

1A, Ultra-Low Dropout, Ultra-Fast CMOS LDO Regulator

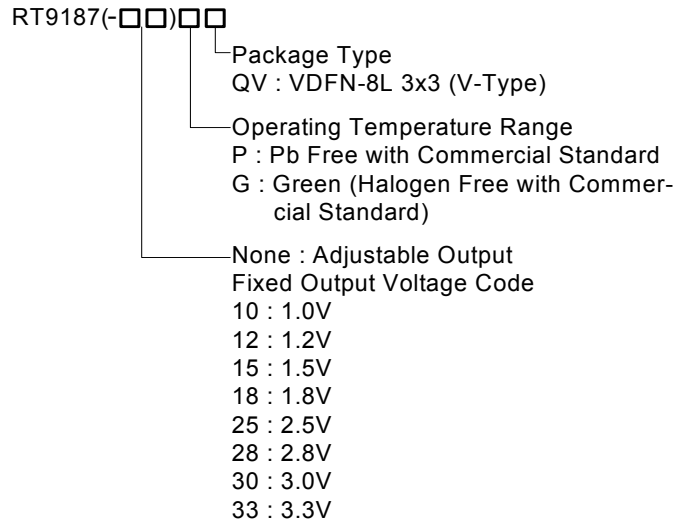
General Description

The RT9187 is a high-performance, 1A LDO regulator, offering extremely high PSRR and ultra-low dropout. Ideal for portable RF and wireless applications with demanding performance and space requirements.

A noise reduction pin is also available for further reduction of output noise. Regulator ground current increases only slightly in dropout, further prolonging the battery life. The RT9187 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, critical in hand-held wireless devices.

The RT9187 consumes less than 0.1µA in shutdown mode and has fast turn-on time less than 40µs. The other features include ultra-low dropout voltage, high output accuracy, current limiting protection, and high ripple rejection ratio. Available in the VDFN-8L 3x3 package.

Ordering Information



Note :

Richtek Pb-free and Green products are :

- ▶RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- ▶Suitable for use in SnPb or Pb-free soldering processes.
- ▶100% matte tin (Sn) plating.

Features

- Ultra-Low-Noise for RF Application
- Ultra-Fast Response in Line/Load Transient
- Quick Start-Up (Typically 40µs)
- < 0.1µA Standby Current When Shutdown
- Low Dropout : 240mV at 1A
- Wide Operating Voltage Ranges : 2.5V to 5.5V
- TTL-Logic-Controlled Shutdown Input
- Current Limiting Protection
- Thermal Shutdown Protection
- Only 2.2µF Output Capacitor Required for Stability
- High Power Supply Rejection Ratio
- RoHS Compliant and 100% Lead (Pb)-Free

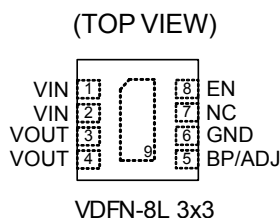
Applications

- CDMA/GSM Cellular Handsets
- Battery-Powered Equipment
- Laptop, Palmtops, Notebook Computers
- Hand-Held Instruments
- Mini PCI & PCI-Express Cards
- PCMCIA & New Cards
- Portable Information Appliances

Marking Information

For marking information, contact our sales representative directly or through a RichTek distributor located in your area, otherwise visit our website for detail.

Pin Configurations



Typical Application Circuit

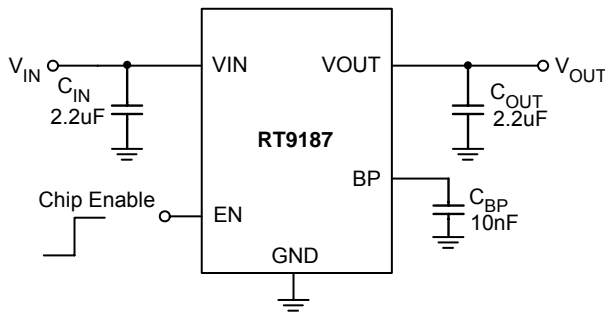


Figure 1. Fixed Operation

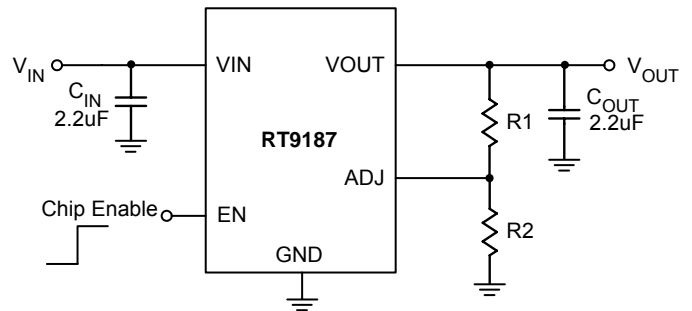


Figure 2. Adjustable Operation

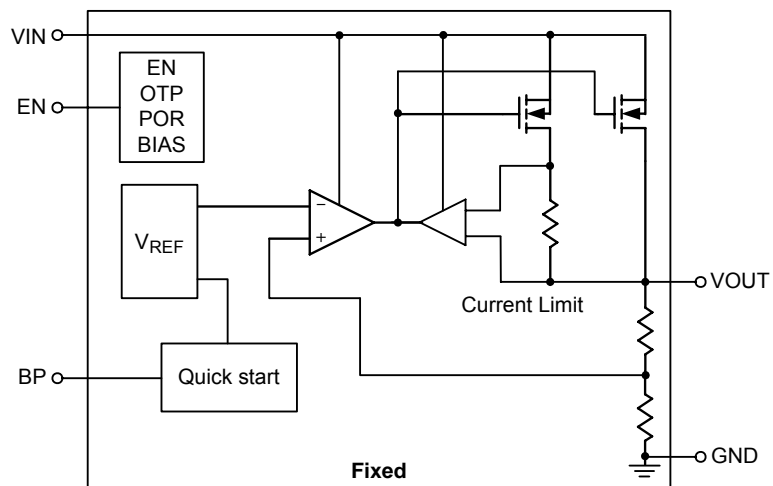
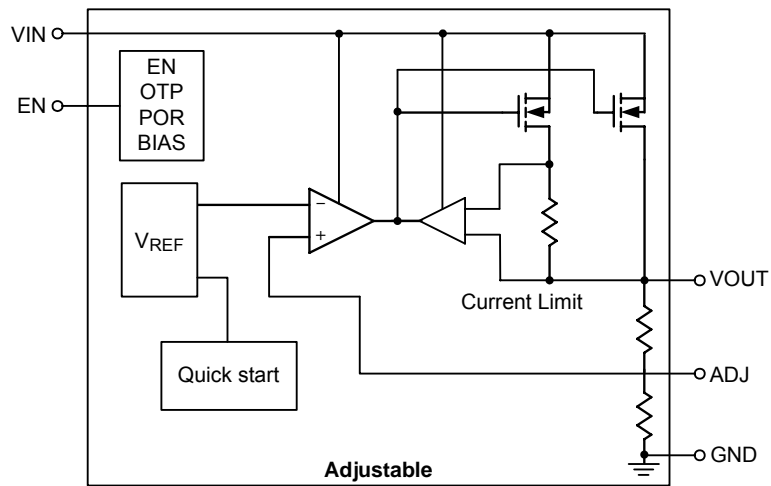
$$V_{OUT} = 0.8 \times \left(1 + \frac{R_1}{R_2}\right) \text{ Volts}$$

Note: The value of R2 should be less than 80k to maintain regulation.

Function Pin Description

| Pin No. | | Pin Name | Pin Function |
|-------------------------|---------------------------|----------|--|
| RT9187-xxPQV (Fixed) | RT9187PQV (Adjustable) | | |
| 1 | 1 | VIN | Supply Input. |
| 2 | 2 | VIN | Supply Input. |
| 3 | 3 | VOUT | Regulator Output. |
| 4 | 4 | VOUT | Regulator Output. |
| 5 | | BP | Noise Reduction. Connecting a 10nF capacitor to GND to reduce output noise. |
| | 5 | ADJ | If external feedback resistors are applied, the output voltage will be: $V_{OUT} = 0.8 \times \left(1 + \frac{R_1}{R_2}\right) \text{ Volts}$ |
| 6 | 6 | GND | Common Ground. |
| 7 | 7 | NC | No Internal Connection. |
| 8 | 8 | EN | Enable Input Logic, Active High. When the EN goes to a logic low, the device is in shutdown mode. |
| Exposed Pad (9) | | NC | No Internal Connection. |

Function Block Diagram



Absolute Maximum Ratings (Note 1)

| | | |
|---|-------|----------------|
| • Supply Input Voltage | ----- | 6V |
| • EN Input Voltage | ----- | 6V |
| • Power Dissipation, P_D @ $T_A = 25^\circ\text{C}$ | | |
| VDFN-8L 3x3 | ----- | 0.923W |
| • Package Thermal Resistance (Note 9) | | |
| VDFN-8L 3x3, θ_{JC} | ----- | 8.2°C/W |
| VDFN-8L 3x3, θ_{JA} | ----- | 108°C/W |
| • Lead Temperature (Soldering, 10 sec.) | ----- | 260°C |
| • Junction Temperature | ----- | 150°C |
| • Storage Temperature Range | ----- | -65°C to 150°C |
| • ESD Susceptibility (Note 2) | | |
| HBM | ----- | 2kV |
| MM | ----- | 200V |

Recommended Operating Conditions (Note 3)

| | | |
|------------------------------|-------|----------------|
| • Supply Input Voltage | ----- | 2.5V to 5.5V |
| • EN Input Voltage | ----- | 0V to 5.5V |
| • Junction Temperature Range | ----- | -40°C to 125°C |
| • Ambient Temperature Range | ----- | -40°C to 85°C |

Electrical Characteristics

($V_{IN} = V_{OUT} + 1V$, $V_{EN} = V_{IN}$, $C_{IN} = C_{OUT} = 2.2\mu\text{F}$ (Ceramic) & $C_{BP} = 10\text{nF}$, $T_A = 25^\circ\text{C}$ unless otherwise specified)

| Parameter | | Symbol | Test Conditions | Min | Typ | Max | Units |
|--|--------------------|-------------------|---|-----|-----|-----|---------------|
| Output Voltage Accuracy (Fixed Output Voltage) | | ΔV_{OUT} | $I_{OUT} = 10\text{mA}$ | -2 | 0 | +2 | % |
| Output Voltage Range (Adjustable) | | V_{OUT_Adj} | | 0.8 | -- | 4.5 | V |
| Quiescent Current (Note 6) | | I_Q | $V_{EN} \geq V_{IH}$, $I_{OUT} = 0\text{mA}$ | -- | 380 | 500 | μA |
| Standby Current (Note 7) | | I_{STBY} | $V_{EN} \leq V_{IL}$, $V_{IN} = 3.3\text{V}$ | -- | 0.1 | 1 | μA |
| Current Limit | | I_{LIM} | $R_{LOAD} = 0.5\Omega$, $V_{IN} = 3.3\text{V}$ | 2 | 2.8 | 3 | A |
| Dropout Voltage (Note 4) | | V_{DROP} | $I_{OUT} = 0.25\text{A}$ (Note 8) | -- | 60 | 100 | mV |
| | | | $I_{OUT} = 0.5\text{A}$ | -- | 120 | 180 | |
| | | | $I_{OUT} = 1.0\text{A}$ | -- | 240 | 360 | |
| Load Regulation (Note 5) (Fixed Output Voltage) | | ΔV_{LOAD} | $V_{IN} = (V_{OUT} + 0.5\text{V})$ $10\text{mA} < I_{OUT} < 1.0\text{A}$ | -- | 0.4 | -- | %/A |
| EN Threshold | Logic-Low Voltage | V_{IL} | $V_{IN} = 3.3\text{V}$ | -- | -- | 0.6 | V |
| | Logic-High Voltage | V_{IH} | $V_{IN} = 3.3\text{V}$ | 1.8 | -- | -- | |
| Enable Pin Current | | I_{EN} | $V_{IN} = 3.3\text{V}$, Enable | -- | 0.1 | 1 | μA |
| Power Supply Rejection Rate | f = 100Hz | PSRR | $I_{OUT} = 300\text{mA}$ | -- | -60 | -- | dB |
| | f = 10kHz | | | -- | -50 | -- | |

To be continued

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|------------------------------|-------------------|--|-------|-----|-------|---------------|
| Line Regulation | ΔV_{LINE} | $V_{IN} = (V_{OUT} + 0.5)$ to 5.5V, $I_{OUT} = 1\text{ mA}$ | -- | -- | 0.3 | % |
| Start-Up Time | T_{Start_Up} | $R_{LOAD} = 3\Omega$, $1\text{ nF} \leq C_{BP} \leq 0.1\mu\text{F}$ | -- | 40 | -- | μs |
| Thermal Shutdown Temperature | T_{SD} | | -- | 170 | -- | °C |
| Thermal Shutdown Hysteresis | ΔT_{SD} | | -- | 30 | -- | |
| ADJ | | | | | | |
| Reference Voltage Tolerance | V_{REF} | | 0.784 | 0.8 | 0.816 | V |
| ADJ Pin Current | I_{ADJ} | $V_{ADJ} = V_{REF}$ | -- | 10 | 100 | nA |

Note 1. Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

Note 3. The device is not guaranteed to function outside its operating conditions.

Note 4. The dropout voltage is defined as $V_{IN} - V_{OUT}$, which is measured when V_{OUT} is $V_{OUT(NORMAL)} - 100\text{mV}$.

Note 5. Regulation is measured at constant junction temperature by using a 2ms current pulse. Devices are tested for load regulation in the load range from 10mA to 1.0A.

Note 6. Quiescent, or ground current, is the difference between input and output currents. It is defined by $I_Q = I_{IN} - I_{OUT}$ under no load condition ($I_{OUT} = 0\text{mA}$). The total current drawn from the supply is the sum of the load current plus the ground pin current.

Note 7. Standby current is the input current drawn by a regulator when the output voltage is disabled by a shutdown signal ($V_{EN} > 1.8\text{V}$).

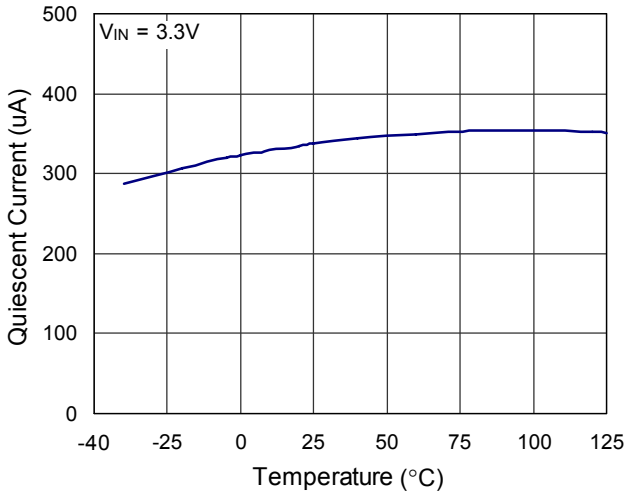
Note 8. Performance at $-5^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$ is assured by design.

Note 9. θ_{JA} is measured in the natural convection at $T_A = 25^\circ\text{C}$ on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

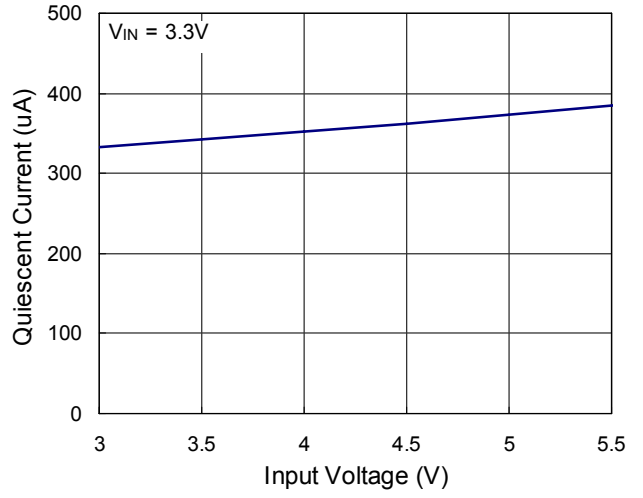
Typical Operating Characteristics

($C_{OUT} = 2.2\mu F/x5R$, $C_{BP} = 10nF$, unless otherwise specified)

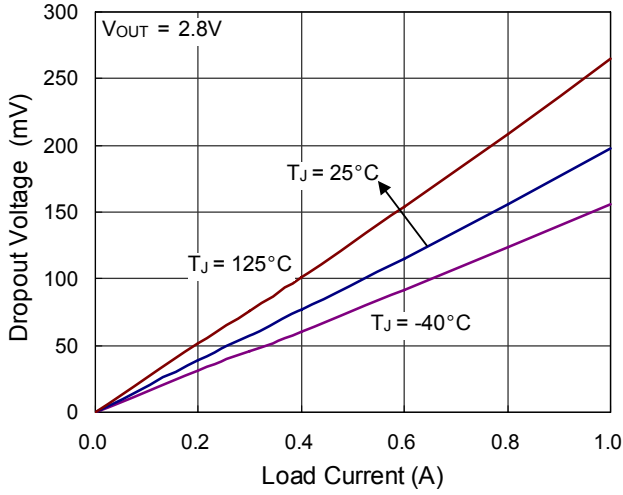
Quiescent Current vs. Temperature



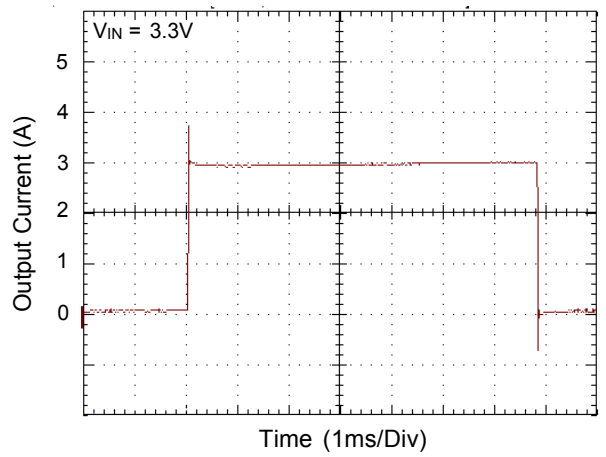
Quiescent Current vs. Input Voltage



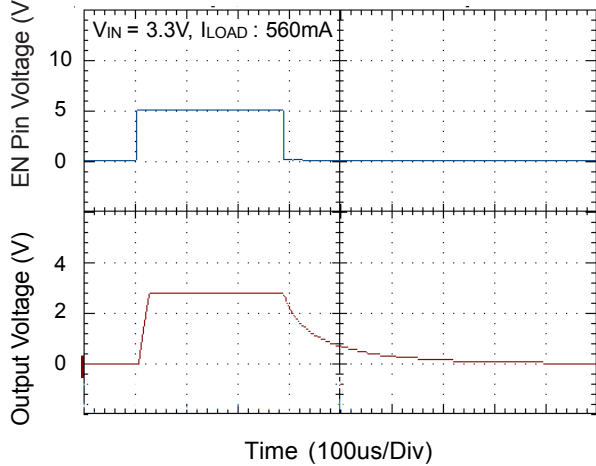
Dropout Voltage vs. Load Current



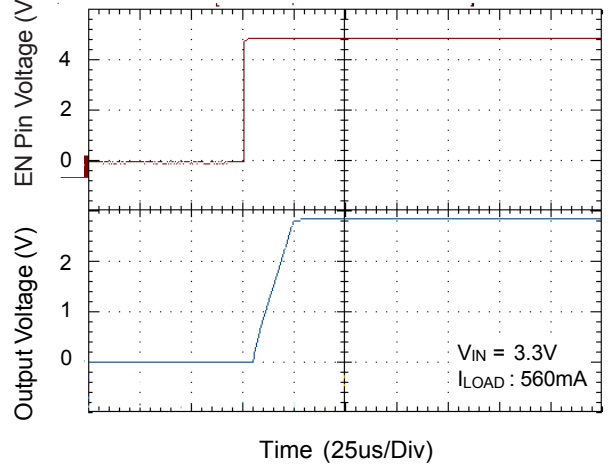
Current Limit



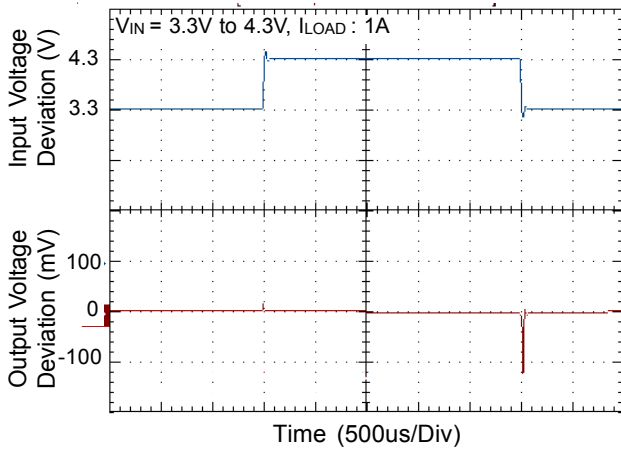
EN Pin Shutdown Response



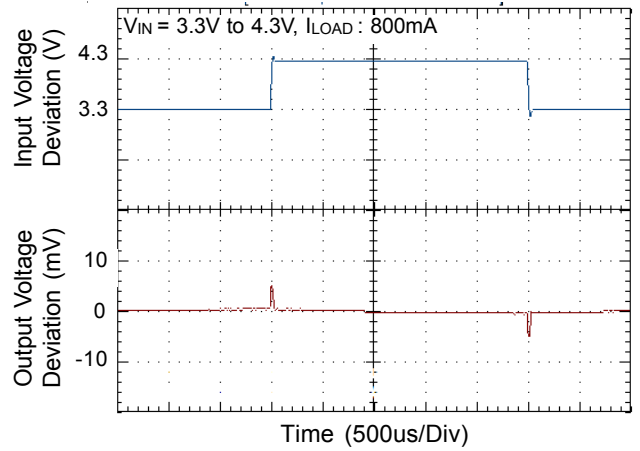
Start Up



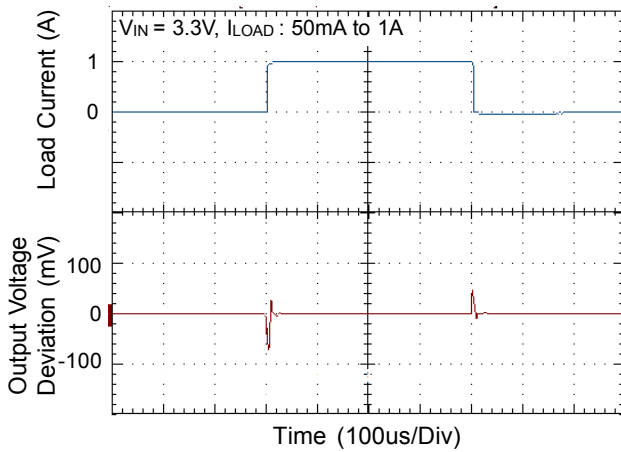
Line Transient Regulation



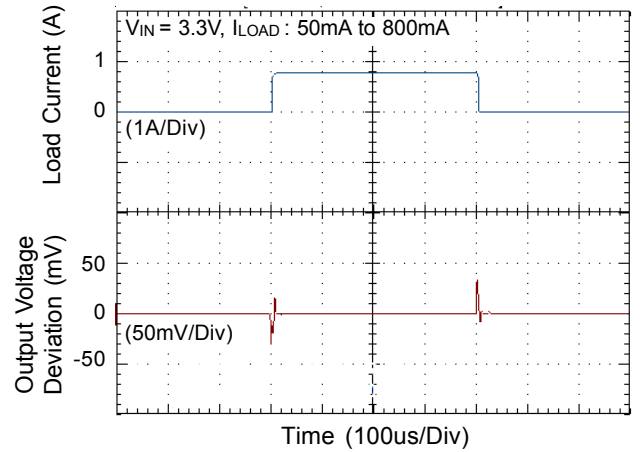
Line Transient Regulation



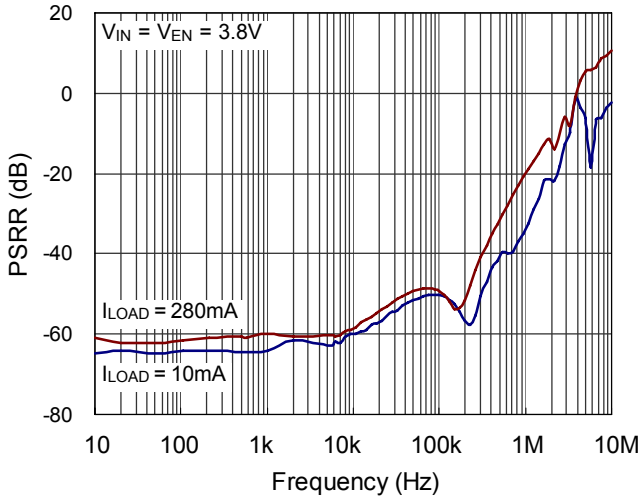
Load Transient Regulation



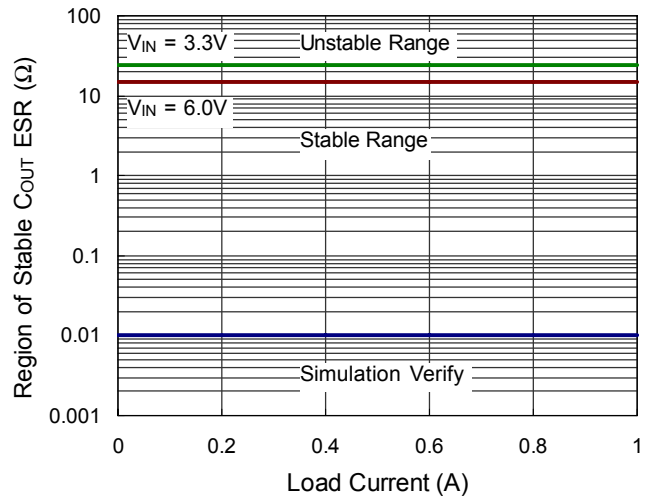
Load Transient Regulation



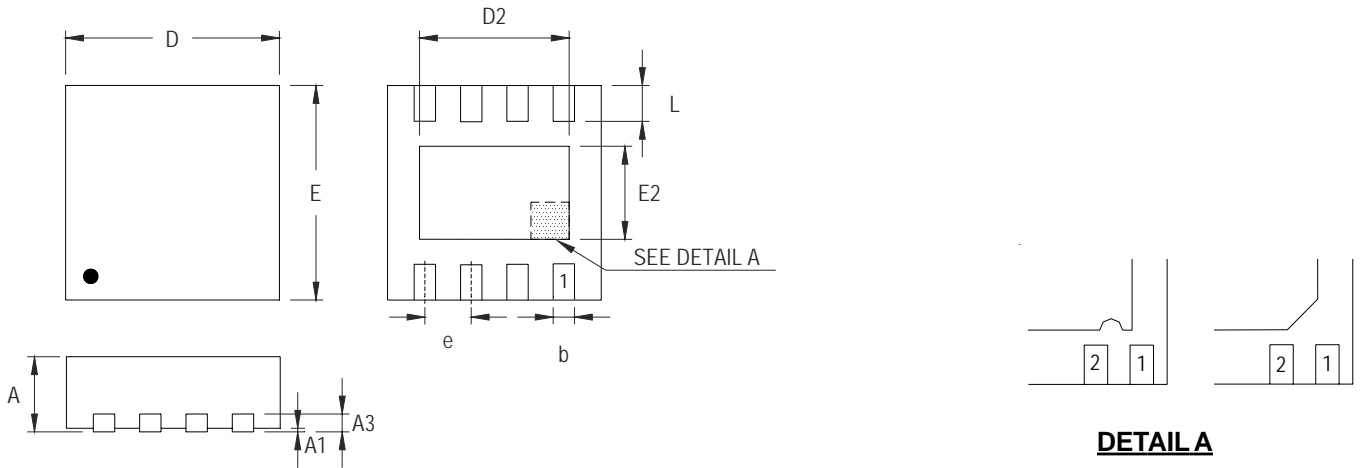
PSRR



Region of Stable C_{OUT} ESR vs. Load Current



Outline Dimension



DETAILA
Pin #1 ID and Tie Bar Mark Options

Note : The configuration of the Pin #1 identifier is optional, but must be located within the zone indicated.

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 0.800 | 1.000 | 0.031 | 0.039 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A3 | 0.175 | 0.250 | 0.007 | 0.010 |
| b | 0.200 | 0.300 | 0.008 | 0.012 |
| D | 2.950 | 3.050 | 0.116 | 0.120 |
| D2 | 2.100 | 2.350 | 0.083 | 0.093 |
| E | 2.950 | 3.050 | 0.116 | 0.120 |
| E2 | 1.350 | 1.600 | 0.053 | 0.063 |
| e | 0.650 | | 0.026 | |
| L | 0.425 | 0.525 | 0.017 | 0.021 |

V-Type 8L DFN 3x3 Package

Richtek Technology Corporation

Headquarter
5F, No. 20, Taiyuen Street, Chupei City
Hsinchu, Taiwan, R.O.C.
Tel: (8863)5526789 Fax: (8863)5526611

Richtek Technology Corporation

Taipei Office (Marketing)
8F, No. 137, Lane 235, Paochiao Road, Hsintien City
Taipei County, Taiwan, R.O.C.
Tel: (8862)89191466 Fax: (8862)89191465
Email: marketing@richtek.com