# Features

# Power Module

- AEC-Q100 qualified constant current power module with integrated shielded inductor
- 36VDC input voltage buck regulator
- 1.5A output current with 0-100% PWM dimming
- SCP, OCP, OTP, and UVLO protection
- 3.0 x 5.0mm low profile QFN package
- Enable, fault, thermal shutdown & soft start functions
- -40 to 125°C operating temperature

RECOM

DC/DC Converter

# RPY-1.5Q

## 1.5 Amp QFN Package

3 YEAR warranty




## Description

The RPY-1.5Q is an automotive grade constant current source buck regulator designed for driving high power LEDs. The integrated inductor means that a complete LED driver can be realized in a compact 3mm x 5mm x 1.6mm thermally-enhanced QFN package with a maximum current output of up to 1500mA set with an external sense resistor. The input voltage range is from 4 to 36VDC, allowing 5V, 12V, or 24V supply voltages to be used. The output is fully protected against continuous short-circuits, input under-voltage, output overcurrent, or over-temperature conditions. A fault indicator flags thermal shutdown or LED open/short circuit conditions. Applications include dimmable LED lighting, visible or IR LED illumination for drones and robotic camera systems, or precision high current CC sources for test and measurement use.

## Selection Guide

| Part Number | Input Voltage Range [VDC] | Output Voltage [VDC] | Output Current [mA] | Efficiency typ. (1) [%] |
|---|---|---|---|---|
| RPY-1.5Q | 4 - 36 | 0.8 - 34.8 | 0-1500 | 95 |

**Notes:**

Note1: Tested at $V_{IN}$= 36VDC, $V_{CTRL/DIM}$= 2VDC, $V_{OUT}$= 2x 3VDC or 2 series LED, $I_{OUT}$= 1.5A, $f_{SW}$= 2.2MHz

## Model Numbering

**RPY-1.5 Q-**

- 1.5 → Output Current
- Q → Automotive Grade
- - → Packaging (2)

**Notes:**

Note2: 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 |
| | $V_{CTRL/DIM}$ | -0.3VDC | | 6VDC |
| | $V_{SW}$ | -0.3VDC | | $V_{IN}$ + 0.3VDC |
| | $V_{OUT}$ | -0.3VDC | | $V_{IN}$ + 0.3VDC |
| | $V_{BST}$ | -0.3VDC | | $V_{SW}$ + 6VDC |
| | others | -0.3VDC | | 6VDC |
| Maximum Continuous Power Losses (3) | @ $T_{AMB}$ = 25°C | | | 2.7W |
| Junction Temperature | $T_J$ | | | 150°C |
| Lead Temperature | | | | 260°C |
| Storage Temperature | | -65°C | | +150°C |

**Notes:**

Note3: Maximum power losses = (150-Tamb)/46. Exceeding this value will activate thermal protection.

EVAL BOARD available

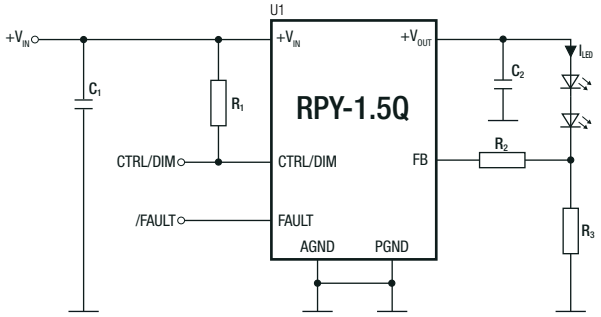
https://www.recom-power.com/pdf/Eval-Boards/RPY-1.5QQ-EVM-1.pdf

## Specifications

### OPERATING CONDITIONS ($V_{IN}$= 36VDC, $I_{OUT}$= 1.5A $T_{AMB}$= +25°C; tested with RECOM evaluation module: RPY-1.5Q-EVM-1 unless otherwise stated)

| Parameter | Condition | Min. | Typ. | Max. |
|---|---|---|---|---|
| Input Voltage Range | | 4VDC | | 36VDC |
| $V_{IN}$ Under-voltage Lockout Threshold | DC-DC ON | 3.2VDC | 3.5VDC | 3.8VDC |
| | DC-DC OFF | 2.8VDC | 3.1VDC | 3.4VDC |
| $V_{IN}$ Under-voltage Lockout Threshold Hysteresis | | | 400mV | |
| Output Voltage Range | | 0.8VDC | | 34.8VDC |
| Standby Current | DC-DC OFF | | | 12µA |
| Switching Frequency | | 1800kHz | 2200kHz | 2600kHz |
| Feedback Voltage | $T_{AMB}$ = 25°C | 192mV | 200mV | 208mV |
| | $T_{AMB}$ = -40°C to +125°C | 184mV | 200mV | 216mV |
| Feedback Current | $V_{FB}$= 820mV | | 30nA | 100nA |
| Start-up Time | | 46ms | | |
| Rise-time | internal soft start | | 0.9ms | |

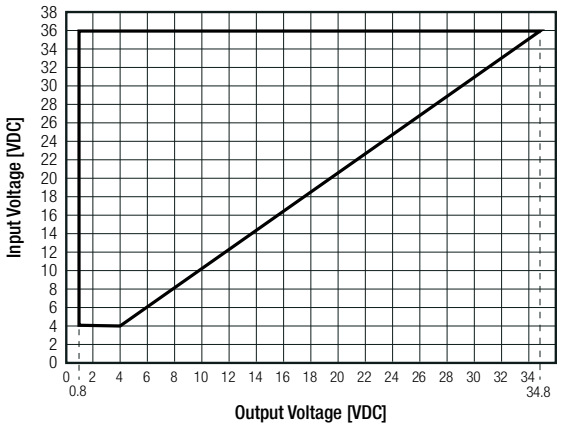
### Typical Application




| C1 ($C_{IN}$) | $R_1$ | $R_2$ | $R_3$ | $C_2$ ($C_{OUT}$) |
|---|---|---|---|---|
| 10µF | 1MΩ | 100kΩ | 400mΩ | 10µF |

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 RPY-1.5Q-EVM-1

### SAFE OPERATING AREA




### CTRL OPERATING CONDITIONS ($V_{IN}$= 36VDC, $I_{OUT}$= 1.5A $T_{AMB}$= +25°C; tested with RECOM evaluation module: RPY-1.5Q-EVM-1 unless otherwise stated)

| Parameter | Condition | Min. | Typ. | Max. |
|---|---|---|---|---|
| CTRL Rising Threshold | | 1.1VDC | 1.45VDC | 1.8VDC |
| CTRL Falling Threshold | | 0.7VDC | 1VDC | 1.3VDC |
| CTRL Input Current | $V_{CTRL}$= 2VDC | | 5nA | 10nA |
| CTRL Frequency Range (4) | | 100Hz | | 2kHz |
| CTRL OFF delay | | 10ms | 25ms | 50ms |

**Notes:**

Note4: Apply an external, 100Hz to 2kHz, PWM waveform to EN/DIM for PWM dimming. The average current is proportional to the PWM duty. The minimum amplitude of the PWM signal is 1.8V.

## Specifications

### FAULT

| Parameter | Condition | Min. | Typ. | Max. |
|---|---|---|---|---|
| FAULT Over Voltage Detection | | | 140% | |
| FAULT Over Voltage Detection Hysteresis | | | 20% | |
| FAULT Detection Delay | | | 10µs | |
| FAULT Sink Current Capability | | | 0.4VDC | |
| FAULT Leakage Current | | | 100nA | |

The RPY-1.5Q has fault indication (FAULT) which is the open drain of a MOSFET and should be connected to VCC or another voltage source through a resistor (e.g. 100kΩ). FAULT is pulled high during normal operation. During the error conditions of output short circuit, open circuit, or thermal shutdown, FAULT is pulled down to indicate a fault status.

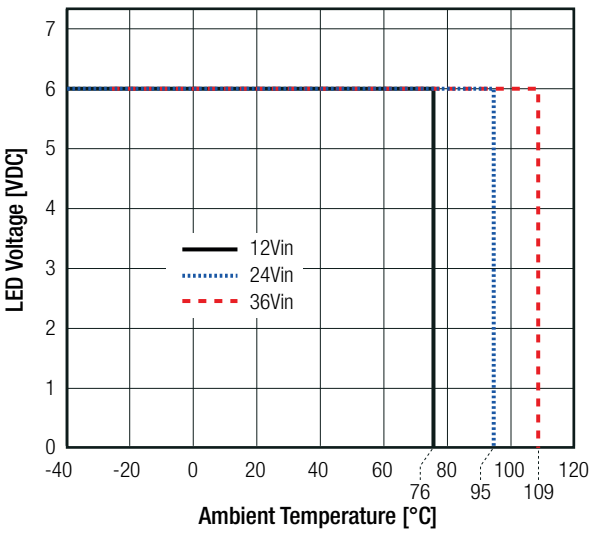
### THERMAL OPERATING CONDITIONS ($V_{IN}$= 36VDC, $I_{OUT}$= 1.5A; tested with RECOM evaluation module: RPY-1.5Q-EVM-1 unless otherwise stated)

| Parameter | Condition | Min. | Typ. | Max. |
|---|---|---|---|---|
| Operating Junction Temperature | | -40°C | | +125°C |
| Thermal Impedance | junction to ambient | | 46K/W | |
| | case to ambient | | 30K/W | |
| Thermal Shutdown | Junction Temperature= 170°C | | auto recovery after cool down | |

**Notes:**

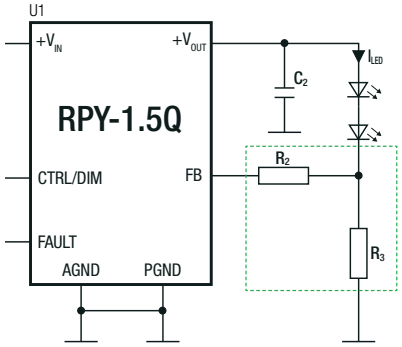
Note6: Tested with RECOM evaluation module: RPY-1.5Q-EVM-1

**Thermal Derating**
($I_{OUT}$= 1.5A)




### OUTPUT CURRENT SETTING

The external resistor $R_3$ divider sets the output current (see ***"Typical Application"***) and should be approximately 400mΩ. $R_3$ can then be calculated with below equation. The resistor ($R_2$) sets the feedback loop bandwidth. The lower the $R_2$ is, the higher the bandwidth. A high BW may cause insufficient phase margin, resulting in loop instability. R3 Ensure that Sense resistor is capable of handling defined current. Thermal drift and resistor tolerance will have an impact on current stability.




**Calculation:**

$$I_{LED} = \frac{0.2VDC}{R_3}$$

**Example:**

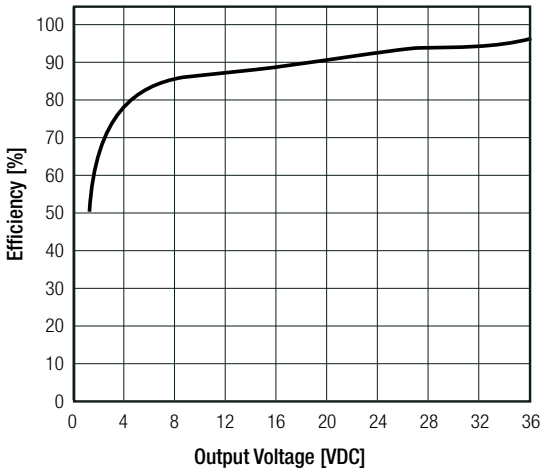
$$I_{LED} = \frac{0.2}{0.4} = 0.5$$

| $V_{FB}$ [VDC] | $I_{LED}$ [A] | $R_2$ [kΩ] | $R_3$ [Ω] |
|---|---|---|---|
| 0.2 | 0.35 | 220 | 0.57 |
| | 0.5 | 200 | 0.4 |
| | 0.7 | 175 | 0.286 |
| | 1.05 | 150 | 0.19 |
| | 1.5 | 100 | 0.133 |

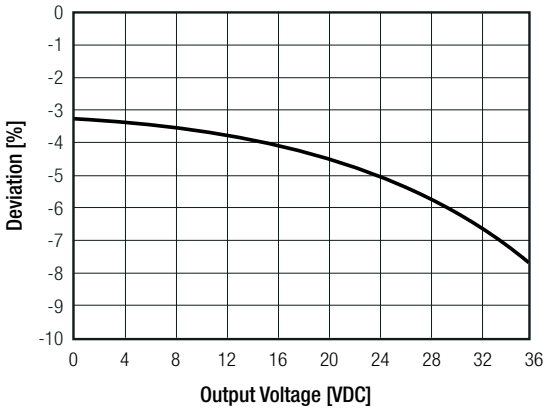
## Specifications

### TYPICAL PERFORMANCE CHARACTERISTICS ($V_{IN}$= 36VDC, $I_{LED}$= 1.5A, $T_{AMB}$= +25°C; tested with RECOM evaluation module: RPY-1.5Q-EVM-1)

Efficiency vs. Output Voltage



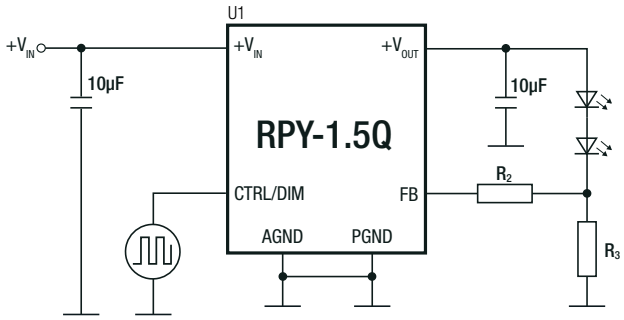

Deviation vs. Output Voltage

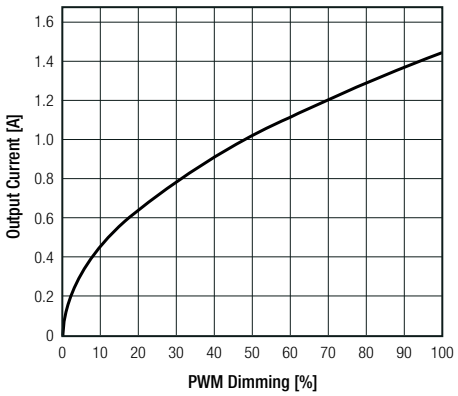



### PWM DIMMING ($V_{IN}$= 36VDC, $I_{LED}$= 1.5A, $T_{AMB}$= +25°C; tested with RECOM evaluation module: RPY-1.5Q-EVM-1 unless otherwise stated)

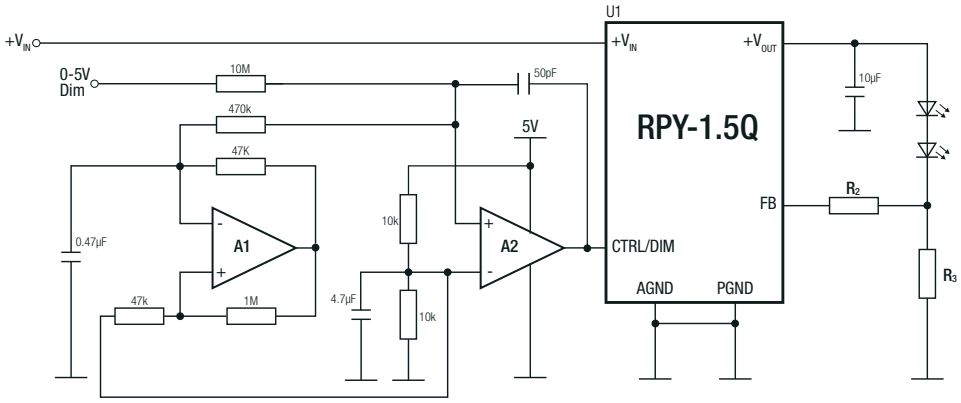
| Parameter | Condition | Min. | Typ. | Max. |
|---|---|---|---|---|
| CTRL/DIM frequency | | 100Hz | | 2kHz |
| PWM Voltage | | 1.8VDC | | |
| PWM on time at start up | | 2s | | |

Dimming tested with RECOM EVM board RPY-1.5Q-EVM-1, with 100Hz to 2kHz and PWM waveform to CTRL/DIM.




### ANALOGE DIMMING ($V_{IN}$= 4-36VDC, $I_{LED}$= 1.5A, $T_{AMB}$= +25°C, unless otherwise stated)



## Specifications

### 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

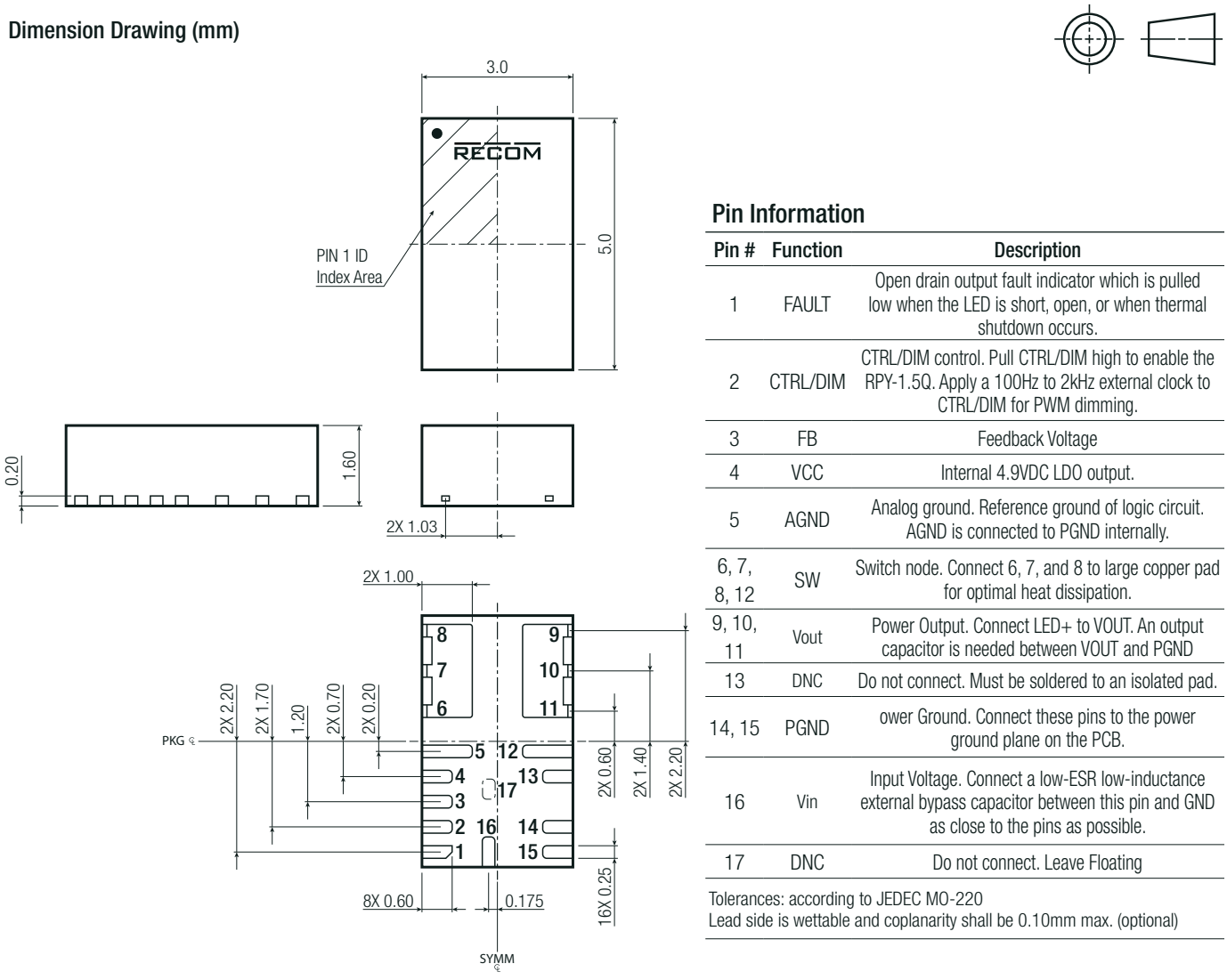
### SAFETY AND CERTIFICATIONS

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

### 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)**




**Pin Information**

| Pin # | Function | Description |
|---|---|---|
| 1 | FAULT | Open drain output fault indicator which is pulled low when the LED is short, open, or when thermal shutdown occurs. |
| 2 | CTRL/DIM | CTRL/DIM control. Pull CTRL/DIM high to enable the RPY-1.5Q. Apply a 100Hz to 2kHz external clock to CTRL/DIM for PWM dimming. |
| 3 | FB | Feedback Voltage |
| 4 | VCC | Internal 4.9VDC LDO output. |
| 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 | Power Output. Connect LED+ to VOUT. An output capacitor is needed between VOUT and PGND |
| 13 | DNC | Do not connect. Must be soldered to an isolated pad. |
| 14, 15 | PGND | ower 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 |

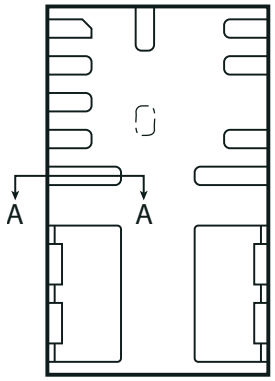
Tolerances: according to JEDEC MO-220
Lead side is wettable and coplanarity shall be 0.10mm max. (optional)

continued on next page

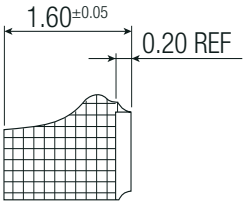
## Specifications

Wettable Flank version available on request, please contact RECOM

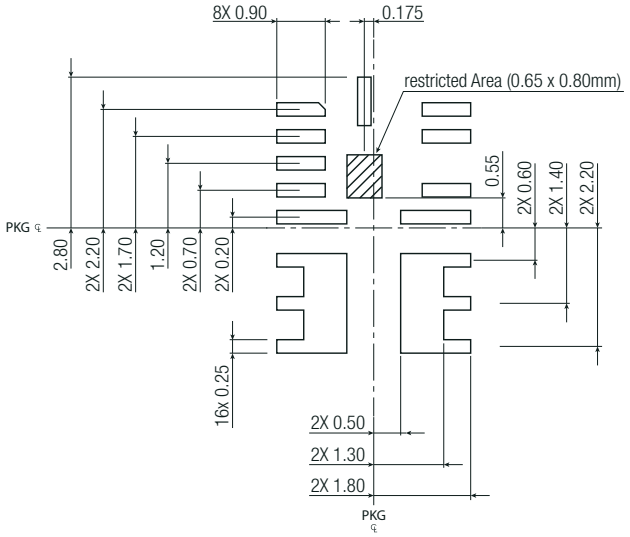
Top View




Section A-A




Recommended Footprint Details (Top View)

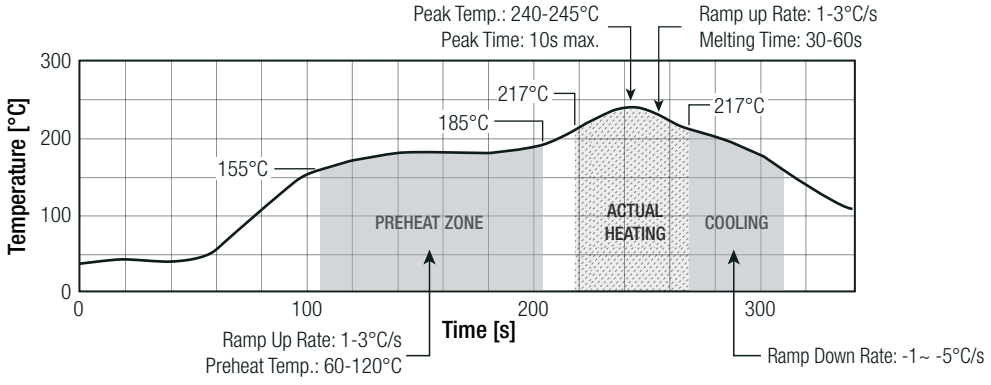



## SOLDERING

| 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) | 245°C |
| 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 ro 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



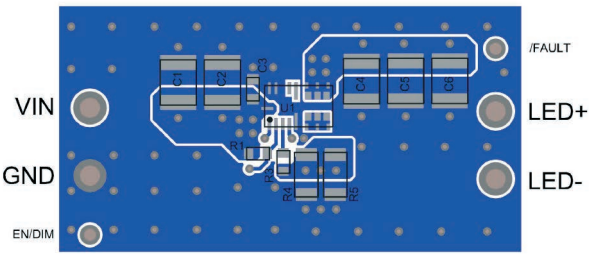
## Specifications

### PCB LAYOUT SUGGESTION

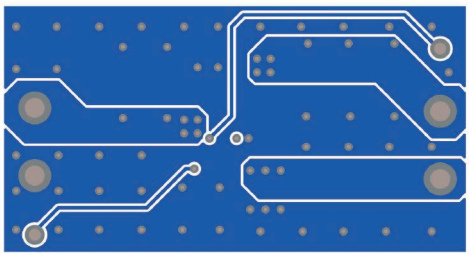
Efficient PCB layout, especially of the input capacitor placement, is critical for stable operation. For best results follow the guidelines below.

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 close to the chip.
6. Use multiple vias to connect power planes to internal layers.

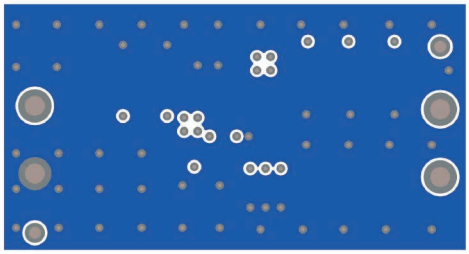
Top Layer



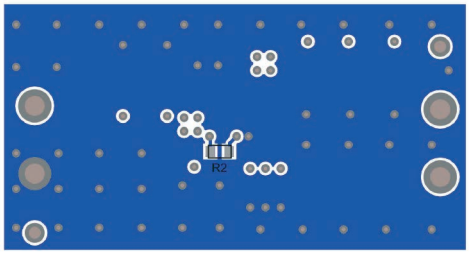

Inner Layer



Inner Layer 2



Bottom Layer




### 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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