranging from 0.6V to 6.65V. This adaptability makes it an ideal choice for applications with varying power requirements, enabling seamless integration into designs that demand precision and customization. Delivering a robust 6A maximum output current, the RPZ-6.0 is engineered to meet the dynamic needs of modern electronics. Safety is paramount, and this module is equipped with Short Circuit Protection (SCP), Overcurrent Protection (OCP), Overtemperature Protection (OTP), and Undervoltage Lockout (UVLO) features, ensuring the longevity and safeguarding of connected devices. Housed in a compact 4mm x 6mm x 1.6mm QFN package, the RPZ-6.0 is designed to optimize space efficiency without compromising performance. The integration of Flip-Chip technology enhances thermal management, ensuring the module operates at peak efficiency even in demanding conditions. With an efficiency rating of up to 90%, the RPZ-6.0 not only meets but exceeds industry standards. This high efficiency not only minimizes energy consumption but also reduces heat generation, contributing to the overall reliability and extended lifespan of the module.

SELECTION GUIDE

| Part Number | Input Voltage | Output Voltage | Output Current | Efficiency ⁽¹⁾ |
|-------------|---------------|----------------|----------------|---------------------------|
| | Range [VDC] | Range [VDC] | max. [mA] | typ. [%] |
| RPZ-6.0 | 2.75 - 7.0 | 0.6 - 6.65 | 6000 | 90 |

Note1: Efficiency is tested at $V_{IN}= 6VDC$, full load and $V_{OUT}= 3.3VDC$

MODEL NUMBERING

RPZ-6.0- _____
 Output Current _____ Packaging ⁽²⁾

Note2: Add suffix "-R" for tape and reel packaging
 Add suffix "-CT" for bag packaging (refer to „Packaging Information“)

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ABSOLUTE MAXIMUM RATINGS (measured @ $T_{AMB} = 25^{\circ}C$, nom. V_{IN} , full load and after warm-up unless otherwise stated)

| Parameter | Symbol | Min. | Typ. | Max. |
|--|--------------------------|---------|------|-------------------|
| Absolute maximum voltage | V_{IN} | -0.3VDC | | 8VDC |
| | V_{SW} | -0.3VDC | | $V_{IN} + 0.7VDC$ |
| | V_{BST} | | | $V_{SW} + 4VDC$ |
| | others | -0.3VDC | | 4VDC |
| Maximum continuous power losses ⁽³⁾ | $T_{AMB} = +25^{\circ}C$ | | | 4.8W |
| Junction Temperature | T_J | | | +150 $^{\circ}C$ |
| Lead Temperature | | | | +260 $^{\circ}C$ |

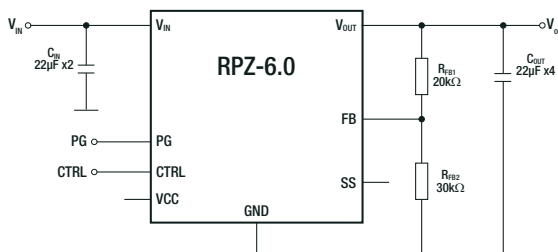
Note3: Exceeding maximum allowable power dissipation causes device to enter thermal shutdown which protects device from permanent damage.

BASIC CHARACTERISTICS (measured @ $T_{AMB} = 25^{\circ}C$, $V_{IN} = 5VDC$, full load and after warm-up unless otherwise stated)

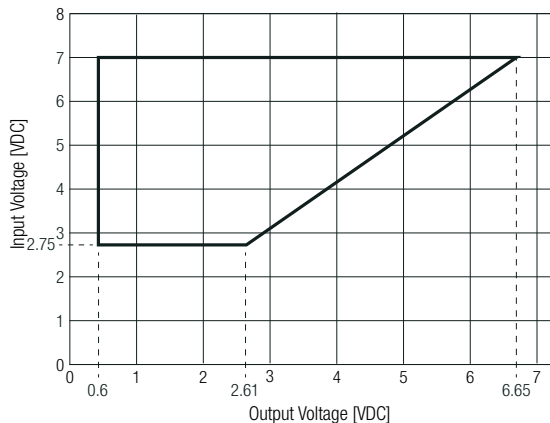
| Parameter | Symbol | Condition | Min. | Typ. | Max. |
|-------------------------|-----------|---|-----------|-------------|-------------|
| Input Voltage Range | V_{IN} | refer to „Safe Operating Area“ | 2.75VDC | | 7VDC |
| Quiescent current | I_Q | $V_{CTRL} = 2VDC$, $V_{FB} = 0.65VDC$ | | 105 μA | 150 μA |
| Output Voltage Range | V_{OUT} | refer to „Safe Operating Area“ | 0.6VDC | | 6.65VDC |
| Standby current | I_{IN} | $V_{CTRL} = 0VDC$, $T_J = 25^{\circ}C$ | | 2 μA | 5 μA |
| Feedback voltage | V_{FB} | $T_J = 25^{\circ}C$ | 594mV | 600mV | 606mV |
| | | $T_J = -40^{\circ}C$ to $125^{\circ}C$ | 591mV | 600mV | 609mV |
| Feedback current | | $V_{FB} = 0.7VDC$ | | 10nA | 50nA |
| Valley Current Limit | | | 6A | 7A | |
| Short hiccup duty cycle | | | | 10% | |
| Maximum duty cycle | | | | 95% | |
| Minimum On Time | | | | 50ns | |
| Minimum Off Time | | | | 100ns | |
| Soft Start current | | | 4 μA | 6 μA | 8 μA |

Typical Application

$V_{IN} = 2.75-7VDC$, $V_{OUT} = 1VDC$, $I_{OUT} = 6A$



Safe Operating Area



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| CTRL OPERATING CONDITIONS (measured @ $T_{AMB}= 25^{\circ}\text{C}$, $V_{IN}= 5\text{VDC}$, full load and after warm-up unless otherwise stated) | | | | | |
|--|--------|-----------|---------|---------------|---------|
| Parameter | Symbol | Condition | Min. | Typ. | Max. |
| CTRL input logic low voltage | | | 1.19VDC | 1.23VDC | 1.27VDC |
| CTRL input logic high voltage | | | 0.96VDC | 1VDC | 1.04VDC |
| CTRL pin pull-down resistor | | | | 3.3M Ω | |

| POWER GOOD OPERATING CONDITIONS (measured @ $T_{AMB}= 25^{\circ}\text{C}$, $V_{IN}= 3.6\text{VDC}$, full load and after warm-up unless otherwise stated) | | | | | |
|--|--------|-----------------------|---------|------------------|------------------|
| Parameter | Symbol | Condition | Min. | Typ. | Max. |
| UV rising threshold | | | 0.85VDC | 0.9VDC | 0.95VDC |
| UV falling threshold | | | 0.75VDC | 0.8VDC | 0.85VDC |
| OV rising threshold | | | 1.15VDC | 1.2VDC | 1.25VDC |
| OV falling threshold | | | 1.05VDC | 1.1VDC | 1.15VDC |
| Delay | | both edges | | 50 μs | |
| Sink current capability | | sink 1mA | | | 0.4VDC |
| Leakage current | | $V_{PG}= 5\text{VDC}$ | | | 10 μA |

| SWITCHING CHARACTERISTICS (measured @ $T_{AMB}= 25^{\circ}\text{C}$, nom. V_{IN} , full load and after warm-up unless otherwise stated) | | | | | |
|--|----------|---|--------|--------|-----------------|
| Parameter | Symbol | Condition | Min. | Typ. | Max. |
| Switching Frequency | f_{SW} | | 0.9MHz | 1.2MHz | 1.6MHz |
| Switch leakage | V_{SW} | $V_{CTRL}= 0\text{VDC}$, $V_{SW}= 7\text{VDC}$ | | | 5 μA |

| VCC CONDITIONS (measured @ $T_{AMB}= 25^{\circ}\text{C}$, $V_{IN}= 5\text{VDC}$, full load and after warm-up unless otherwise stated) | | | | | |
|---|--------|-----------------------|--------|--------|--------|
| Parameter | Symbol | Condition | Min. | Typ. | Max. |
| VCC regulator | | $V_{IN}= 5\text{VDC}$ | | 3.5VDC | |
| VCC load regulation | | $I_{CC}= 5\text{mA}$ | | 3% | |
| VCC UVLO rising threshold | | | 2.4VDC | 2.5VDC | 2.6VDC |
| VCC UVLO threshold hysteresis | | | | 200mV | |

| PROTECTIONS (measured @ $T_{AMB}= 25^{\circ}\text{C}$, nom. V_{IN} , full load and after warm-up unless otherwise stated) | | | | | |
|--|------------------------|-----------------------|-----------------------------|--|--|
| Parameter | Condition | Value | | | |
| Short Circuit Protection SCP | | hiccup, auto recovery | | | |
| Over Current Protection OCP | | hiccup, auto recovery | | | |
| Thermal shutdown | restart after cooldown | junction temperature | 150 $^{\circ}\text{C}$ typ. | | |
| | | hysteresis | 20 $^{\circ}\text{C}$ typ. | | |

| THERMAL OPERATING CONDITIONS (measured @ $T_{AMB}= 25^{\circ}\text{C}$, nom. V_{IN} , full load and after warm-up unless otherwise stated) | | | | | |
|---|------------|-----------------------------|------------------------|------|-------------------------|
| Parameter | Symbol | Condition | Min. | Typ. | Max. |
| Operating Junction Temperature | T_J | refer to „Thermal Derating“ | -40 $^{\circ}\text{C}$ | | +125 $^{\circ}\text{C}$ |
| Thermal Resistance ⁽⁴⁾ | R_{thJA} | junction to ambient | | | 25.99K/W |
| | R_{thJC} | junction to case | | | 7.18K/W |

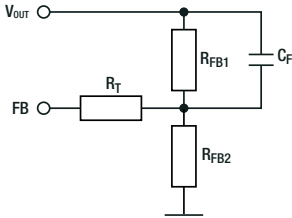
Note4: Test PCB= 6.4 x 6.4cm double sided PCB with 20oz copper, natural convection

| ENVIRONMENTAL | | | | | |
|--------------------------|----------------------|--|--|--|--|
| Parameter | Condition | Value | | | |
| Electrostatic discharge | human body model | 2kVDC | | | |
| | charged device model | 2kVDC | | | |
| Moisture Sensitive Level | | Level 3, 245 $^{\circ}\text{C}$, 168hrs | | | |

OUTPUT VOLTAGE SETTING

The RPZ-6.0 series offers the feature of trimming the output voltage by using external trim resistors (see „**Typical Application**“). The external resistor divider is used to set the output voltage. First, choose a value for R_{FB2} . R_{FB2} should be chosen carefully, as too small a value leads to considerable quiescent current loss while too great a value makes FB noise sensitive. It is recommended to choose a value between 2k Ω and 100k Ω for R_{FB2} . Typically, setting the current through R_{FB2} to less than 250 μ A provides a good balance between system stability and minimal load loss. Then R_{FB1} can be calculated with Equation:

Feedback Network



Calculation:

$$R_{FB1} = \frac{V_{out} - V_{ref}}{V_{ref}} * R_{FB2}$$

Practical example with $V_{out} = 1.8VDC$

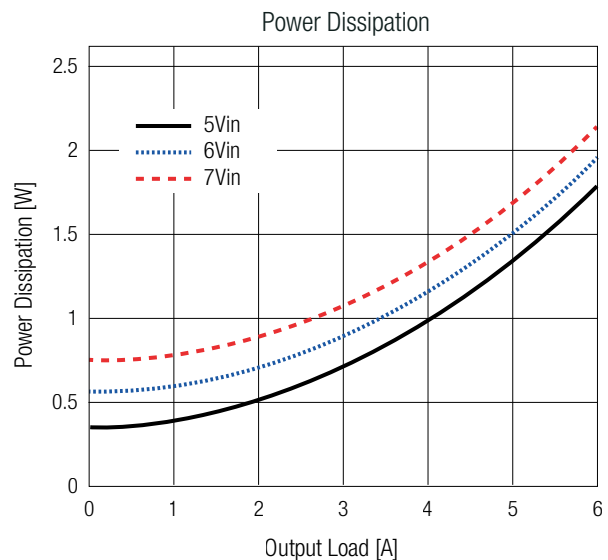
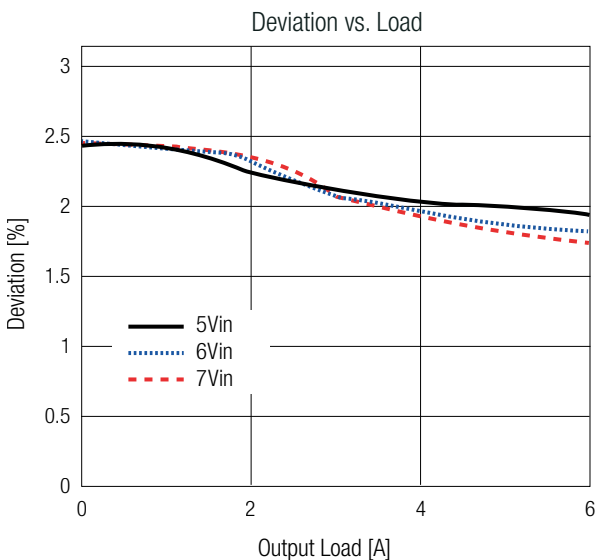
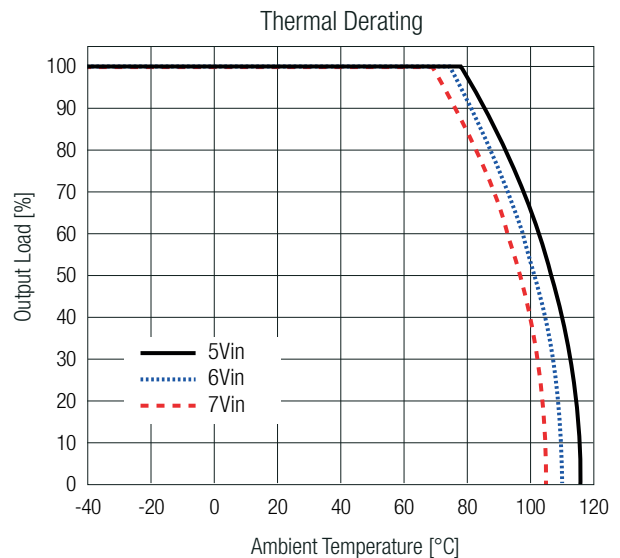
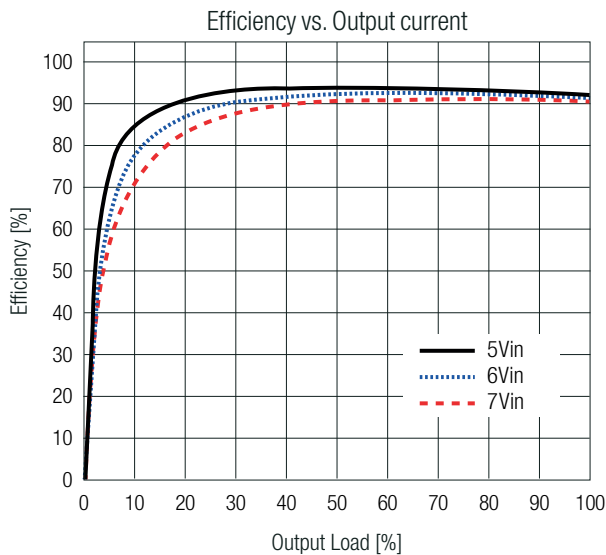
$$R_{FB1} = \frac{1,8V - 0,6V}{0,6V} * 10k\Omega = 20k\Omega$$

Table below lists recommended resistor values for common V_{out} :

| V_{out} [VDC] | R_{FB1} [Ω] | R_{FB2} [Ω] | CF [pF] | RT [Ω] |
|-----------------|------------------------|------------------------|---------|-----------------|
| 1.0 | 20k | 30k | 39 | 0 |
| 1.2 | | 20k | | |
| 1.5 | | 13k | | |
| 1.8 | | 10k | | |
| 2.5 | | 6k34 | | |
| 3.3 | | 4k42 | | |

*(according to E96)

TYPICAL PERFORMANCE CHARACTERISTICS (measured @ $T_{AMB} = 25^{\circ}C$, $V_{out} = 3.3VDC$)



SAFETY & CERTIFICATIONS

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

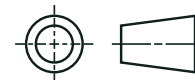
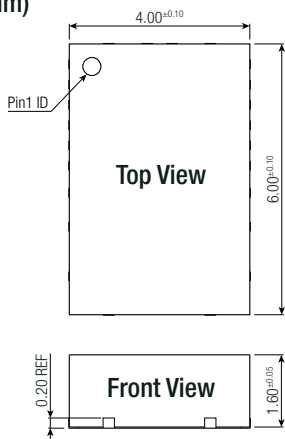
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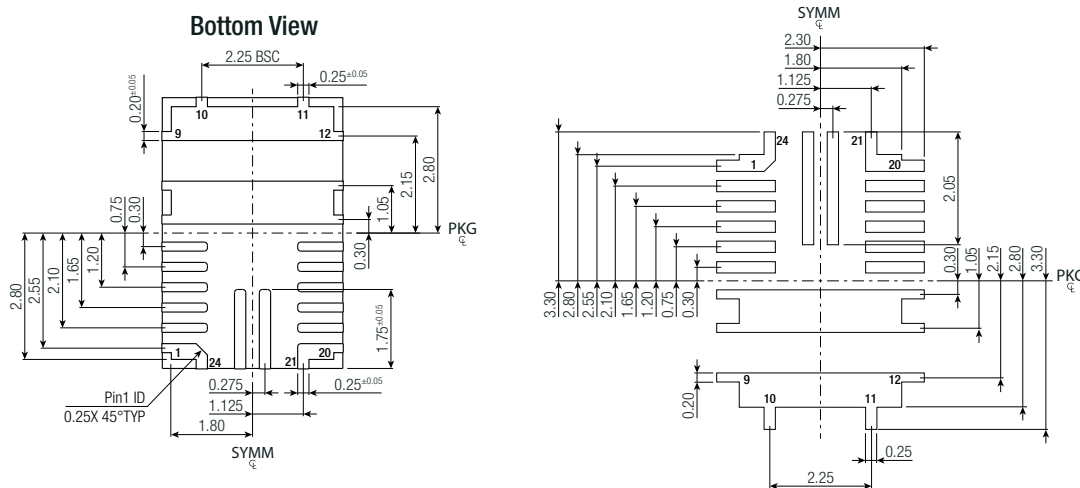
DIMENSION & PHYSICAL CHARACTERISTICS

| Parameter | Type | Value |
|-------------------|------|--|
| Material | case | plastic |
| Dimension (LxWxH) | | 4.0 x 6.0 x 1.6mm 0.157 x 0.236 x 0.063inch |
| Weight | | 0.1g typ. 0.0002lbs |

Dimension Drawing (mm)



Recommended Footprint Details (Top View)



Pad Information

| Pad # | Function | Description |
|-------------------|----------|--|
| 1, 2, 3, 4, 5, 24 | PGND | System Ground. This pin is the reference ground of the regulated output voltage. Because of this, extra care must be taken when laying out the PCB. It is recommended to connect this pin to GND with copper and vias. |
| 6 | VCC | Internal bias supply output. |
| 7, 8, 13, 14, 23 | SW | Switch output. This pin can be left floating. |
| 9, 10, 11, 12 | OUT | Output pin. Connect this pin to COUT. |
| 15 | BST | Bootstrap. Internal capacitor connected between SW and BST pins to form a floating supply across the high-side switch driver. |
| 16 | CTRL | Enable. Pull CTRL high to enable the part. When floating, CTRL is pulled down to FND by internal 3.3MΩ resistor and is disabled. |
| 17 | FB | Feedback. Sets the output voltage when connected to the tap of an external resistor divider that is connected between output and GND. |
| 18 | AGND | Signal ground. AGND is not internally connected to PGND, so ensure that AGND is connected to PGND in the PCB layout. |
| 19 | SS | Soft start. Connect a capacitor across SS and GND to set the soft-start time and avoid start-up inrush current. This pin includes an internal 22nF SS capacitor. |
| 20, 21 | PG | Power good output. The output of this pin is an open-drain output. Its state changes UVP, OCP, OTP or OV occurs. |
| 22 | VIN | Supply Voltage. The part operates from a 2.75V to 7V input rail. C1 is necessary to decouple the input rail. Use a wide PCB trace to make the connection. |

Tolerances:
x.x= ±0.1mm
x.xx= ±0.05mm

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PACKAGING INFORMATION

| Parameter | Type | Value |
|-----------------------------|----------------------------------|------------------------|
| Packaging Dimension (LxWxH) | Suffix -R: tape & reel | 355.6 x 355.6 x 50.8mm |
| | | 14.0 x 14.0 x 2.0inch |
| | Suffix -CT: moisture barrier bag | 100 x 100 x 30mm |
| | | 3.94 x 3.94 x 1.18inch |
| Packaging Quantity | Suffix -R: tape & reel | 500pcs. |
| | Suffix -CT: moisture barrier bag | 10pcs. |
| Storage Temperature Range | | -65°C to +150°C |
| Storage Humidity | non-condensing | 60% RH max. |

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