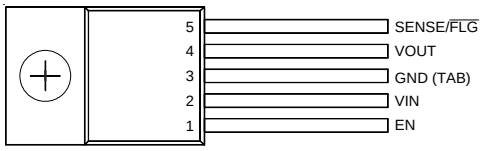
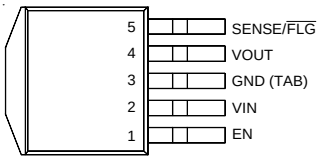
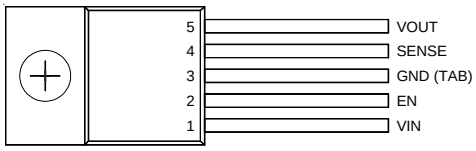


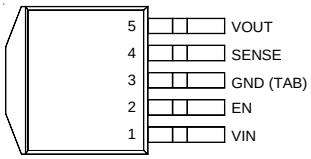

TO-220-5
RT9172N-□□xT5
RT9172F-□□xT5




TO-263-5
RT9172N-□□xM5
RT9172F-□□xM5




TO-220-5
RT9172S-□□xT5




TO-263-5
RT9172S-□□xM5

## Functional Pin Description

| Pin No. | | | | Pin Name | Pin Function |
|---|---|---|---|---|---|
| RT9172F | RT9172N | RT9172S | RT9172-□□xT<br>RT9172-□□xM<br>RT9172-□□xG | | |
| 1 | 1 | 2 | -- | EN | Chip Enable. (Active Hight) |
| 2 | 2 | 1 | 1 | VIN | Power Input Voltage. |
| 3 | 3 | 3 | 2 | GND | Ground. |
| 4 | 4 | 5 | 3 | VOUT | Output Voltage. |
| 5 | -- | -- | -- | $\overline{FLG}$ | ERROR Flag. |
| -- | 5 | 4 | -- | SENSE | Remote Sense. |

## Typical Application Circuit

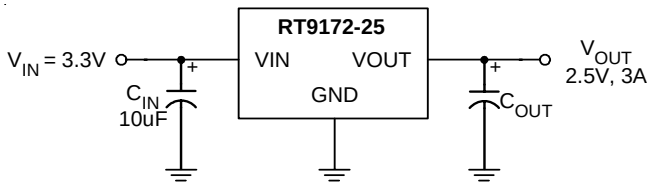



Figure 1

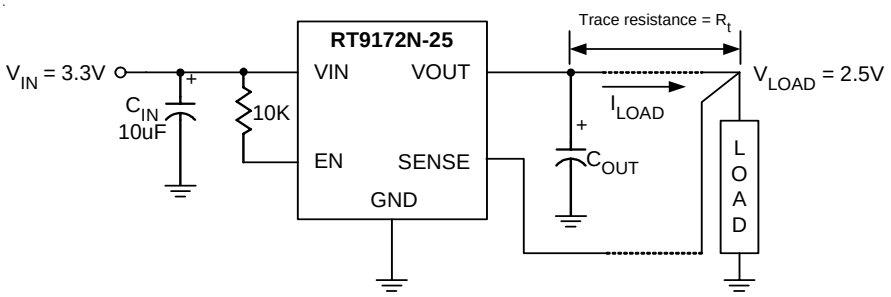



Figure 2

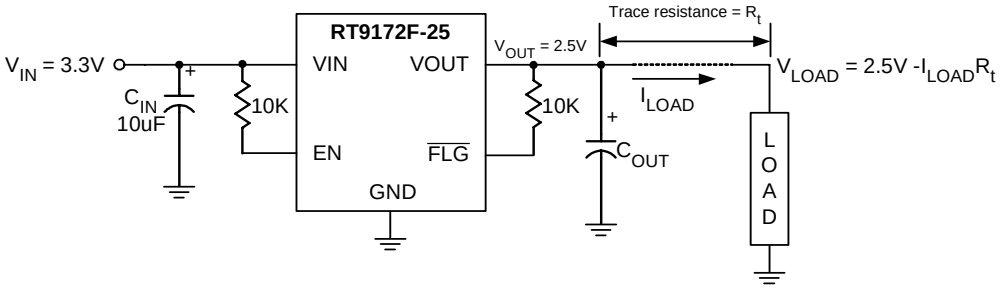
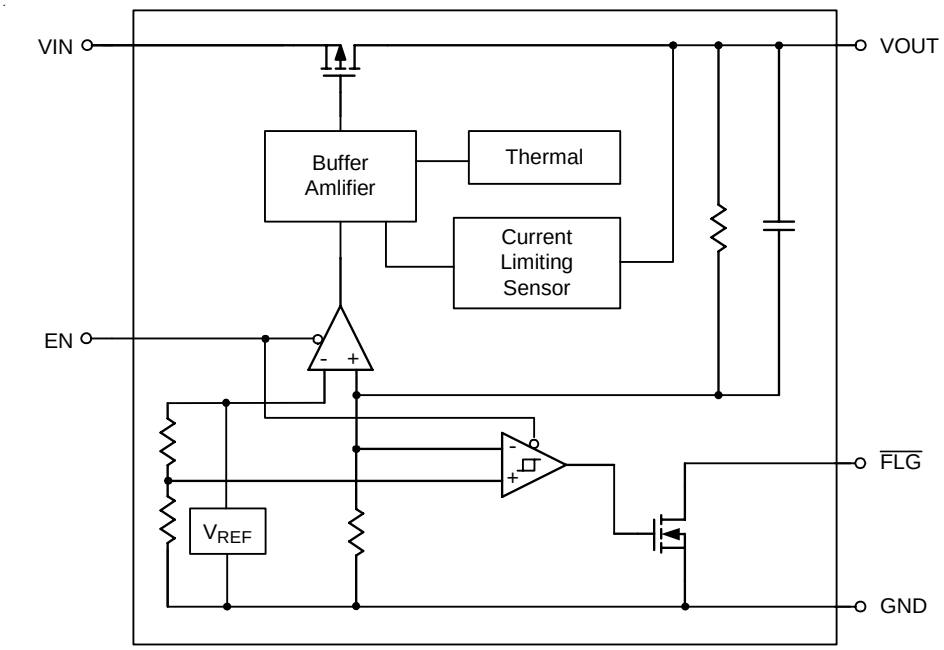



Figure 3

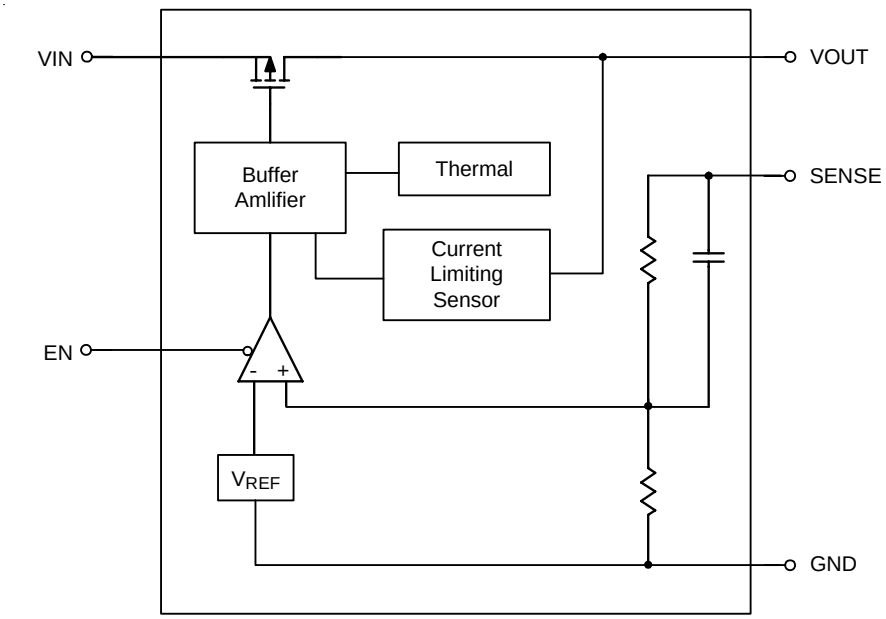
Recommend $C_{OUT}$: Please note that the part must be paralleled with the least a 100µF electrolytic capacitor when using a 10µF (or greater) ceramic type as the output capacitor to prevent the output oscillating.

## Function Block Diagram

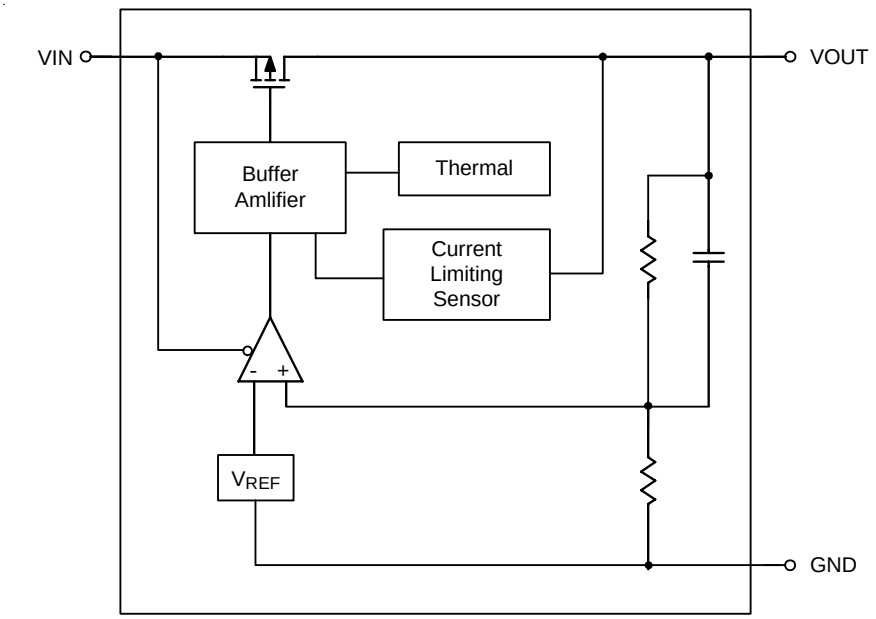
**RT9172F**



**RT9172N/RT9172S**




**RT9172**



## Absolute Maximum Ratings

- Input Voltage ---------- 6V
- Power Dissipation, $P_D$ @ $T_A$ = 25°C
  - SOT-223 ---------- 0.741W
  - SOP-8 ---------- 0.625W
  - TO-263 ---------- 2.222W
  - TO-220 ---------- 1.820W
- Package Thermal Resistance (Note 1)
  - SOT-223, $\theta_{JC}$ ---------- 23°C/W
  - SOT-223, $\theta_{JA}$ ---------- 135°C/W
  - SOP-8, $\theta_{JC}$ ---------- 45°C/W
  - SOP-8, $\theta_{JA}$ ---------- 160°C/W
  - TO-263, $\theta_{JC}$ ---------- 7.8°C/W
  - TO-263, $\theta_{JA}$ ---------- 45°C/W
  - TO-220, $\theta_{JC}$ ---------- 15°C/W
  - TO-220, $\theta_{JA}$ ---------- 55°C/W
- ESD Rating ---------- 3 kV
- Storage Temperature Range ---------- –65°C to 150°C
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Junction Temperature Range ---------- –40°C to 125°C

## Electrical Characteristics

(Limits in standard typeface are for $T_A$ = 25°C, unless otherwise specified: $V_{IN}$ = $V_{O(NOM)}$ + 1.0V, $I_L$ = 10mA, $C_{OUT}$ = 10uF(Electrolytic), $V_{EN}$ = $V_{IN}$)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Tolerance | | | –1.5 | 0 | 1.5 | % |
| Input Voltage Range | $V_{IN}$ | | 2.25 | -- | 5.5 | V |
| Line Regulation | $\Delta V_{LINE}$ | $V_{OUT}$ + 0.4V < $V_{IN}$ < 5.5V | -- | 0.35 | 1 | % |
| Load Regulation | $\Delta V_{LOAD}$ | Note 2 | -- | 0.4 | 1 | % |
| | | Note 3 | -- | 0.1 | 0.4 | |
| | | Note 4 | -- | 0.1 | 0.4 | |
| Dropout Voltage | $V_{DROP}$ | $I_L$ = 3A | -- | 400 | 700 | mV |
| Quiescent Current | $I_Q$ | | -- | 1.2 | 3 | mA |
| Shutdown Supply Current | $I_{GSD}$ | $V_{EN}$ = 0V | -- | 0.5 | 5 | μA |
| Peak Output Current | $I_{O(PEAK)}$ | | 3.5 | 5 | -- | A |
| **Short Circuit Protection** | | | | | | |
| Current Limit | $I_{LIMIT}$ | | 3.5 | 5 | -- | A |
| **Over Temperature Protection** | | | | | | |
| Shutdown Threshold | $T_{SD}$ | Guaranteed by design | -- | 170 | -- | °C |
| Thermal Shutdown Hysteresis | | Guaranteed by design | -- | 10 | -- | °C |

*To be continued*

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Shutdown Function** | | | | | | |
| EN Pin Shutdown Threshold | $V_{EN}$ | Output = High | 1.2 | $V_{IN}$ | -- | V |
| | | Output = Low | -- | 0 | 0.4 | |
| EN Input Current | | $V_{EN} = V_{IN}$ | -- | 0.1 | -- | nA |
| $\overline{FLG}$ Pin Leakage Current | $I_{LEAKAGE}$ | | -- | 1 | -- | nA |
| $\overline{FLG}$ Pin Sink Current | | $V_{FLG}$ = 0.5V | 2 | -- | -- | mA |

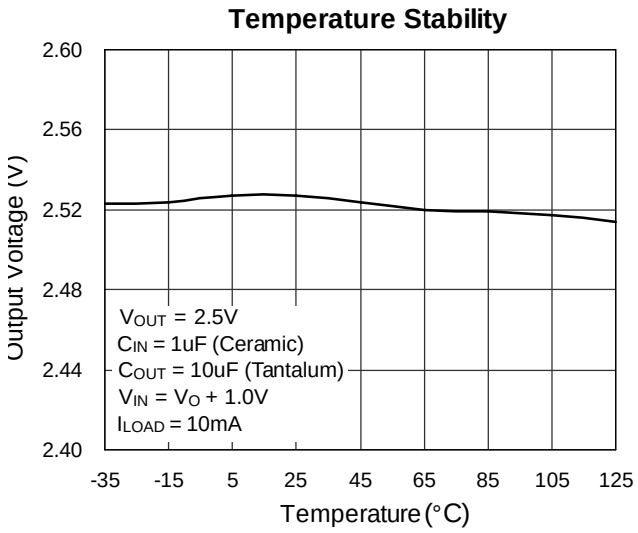
**Note 1.** $\theta_{JA}$ is measured in the natural convection at $T_A$ = 25°C on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard. The case point of $\theta_{JC}$ is on the center of the exposed pad. The pad size is 125mm$^2$ on TO-263 packages.

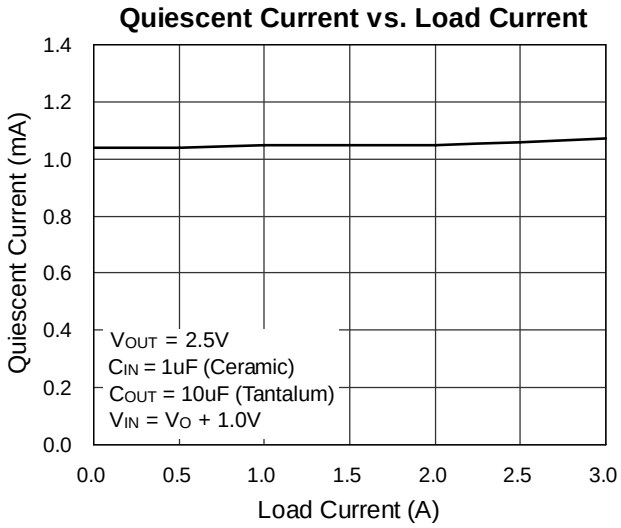
**Note 2.** RT9172-xX, RT9172F-XXxX5, 10mA < $I_L$ < 3A

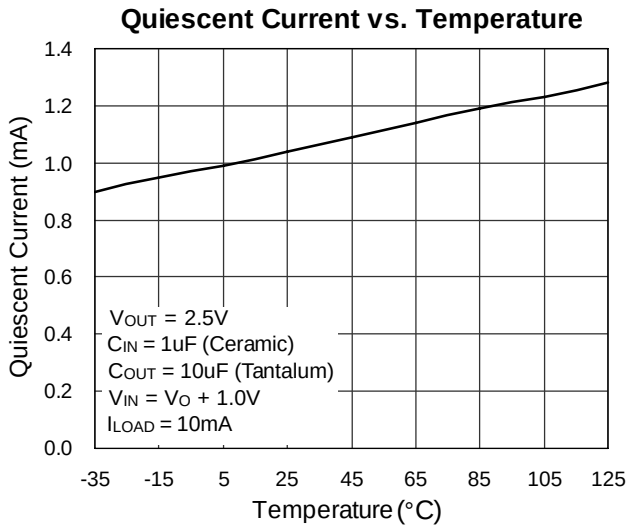
**Note 3.** RT9172S-XXxX5, RT9172N-XXxX5, 10mA < $I_L$ < 3A

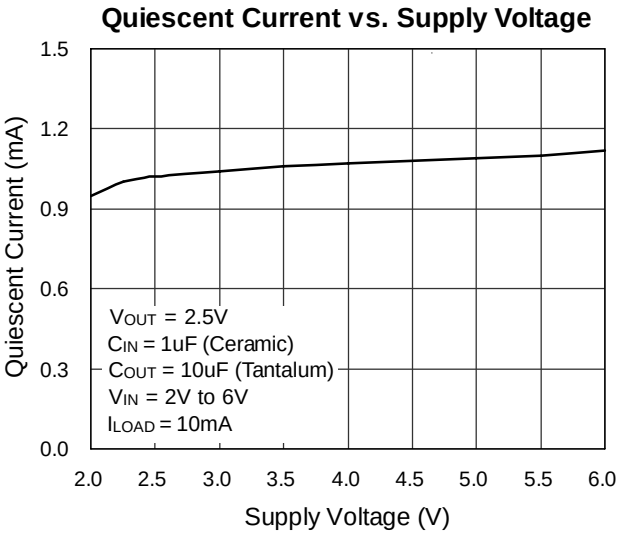
**Note 4.** RT9172xS, 10mA < $I_L$ < 1.5A

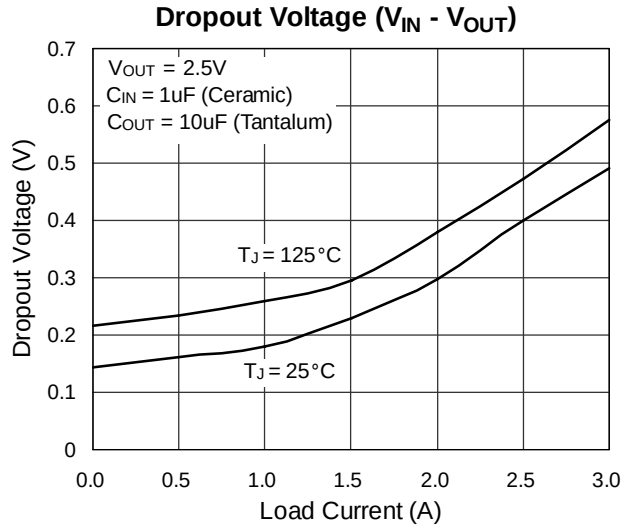
## Typical Operating Characteristics

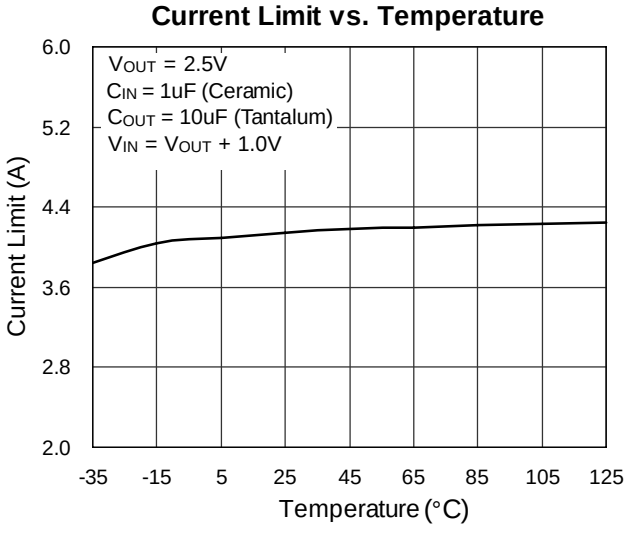


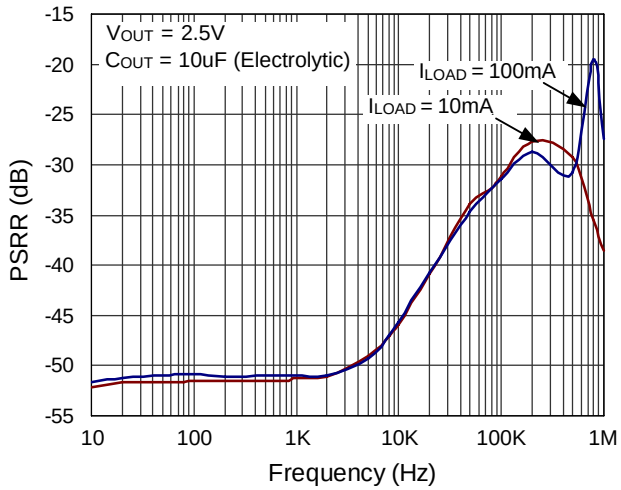



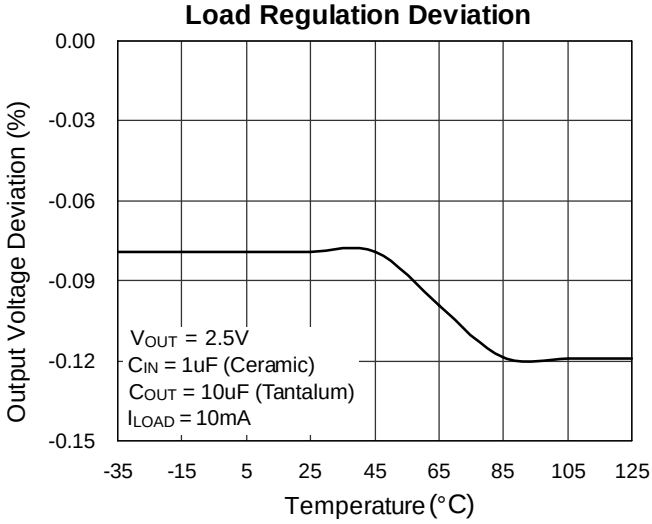



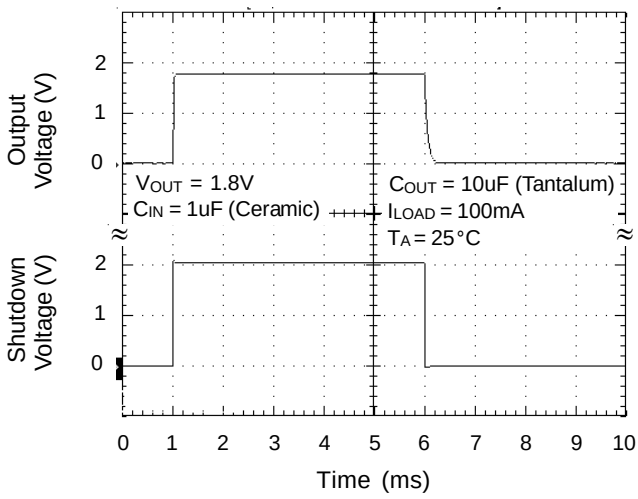
### PSRR



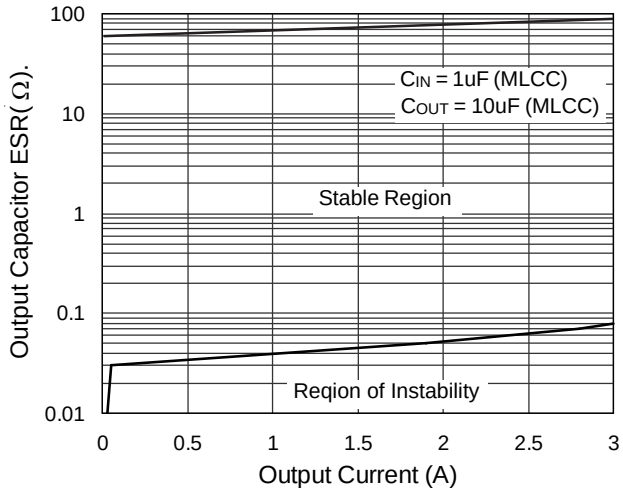

### Load Regulation Deviation



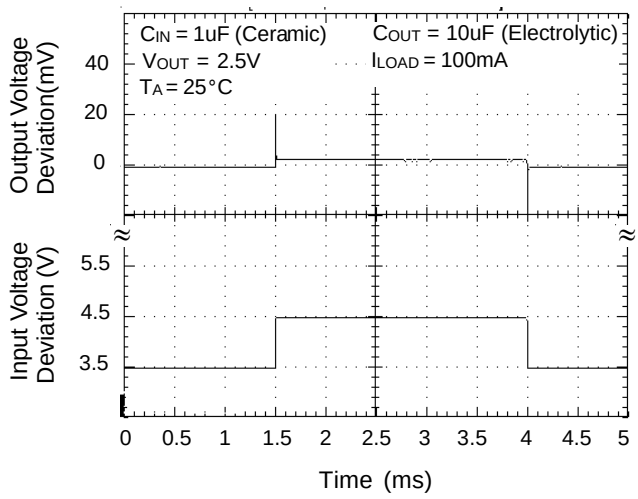

### EN Pin Shutdown Response



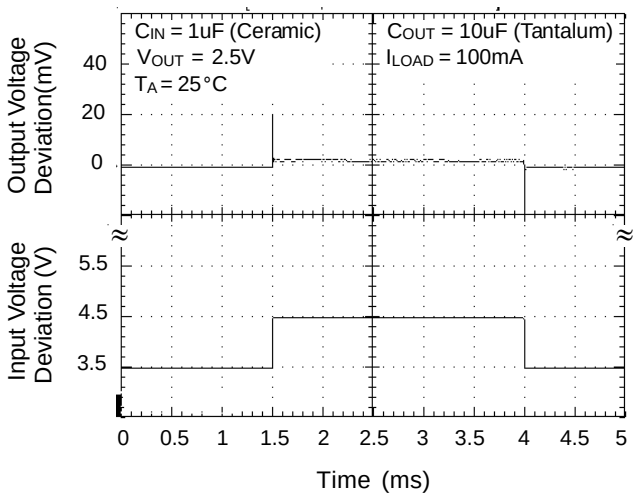

### Range of Stable ESR Values



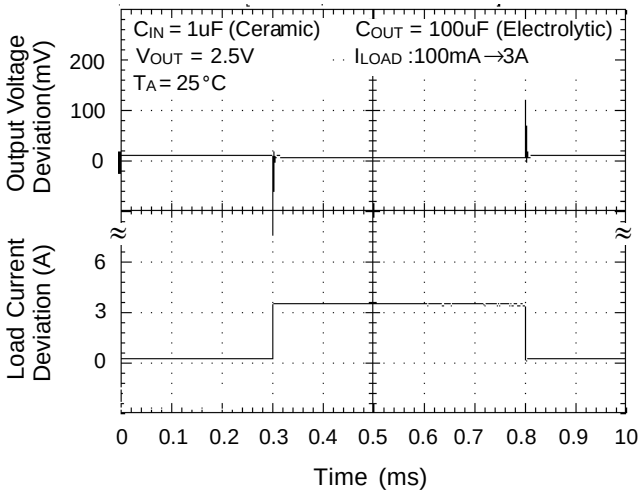

### Line Transient Response



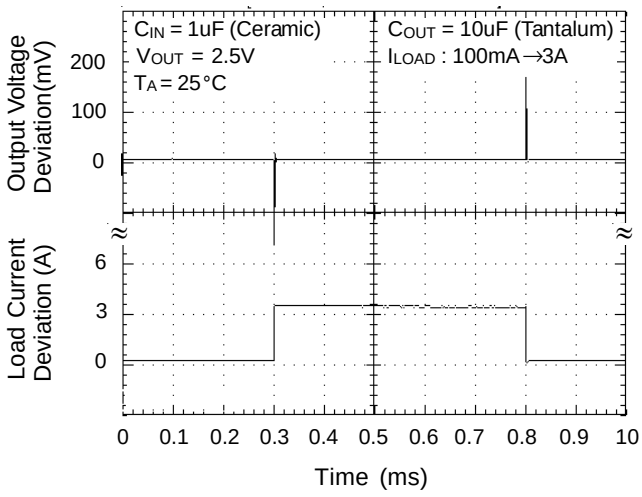

### Line Transient Response



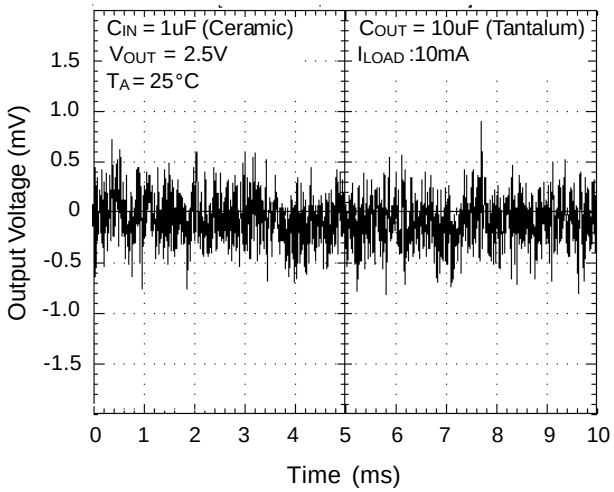
**Load Transient Response**



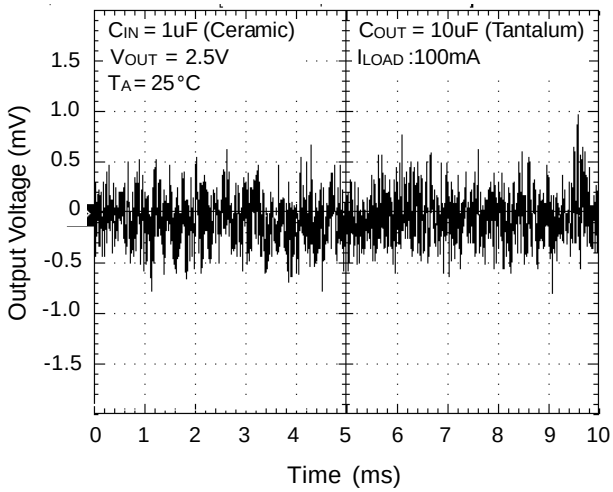

**Load Transient Response**




**Noise Signal**




**Noise Signal**



## Application Information

### Capacitor Selection

- An output capacitor as part of the device frequency compensation to maintain stability and improve transient response.
- Proper capacitor selection is important to ensure proper operation. When the output capacitor is 10μF or greater, the output capacitor should have an ESR less than 2Ω. This will improve transient response as well as promote stability.
- Ultra-low-ESR capacitor (<100mΩ), such as ceramic chip capacitors, may promote instability. These very low ESR levels may cause an oscillation and/or underdamped transient response. A low-ESR solid tantalum capacitor works extremely well and provides good transient response and stability over temperature. Aluminum electrolytics can also be used, as long as the ESR of the capacitor is <2Ω. The value of the output capacitor can be increased without limit. Higher capacitor values help to improve transient response and ripple rejection and reduce output noise.

The RT9172 requires a minimum input capacitance of 1μF between the input and ground pins to prevent any impedance interactions with the supply. The RT9172 requires a minimum of 10μF (tantalum, or electrolytic) capacitance between the output and ground pins for proper operation. Please note that the part must be paralleled with the least a 100μF electrolytic capacitor when using a 10μF (or greater) ceramic type as the output capacitor to prevent the output oscillating.

### Error Operation ($\overline{FLG}$)

The RT9172 produces a logic low signal at the $\overline{FLG}$ pin when the output drops out of regulation due to low input voltage, current limiting, or thermal limiting.

The internal error $\overline{FLG}$ comparator has an open drain output stage. Hence, the $\overline{FLG}$ pin should be pulled high through a pull up resistor.

### Sense Pin

In applications where the regulator output is not very close to the load, RT9172 can provide better remote load regulation using the SENSE pin. Figure 2. and Figure 3. depict the advantage of the SENSE option. RT9172 regulates the voltage at the output pin. Hence, the voltage at the remote load will be the regulator output voltage minus the drop across the trace resistance. For example, in the case of a 3.3V output, if the trace resistance is 100mΩ, the voltage at the remote load will be 3V with 3A of load current, $I_{LOAD}$. The RT9172 regulates the voltage at the sense pin. Connecting the sense pin to the remote load will provide regulation at the remote load, as shown in Figure 2. and Figure 3.

### Chip Enable Operation

A CMOS logic level signal at the chip enable (EN) pin will turn-off the regulator. Pin EN must be actively terminated through a 10kΩ pull-up resistor for a proper operation. If this pin is driven from a source that actively pulls high and low (such as a CMOS rail to rail comparator), the pull-up resistor is not required. This pin must be tied to $V_{IN}$ if not used.

### Dropout Voltage

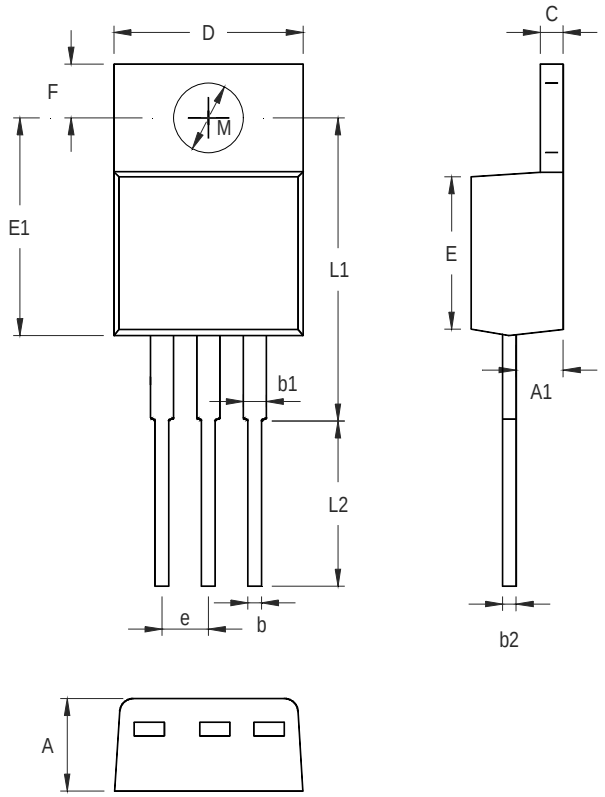
The dropout voltage of a regulator is defined as the minimum input-to-output differential required to stay within 2% of the output voltage. The RT9172 uses an internal MOSFET with an $R_{DS(ON)}$ 160mΩ. For CMOS LDOs, the dropout voltage is the product of the load current and the $R_{DS(ON)}$ of the internal MOSFET.

### Maximum Output Current Capability

RT9172 can deliver a continuous current of 1.5 A over the full operating temperature range. A heatsink may be required depending on the maximum power dissipation and maximum ambient temperature of the application. Under all possible conditions, the junction temperature must be within the range specified under operating conditions. The total power dissipation of the device is given by : $PD = (V_{IN} - V_{OUT})\ I_{OUT} + (V_{IN})\ I_{GND}$

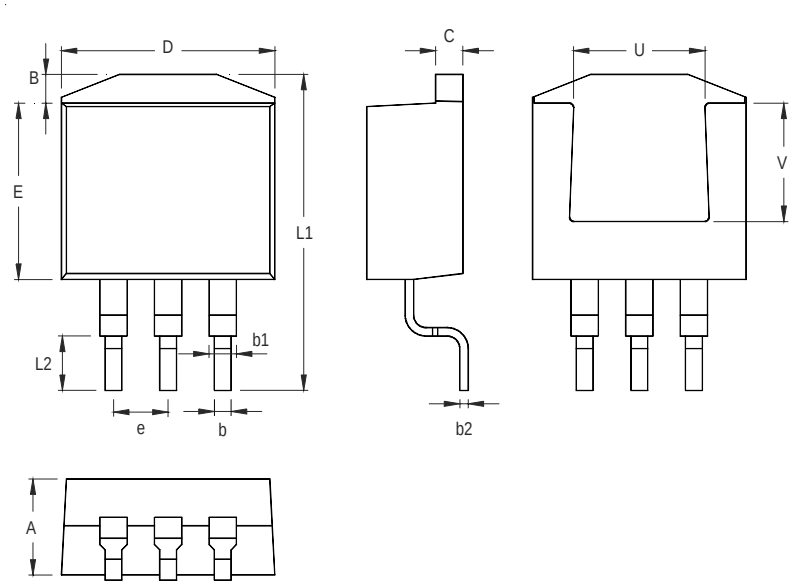
where $I_{GND}$ is the operating ground current of the device (specified under Electrical Characteristics).

## Outline Dimension



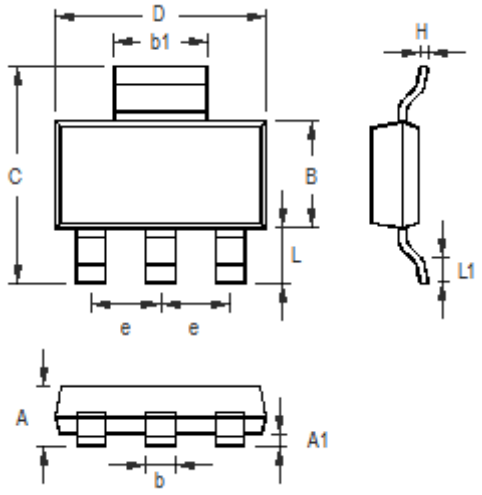

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 4.064 | 4.826 | 0.160 | 0.190 |
| A1 | 2.032 | 2.921 | 0.080 | 0.115 |
| b | 0.635 | 1.016 | 0.025 | 0.040 |
| b1 | 1.143 | 1.524 | 0.045 | 0.060 |
| b2 | 0.305 | 0.559 | 0.012 | 0.022 |
| C | 1.143 | 1.397 | 0.045 | 0.055 |
| D | 9.779 | 10.668 | 0.385 | 0.420 |
| E | 7.620 | 9.398 | 0.300 | 0.370 |
| e | 2.286 | 2.794 | 0.090 | 0.110 |
| E1 | 11.176 | 12.954 | 0.440 | 0.510 |
| F | 2.616 | 2.870 | 0.103 | 0.113 |
| L1 | 17.526 | 18.542 | 0.690 | 0.730 |
| L2 | 7.544 | 8.636 | 0.297 | 0.340 |
| M | 3.708 | 3.962 | 0.146 | 0.156 |

**3-Lead TO- 220 Plastic Package**



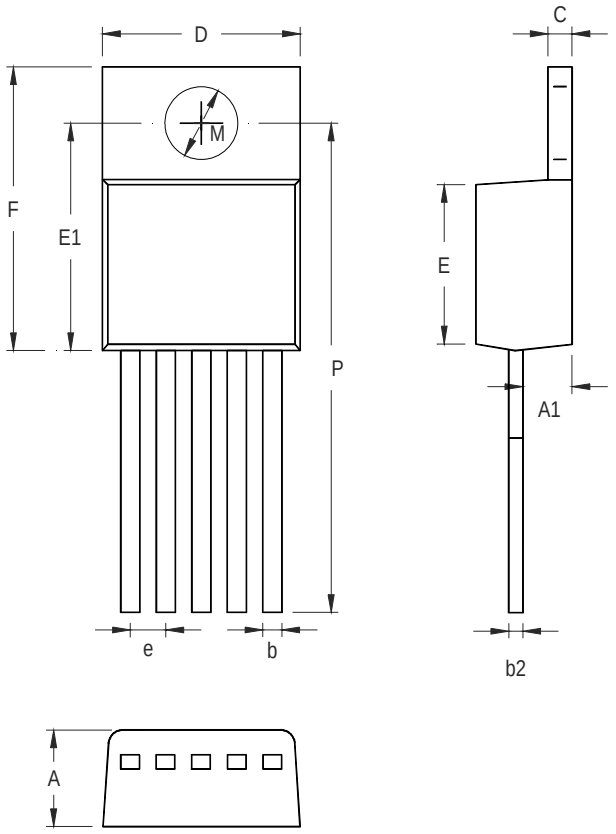

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 4.064 | 4.826 | 0.160 | 0.190 |
| B | 1.143 | 1.676 | 0.045 | 0.066 |
| b | 0.660 | 0.914 | 0.026 | 0.036 |
| b1 | 1.143 | 1.397 | 0.045 | 0.055 |
| b2 | 0.305 | 0.584 | 0.012 | 0.023 |
| C | 1.143 | 1.397 | 0.045 | 0.055 |
| D | 9.652 | 10.668 | 0.380 | 0.420 |
| E | 8.128 | 9.652 | 0.320 | 0.380 |
| e | 2.286 | 2.794 | 0.090 | 0.110 |
| L1 | 14.605 | 15.875 | 0.575 | 0.625 |
| L2 | 2.286 | 2.794 | 0.090 | 0.110 |
| U | 6.223 Ref. | | 0.245 Ref. | |
| V | 7.620 Ref. | | 0.300 Ref. | |

**3-Lead TO- 263 Surface Mount**



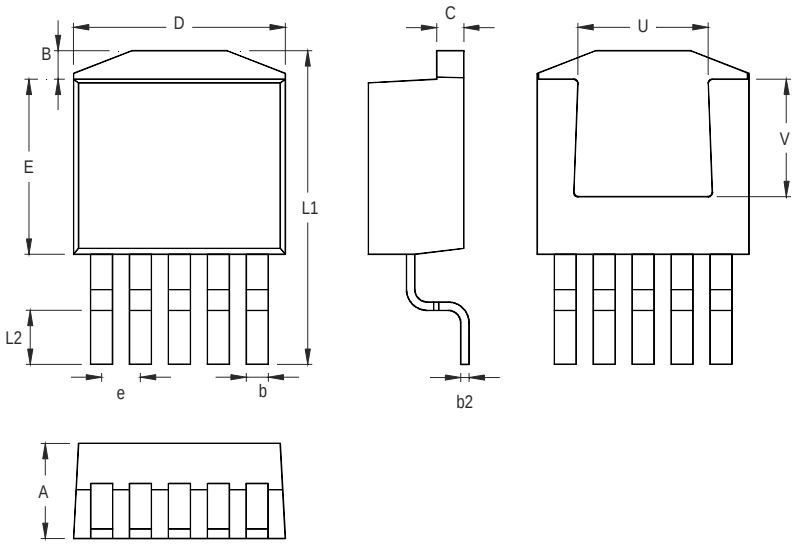

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.400 | 1.800 | 0.055 | 0.071 |
| A1 | 0.020 | 0.100 | 0.001 | 0.004 |
| b | 0.600 | 0.840 | 0.024 | 0.033 |
| B | 3.300 | 3.700 | 0.130 | 0.146 |
| C | 6.700 | 7.300 | 0.264 | 0.287 |
| D | 6.300 | 6.700 | 0.248 | 0.264 |
| b1 | 2.900 | 3.100 | 0.114 | 0.122 |
| e | 2.300 | | 0.091 | |
| H | 0.230 | 0.350 | 0.009 | 0.014 |
| L | 1.500 | 2.000 | 0.059 | 0.079 |
| L1 | 0.800 | 1.100 | 0.031 | 0.043 |

**3-Lead SOT-223 Surface Mount Package**



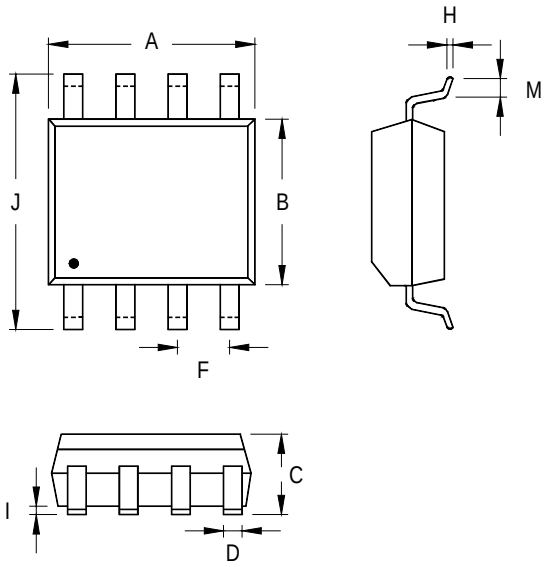

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 4.064 | 4.826 | 0.160 | 0.190 |
| A1 | 2.032 | 2.921 | 0.080 | 0.115 |
| b | 0.635 | 1.016 | 0.025 | 0.040 |
| b2 | 0.305 | 0.559 | 0.012 | 0.022 |
| C | 1.143 | 1.397 | 0.045 | 0.055 |
| e | 1.524 | 1.829 | 0.060 | 0.072 |
| D | 9.779 | 10.668 | 0.385 | 0.420 |
| E | 7.620 | 9.398 | 0.300 | 0.370 |
| E1 | 11.176 | 12.954 | 0.440 | 0.510 |
| F | 14.224 | 15.113 | 0.560 | 0.595 |
| M | 3.708 | 3.962 | 0.146 | 0.156 |
| P | 24.689 | 26.416 | 0.972 | 1.040 |

**5-Lead TO-220 Plastic Package**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 4.064 | 4.826 | 0.160 | 0.190 |
| B | 1.143 | 1.676 | 0.045 | 0.066 |
| b | 0.660 | 0.914 | 0.026 | 0.036 |
| b2 | 0.305 | 0.584 | 0.012 | 0.023 |
| C | 1.143 | 1.397 | 0.045 | 0.055 |
| D | 9.652 | 10.668 | 0.380 | 0.420 |
| E | 8.128 | 9.652 | 0.320 | 0.380 |
| e | 1.524 | 1.829 | 0.060 | 0.072 |
| L1 | 14.605 | 15.875 | 0.575 | 0.625 |
| L2 | 2.286 | 2.794 | 0.090 | 0.110 |
| U | 6.223 Ref. | | 0.245 Ref. | |
| V | 7.620 Ref. | | 0.300 Ref. | |

**5-Lead TO-263 Plastic Surface Mount Package**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 4.801 | 5.004 | 0.189 | 0.197 |
| B | 3.810 | 3.988 | 0.150 | 0.157 |
| C | 1.346 | 1.753 | 0.053 | 0.069 |
| D | 0.330 | 0.508 | 0.013 | 0.020 |
| F | 1.194 | 1.346 | 0.047 | 0.053 |
| H | 0.170 | 0.254 | 0.007 | 0.010 |
| I | 0.050 | 0.254 | 0.002 | 0.010 |
| J | 5.791 | 6.200 | 0.228 | 0.244 |
| M | 0.400 | 1.270 | 0.016 | 0.050 |

**8-Lead SOP Plastic Package**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