# Features

# Power Module

- 36V 3A SMD Power Module
- High power density in 12.2x12.2x3.75mm case
- -40°C to +100°C with derating, convection cooled
- Efficiency up to 94%
- 6-sided shielding
- Thermally enhanced 25 pad LGA package (DOSA conform)

RECOM
DC/DC Converter

# RPMB-3.0

## 3 Amp Single Output

3 YEAR warranty


RoHS 2+ compliant 10 from 10 — RECOM-CONVERTERS COMPLIANT PRODUCTS

REACH compliant — RECOM-CONVERTERS COMPLIANT PRODUCTS

EN55032 compliant

## Description

The RPMB-3.0 series is a 3A non-isolated SMD switching regulator power module with up to 36V input voltage. Despite its compact LGA footprint and low profile (12.2x12.2x3.75mm), it offers a full set of features including adjustable output from 1V up to 24V, on/off control, sense and power good output signals. With an efficiency of up to 94% which remains nearly constant over a 5% to 100% load range, the device can operate at ambient temperatures as high as +100°C without forced air cooling. The package is complete with 6-sided shielding for optimal EMC performance and excellent heat management. The fully protected module (UVLO, SCP, OCP, OTP) can drive high capacitive loads of up to 0.2F.

## Selection Guide

| Part Number | Input Voltage Range [VDC] | Output Voltage [VDC] | Vout Adjust Range [VDC] | Output Current max. [A] | Efficiency typ. [%] | Max Capacitive typ. Load (1) [µF] |
|---|---|---|---|---|---|---|
| RPMB3.3-3.0 | 4-36 | 3.3 | 1-9 | 3.0 | 84 | 200000 |
| RPMB5.0-3.0 | 5.5-36 | 5 | 1-9 | 3.0 | 88 | 200000 |
| RPMB12-3.0 | 12.8-36 | 12 | 9-24 | 3.0 | 93 | 15000 |
| RPMB15-3.0 | 16-36 | 15 | 9-24 | 3.0 | 94 | 12000 |

**Notes:**

Note1: Max. Capacitive Load is tested at nominal input, nominal output, and full resistive load, below 1 second start-up

## Model Numbering

RPMB__-3.0-__

- Output Voltage
- max. Output Current
- Packaging (2)

**Notes:**

Note2: Add suffix "-CT" for tube packaging; for more details refer to **"PACKAGING INFORMATION"** without suffix, standard tape and reel packaging

## Specifications (@ Ta= 25°C, nom. Vin, full load, with input cap (3), after warm-up unless otherwise stated)

| BASIC CHARACTERISTICS | | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Condition** | | **Min.** | **Typ.** | **Max.** |
| Internal Input Filter | | | | | capacitor |
| Input Voltage Range (4) | 3.3Vout<br>5.0Vout<br>12Vout<br>15Vout | | 4VDC<br>5.5VDC<br>12.8VDC<br>16VDC | 24VDC (nominal) | 36VDC |
| Absolute Maximum Input Voltage | | | | | 38VDC |
| Input Current | nom. Vin= 24VDC | 3.3Vout<br>5.0Vout<br>12Vout<br>15Vout | | 0.5A<br>0.7A<br>1.6A<br>2A | |

continued on next page

EVAL BOARD available

www.recom-power.com/eval-ref-boards

**Notes:**

Note3: 4.7µF/50V/X7R input cap required

## Specifications (@ Ta= 25°C, nom. Vin= 24VDC, full load, with input cap [3], after warm-up unless otherwise stated)

| Parameter | Condition | | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Quiescent Current | nom. Vin= 24VDC | 3.3Vout<br>5.0Vout<br>12Vout<br>15Vout | | 30µA<br>36µA<br>70µA<br>140µA | |
| Internal Power Dissipation | nom. Vin= 24VDC | 3.3Vout<br>5.0Vout<br>12Vout<br>15Vout | | 1.9W<br>2W<br>2.7W<br>2.9W | |
| Output Voltage Trimming | refer to **"OUTPUT VOLTAGE TRIMMING"** | 3.3, 5.0Vout | 1VDC | | 9VDC |
| | | 12, 15Vout | 9VDC | | 24VDC |
| Minimum Load | | | 0% | | |
| Start-up Time | power up<br>using CTRL function | | | 4.8ms<br>3.8ms | |
| Rise-time | | | | 900µs | |
| ON/OFF CTRL | DC-DC ON<br>DC-DC OFF | | Open or 1.26VDC<$V_{CTRL}$<Vin<br>Short to GND or -0.3VDC<$V_{CTRL}$<0.3VDC | | |
| Input Current of CTRL Pin | DC-DC OFF | | | 25µA | |
| Standby Current | DC-DC OFF | | | 35µA | |
| Internal Operating Frequency | for all types | | | 1.4MHz | |
| Output Ripple and Noise [5] | 20MHz BW | 3.3Vout<br>5.0Vout<br>12Vout<br>15Vout | | 20mVp-p<br>25mVp-p<br>40mVp-p<br>50mVp-p | 50mVp-p<br>60mVp-p<br>90mVp-p<br>100mVp-p |

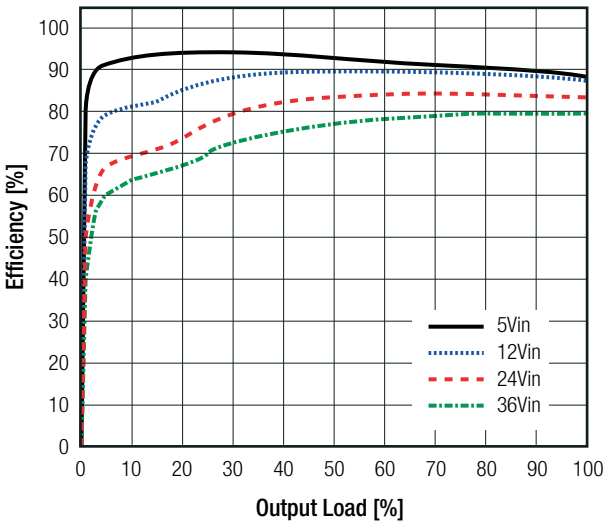
**Notes:**

Note4: Below minimum input voltage range, the module enters 98% duty cycle mode. Output voltage will not meet the output accuracy specification

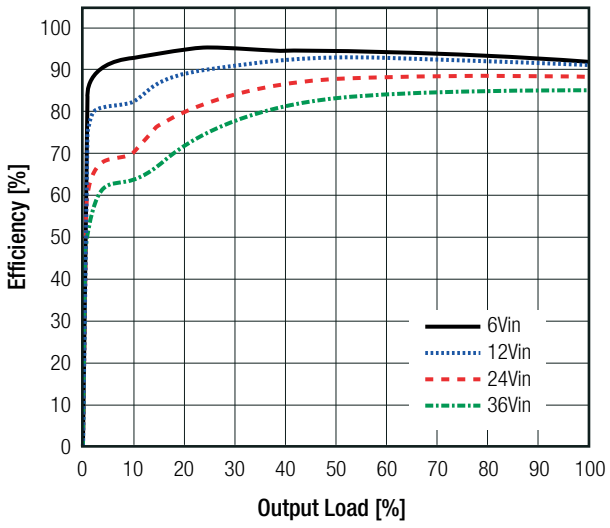
Note5: Measurements are made with a 22µF MLCC across output (low ESR)

### Efficiency vs. Load

RPMB3.3-3.0




RPMB5.0-3.0

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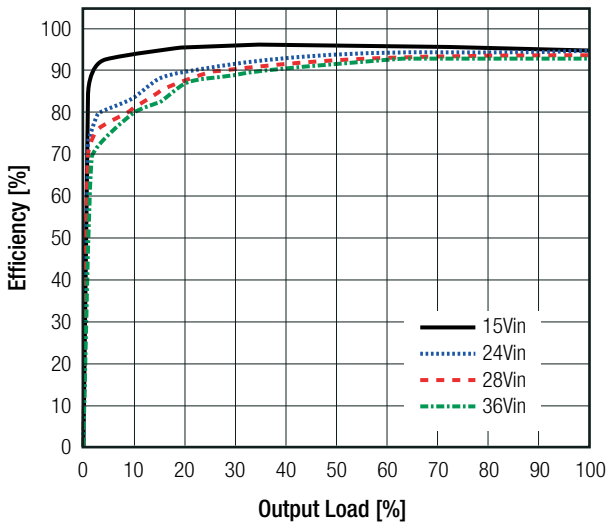
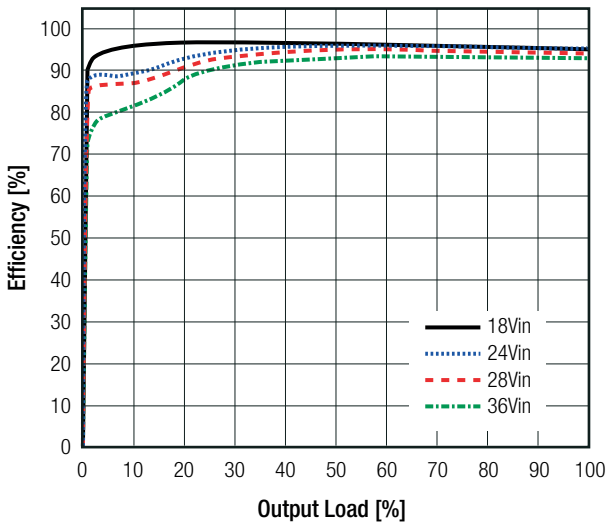
## Specifications (@ Ta= 25°C, nom. Vin= 24VDC, full load, with input cap [3], after warm-up unless otherwise stated)

### Efficiency vs. Load

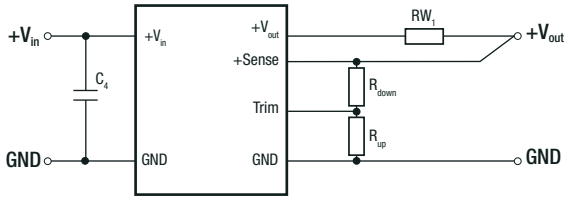
RPMB12-3.0




RPMB15-3.0



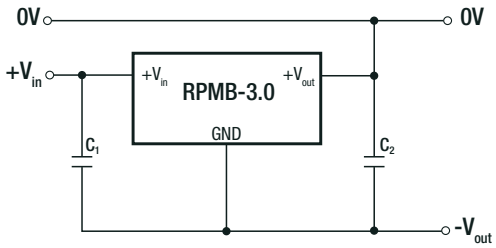

## REMOTE SENSE




**$RW_1$** ... wire losses +
**$R_{up}$** ... trim up resistor
**$R_{down}$** ... trim down resistor

The output voltage can be adjusted via trim and sense functions. The maximum output voltage from trim and sense functions combined is 9V and 24V (based on models). Power or thermal derating may be required when using trim and/or sense functions.

## POSITIVE TO NEGATIVE




**$C_1$** and **$C_2$** may be added to reduced ripple and should be fitted close to the converter pins.

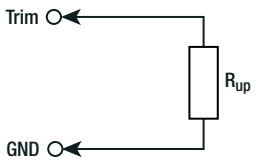
**Notes:**

Note6: RECOM Power Modules can also be used to convert a positive voltag into a negative voltage. Parameters such as maximum Vin, efficiency and maximum operating temperature are reduced. Please contact RECOM for further details.

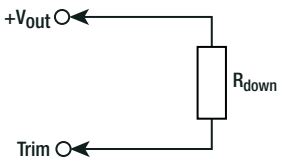
## OUTPUT VOLTAGE TRIMMING

The RPMB-series offers the feature of trimming the output voltage by using external trim resistors. The values for trim resistors shown in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary. Refer to **"Selection Guide"** for applicable Vout Adjust Range.

**Trim up**




**Trim down**




| | | |
|---|---|---|
| $Vout_{nom}$ | = nominal output voltage | [VDC] |
| $Vout_{set}$ | = trimmed output voltage | [VDC] |
| $R_{up}$ | = trim up resistor | [Ω] |
| $R_{down}$ | = trim down resistor | [Ω] |
| $R_3$, $R_4$ | = internal resistors | [Ω] |

| $Vout_{nom}$ | $R_3$ | $R_4$ |
|---|---|---|
| 3.3VDC | 100kΩ | 43.2kΩ |
| 5VDC | 100kΩ | 24.9kΩ |
| 12VDC | 100kΩ | 9.09kΩ |
| 15VDC | 90.9kΩ | 6.49kΩ |

**Calculation:**

$$R_{up} = \frac{R_4 \times (Vout_{set} - 1) - R_3 \times (R_4 + 1)}{R_3 - R_4 \times (Vout_{set} - 1)}$$

$$R_{down} = \frac{R_4 \times (Vout_{set} - 1) \times (R_3 + 1) - R_3}{R_3 - R_4 \times (Vout_{set} - 1)}$$

continued on next page

## Specifications (@ Ta= 25°C, nom. Vin= 24VDC, full load, with input cap [3], after warm-up unless otherwise stated)

### Practical Example RPMB12-3.0

$Vout_{set}$ = 15VDC

$$R_{up} = \frac{9.09 \times (15-1) - 100 \times (9.09+1)}{100 - 9.09 \times (15-1)}$$

$R_{up}$ according to E96 ≈ **32k4Ω**

### Practical Example RPMB12-3.0

$Vout_{set}$ = 9VDC

$$R_{down} = \frac{9.09 \times (9-1) \times (100+1) - 100}{100 - 9.09 \times (9-1)}$$

$R_{down}$ according to E96 ≈ **267kΩ**

### RPMB3.3-3.0

**Trim up**

| $Vout_{set}$ = | 5 | [VDC] |
|---|---|---|
| $R_{up}$ (E96) ≈ | 57k6 | [Ω] |

**Trim down**

| $Vout_{set}$ = | 2.5 | 1.8 | 1.5 | 1.2 | 1.1 | [VDC] |
|---|---|---|---|---|---|---|
| $R_{down}$ (E96) ≈ | 182k | 52k3 | 26k7 | 8k45 | 3k48 | [Ω] |

### RPMB12-3.0

**Trim up**

| $Vout_{set}$ = | 15 | 24 | [VDC] |
|---|---|---|---|
| $R_{up}$ (E96) ≈ | 32k4 | 7k32 | [Ω] |

**Trim down**

| $Vout_{set}$ = | 10 | 9 | [VDC] |
|---|---|---|---|
| $R_{down}$ (E96) ≈ | 453k | 267k | [Ω] |

### RPMB5.0-3.0

**Trim up**

| $Vout_{set}$ = | 5.5 | 9 | [VDC] |
|---|---|---|---|
| $R_{up}$ (E96) ≈ | 205k | 23k7 | [Ω] |

**Trim down**

| $Vout_{set}$ = | 3.3 | 2.5 | [VDC] |
|---|---|---|---|
| $R_{down}$ (E96) ≈ | 133k | 59k | [Ω] |

### RPMB15-3.0

**Trim up**

| $Vout_{set}$ = | 20 | 24 | [VDC] |
|---|---|---|---|
| $R_{up}$ (E96) ≈ | 16k9 | 9k09 | [Ω] |

**Trim down**

| $Vout_{set}$ = | 12 | 9.99 | [VDC] |
|---|---|---|---|
| $R_{down}$ (E96) ≈ | 332k | 162k | [Ω] |

### REGULATIONS

| Parameter | Condition | Value |
|---|---|---|
| Output Accuracy | | ±1.0% typ. / ±3.0% max. |
| Line Regulation | low line to high line, full load | ±0.25% typ. / ±0.5% max. |
| Load Regulation | 10% to 100% load | 0.05% typ. |
| Transient Response | 25% load step change<br>recovery time | 200mV<br>100µs |

### PROTECTIONS

| Parameter | Condition | | Value |
|---|---|---|---|
| Short Circuit Protection (SCP) | less than 50mΩ | | hiccup mode, automatic recovery |
| Over Current Protection (OCP) | | | 120% min. |
| Over Temperature Protection (OTP) | case temperature<br>(measured on tc point) | DC-DC OFF<br>DC-DC ON | 105°C min., auto restart after cool down<br>100°C typ. |

### ENVIRONMENTAL

| Parameter | Condition | Value |
|---|---|---|
| Operating Temperature Range [7] | @ natural convection 0.1m/s with derating (refer to **"Derating Graph"**) | -40°C to +100°C |
| Maximum Case Temperature | measured on tc point (refer to **"Dimension Drawing"**) | +105°C |
| Temperature Coefficient | | 0.02%/K |
| Thermal Impedance [7] | 0.1m/s, horizontal ($T_{case}$ to $T_{AMB}$) | 12K/W |
| Operating Altitude [8] | with derating @ natural convection 0.1m/s | 5000m |
| Operating Humidity | non-condensing | 5% - 95% RH |

**continued on next page**

## Specifications (@ Ta= 25°C, nom. Vin= 24VDC, full load, with input cap [3], after warm-up unless otherwise stated)

| Parameter | Condition | | Value |
|---|---|---|---|
| Shock | MIL-STD-810G, Method 516.6, Procedure I | | 40g, 11ms, saw-tooth, 3 shocks ± per axis 3 axis; unit is operating |
| | MIL-STD-810G, Method 516.6, Procedure IV | | drop on 50mm plywood on concrete 26 times from 1 meter |
| Random Vibration | MIL-STD-810G, Method 514.6, Procedure I, Category 24 | | Category 24 - Figure 514.6E-1 - power spectral density = 0.04g²/Hz at 20Hz –1000Hz; -6dB/octave at 1000Hz – 2000Hz; 60 minutes x 3 axis; unit is operating during tests |
| MTBF | according to MIL-HDBK-217F, G.B. @ full load | +25°C | 1761 x 10³ hours |
| | | max. $T_{AMB}$ | 984 x 10³ hours |

**Notes:**

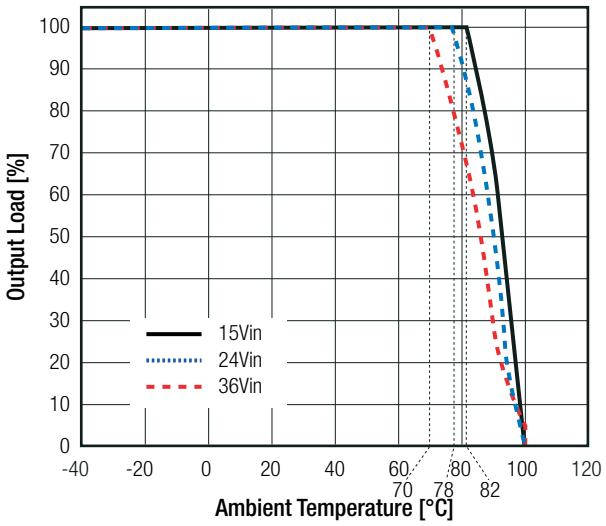
Note7: Tested with a eurocard 160x100mm 70µm copper, 4 layer

Note8: At altitudes above 2000m, derate output power by 5%/1000m

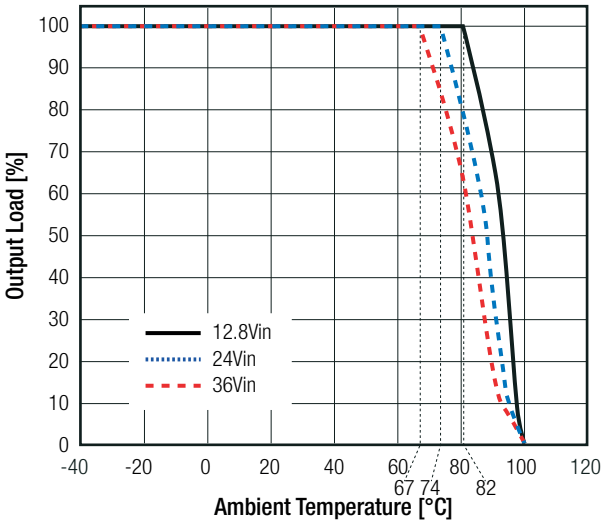
### Derating Graph [6]

(@ chamber and natural convection 0.1m/s, @24Vin)

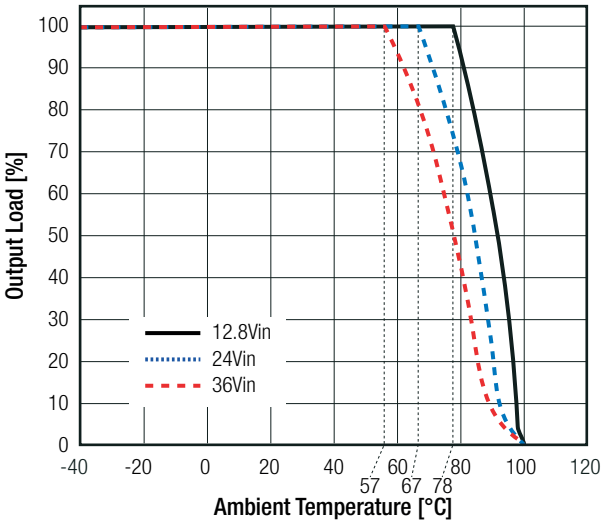
RPMB3.3-3.0



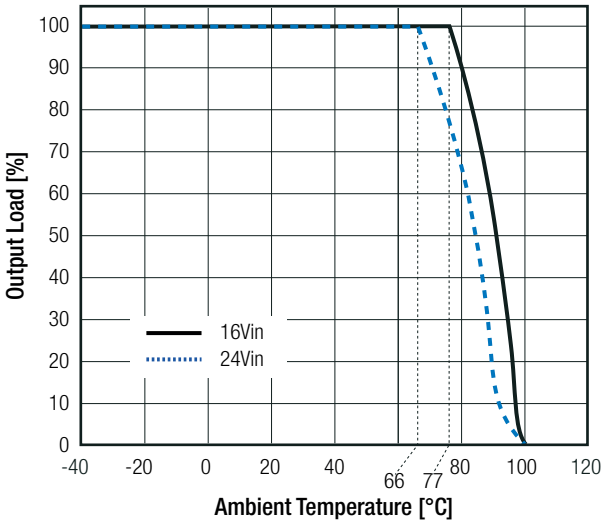

RPMB5.0-3.0




RPMB12-3.0




RPMB15-3.0



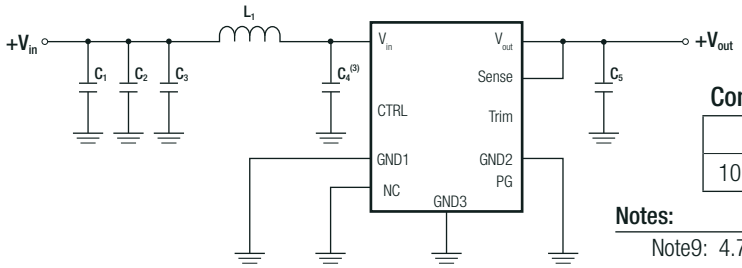
## Specifications (@ Ta= 25°C, nom. Vin= 24VDC, full load, with input cap [3], after warm-up unless otherwise stated)

### SAFETY AND CERTIFICATIONS

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

| EMC Compliance | Condition | Standard / Criterion |
|---|---|---|
| Electromagnetic compatibility of multimedia equipment - emission requirements [9] | with external components (see filter suggestions below) | EN55032, Class B |

**EMC filtering suggestion according to EN55032**




**Component List Class B**

| C1, C2, C3, C4 | L1 | C5 |
|---|---|---|
| 10µF 50V X7R, 1210 | 2.2µH shielded inductor | 10µF 25V X7R, 1206 |

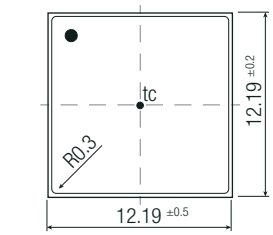
**Notes:**

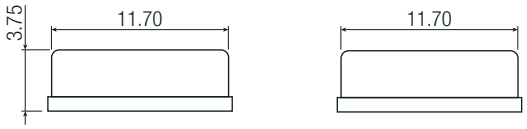
Note9: 4.7µF input capacitor (Note3) is not required if using EMC filter suggestion

### DIMENSION AND PHYSICAL CHARACTERISTICS

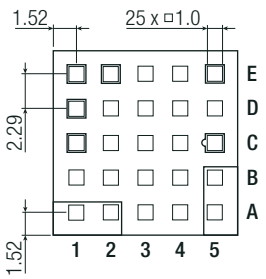
| Parameter | Type | Value |
|---|---|---|
| Material | case<br>PCB<br>solder pads | metal<br>FR4, (UL94 V-0)<br>copper with electrolytic nickel-gold |
| Dimension (LxWxH) | | 12.19 x 12.19 x 3.75mm |
| Weight: | | 1.1g typ. |

**Dimension Drawing (mm)**



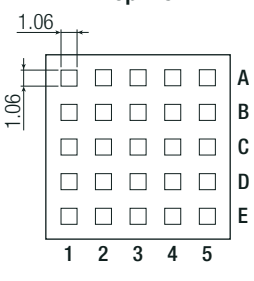




**Bottom View**




**Recommended Footprint Details**

**Top View**



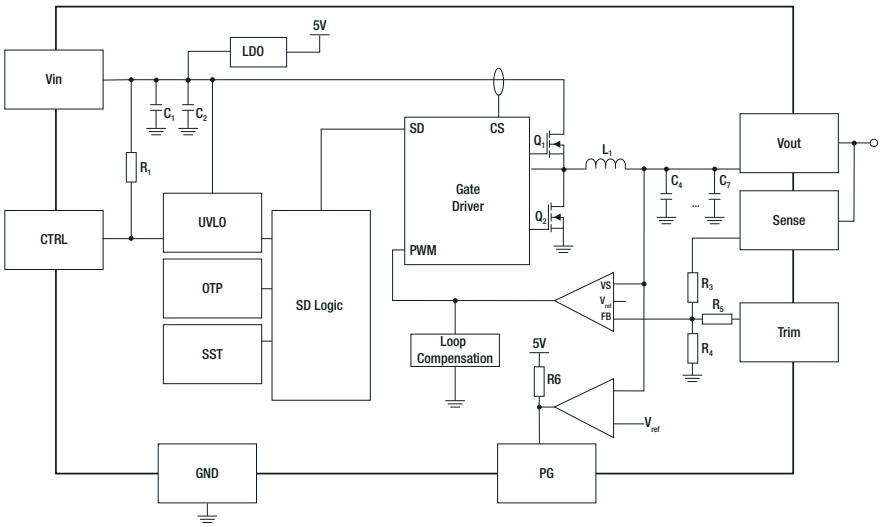

**Pinning information**

| Pad # | Function | Description |
|---|---|---|
| A1, A2 | Vin | Positive input voltage with respect to GND. Connect to a Vin plane for enhanced thermal performance |
| C1 | CTRL | Active High: pull to GND to disable the device. Pull high or leave open to enable the device |
| A5, B5 | Vout | Positive output voltage. Connect to a Vout plane for enhanced thermal performance |
| C5 | Sense | Connect this pad to the load or directly to Vout. This pad must not be left floating |
| E5 | Trim | Used to set the output voltage between 1V and 24V, leave open if not used |
| E2 | NC | Not connected, leave open or connect to GND |
| E1 | NC | Not connected, leave open or connect to GND |
| D1 | PGood | Output power good. HIGH = power OK, LOW = power bad. PG pulls low when CTRL = LOW. PG HIGH when VOUT is between 95% and 107% of nominal (VOUT rising) or when between 105% and 93% (VOUT falling) of nominal – typical values. PG delay is typically 110us (±50%). Maximum sink current is 5mA. Open drain output internally tied to 5V (typical) reference through 100kΩ resistor. Float if not used. |
| others | GND | Negative input voltage. Connect to GND plane(s) for enhanced thermal performance |

tc = case temperature measuring point
Pad tolerance= ±0.05mm
Case tolerance= ±0.25mm

## Specifications (@ Ta= 25°C, nom. Vin= 24VDC, full load, with input cap [3], after warm-up unless otherwise stated)

### BLOCKDIAGRAM




### Component List

| $Vout_{nom}$ | R3 | R4 | R5 |
|---|---|---|---|
| 3.3VDC | 100kΩ | 43.2kΩ | 1kΩ |
| 5VDC | | 24.9kΩ | |
| 12VDC | | 9.09kΩ | |
| 15VDC | 90.9kΩ | 6.49kΩ | |

| $Vout_{nom}$ | L1 | C1, C2 | C4-C7 |
|---|---|---|---|
| 3.3VDC | 2.2µH | 1µF, in parallel | 10µF, in parallel |
| 5VDC | | | |
| 12VDC | 3.3µH | | |
| 15VDC | | | |

### PACKAGING INFORMATION

| Parameter | Type | Value |
|---|---|---|
| Packaging Dimension (LxWxH) | tape and reel | 330.2 x 330.2 x 30.4mm |
| | tape and reel (carton) | 365.0 x 365.0 x 55.0mm |
| | tube ("-CT") | 530.0 x 30.3 x 19.2mm |
| Packaging Quantity | tape and reel | 500pcs |
| | tube ("-CT") | 30pcs |
| Tape Width | | 24mm |
| Storage Temperature Range | | -55°C to +125°C |
| Storage Humidity | non-condensing | 95% RH max. |

# Mouser Electronics

Authorized Distributor

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RECOM:

RPMB15-3.0 RPMB3.3-3.0-CT RPMB15-3.0-CT RPMB5.0-3.0 RPMB12-3.0-CT RPMB3.3-3.0 RPMB5.0-3.0-CT RPMB12-3.0