25μA I_Q, 250mA Low-Dropout Linear Regulator

General Description

The RT9076 is a low-dropout (LDO) linear regulator that features high input voltage, low dropout voltage, ultra-low operating current, and miniaturized packaging. With quiescent current as low as 25μA, the RT9076 is ideal for battery-powered equipment.

The RT9076's stability requirements are easily met with all types of output capacitors, including tiny ceramic capacitors, over its wide input range and its load current range (0mA to 250mA). The RT9076 offers standard output voltages of 1.2V, 1.5V, 1.8V, 2.5V and 3.3V.

Ordering Information

RT9076-□□□□

- Package Type
  V : SOT-23-3
  VN : SOT-23-3 (N-Type)
- Lead Plating System
  G : Green (Halogen Free and Pb Free)
- Output Voltage
  12 : 1.2V
  :
  33 : 3.3V
  Special request: Any output voltage between 1.2V and 3.3V under specific business agreement

Note :

Richtek 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.

Features

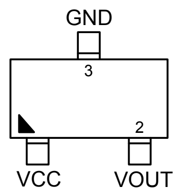
- **25μA Quiescent Current**
- **±2% Output Accuracy**
- **250mA Output Current**
- **Dropout Voltage : 0.4V at 200mA**
- **Fixed Output Voltage 1.2V/1.5V/1.8V/2.5V/3.3V**
- **Stable with Ceramic or Tantalum Capacitor**
- **Current Limit Protection**
- **Over-Temperature Protection**
- **SOT-23-3 Packages**
- **RoHS Compliant and Halogen Free**

Applications

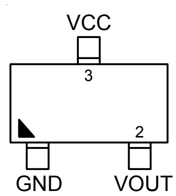
- Portable, Battery Powered Equipment
- Ultra Low Power Microcontrollers

Pin Configurations

(TOP VIEW)



SOT-23-3

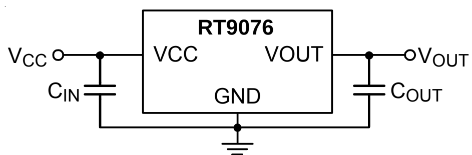


SOT-23-3 (N-Type)

Marking Information

For marking information, contact our sales representative directly or through a Richtek distributor located in your area.

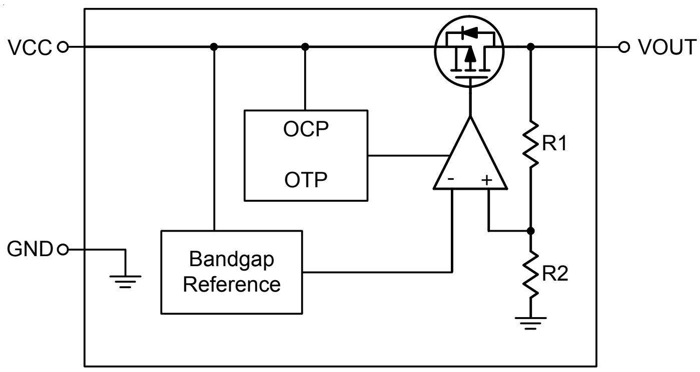
Simplified Application Circuit



Functional Pin Description

Pin No.		Pin Name	Pin Function
SOT-23-3	SOT-23-3 (N-Type)		
1	3	VCC	Supply Voltage Input.
2	2	VOUT	Output of the Regulator.
3	1	GND	Ground.

Function Block Diagram



Operation

The RT9076 is a high input voltage linear regulator specifically designed to minimize external components.

The minimum required output capacitance for stable operation is 1μF effective capacitance after consideration of the temperature and voltage coefficient of the capacitor.

Output Transistor

The RT9076 includes a built-in low on-resistance P-MOSFET output transistor for low dropout voltage applications.

Error Amplifier

The Error Amplifier compares the output feedback voltage from an internal feedback voltage divider to an internal reference voltage and controls the P-MOSFET's gate voltage to maintain output voltage regulation.

Current Limit

The RT9076 provides a current limit function to prevent damage during output over-load or shorted-circuit conditions. The output current is detected by an internal sensing transistor.

Over-Temperature Protection

The over-temperature protection function will turn off the P-MOSFET when the internal junction temperature exceeds 150°C (typ.) and the output current exceeds 30mA. Once the junction temperature cools down by approximately 20°C, the regulator will automatically resume operation.

Absolute Maximum Ratings (Note 1)

- VCC to GND -- –0.3V to 7V
- VOUT to VCC -- –7V to 0.3V
- VOUT to GND -- –0.3V to 7V
- Power Dissipation, P_D @ T_A = 25°C
  SOT-23-3 -- 0.41W
- Package Thermal Resistance (Note 2)
  SOT-23-3, θ_{JA} -- 243.3°C/W
- Lead Temperature (Soldering, 10 sec.) -- 260°C
- Junction Temperature -- 150°C
- Storage Temperature Range -- –65°C to 150°C
- ESD Susceptibility (Note 3)
  HBM (Human Body Model) -- 2kV
  MM (Machine Model) -- 200V

Recommended Operating Conditions (Note 4)

- Supply Input Voltage, VCC -- 2.5V to 6V
- Junction Temperature Range -- –40°C to 125°C
- Ambient Temperature Range -- –40°C to 85°C

Electrical Characteristics

((V_{OUT} + 1) < V_{CC} < 6V, T_A = 25°C, unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage Range	V_{OUT}		1.2	--	3.3	V
DC Output Accuracy		I_{LOAD} = 1mA	–2	--	2	%
Dropout Voltage	V_{Drop}	I_{LOAD} = 0.2A, $V_{OUT} \geq$ 3V	--	0.4	1.2	V
		I_{LOAD} = 0.1A, V_{OUT} < 3V	--	0.3	1	
Quiescent Current	I_Q	I_{LOAD} = 20mA	--	25	50	μA
Line Regulation		I_{LOAD} = 1mA, V_{OUT} > 1.8V	--	0.6	1	%
		I_{LOAD} = 1mA, $V_{OUT} \leq$ 1.8V	--	0.6	1.3	
Load Regulation		10mA < I_{LOAD} < 200mA, V_{OUT} < 1.5V	--	1	1.4	
		10mA < I_{LOAD} < 200mA, 1.5V ≤ V_{OUT} < 2.5V	--	0.7	1.2	%
		10mA < I_{LOAD} < 250mA, $V_{OUT} \geq$ 2.5V	--	0.6	1	
Power Supply Rejection Ratio	PSRR	f = 100Hz, I_{OUT} = 50mA	--	–70	--	dB
		f = 10kHz, I_{OUT} = 50mA	--	–40	--	
Output Current Limit		V_{OUT} = 0.5 x $V_{OUT(Normal)}$	300	400	500	mA
OTP Threshold		I_{LOAD} = 30mA	--	150	--	°C
OTP Hysteresis		I_{LOAD} = 30mA	--	20	--	°C

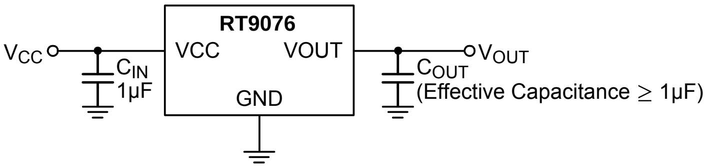
Note 1. Stresses beyond those listed "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

Note 2. θ_{JA} is measured at $T_A = 25°C$ on a high effective thermal conductivity four-layer test board per JEDEC 51-7.

Note 3. Devices are ESD sensitive. Handling precaution is recommended.

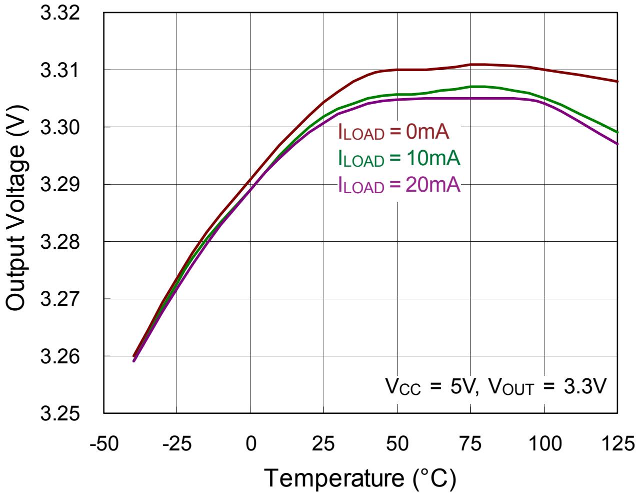
Note 4. The device is not guaranteed to function outside its operating conditions.

Typical Application Circuit

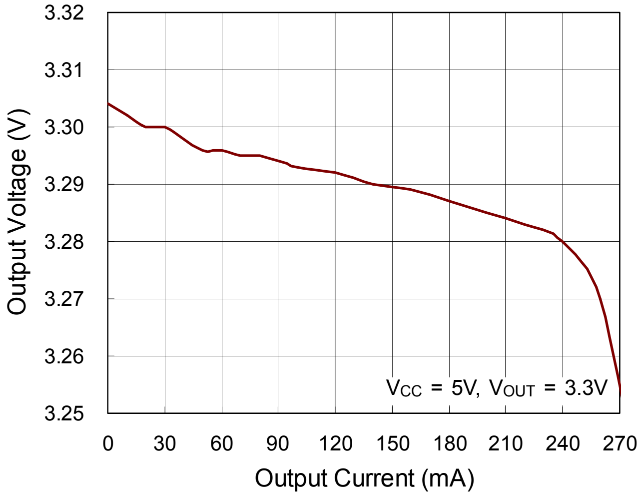


Typical Operating Characteristics

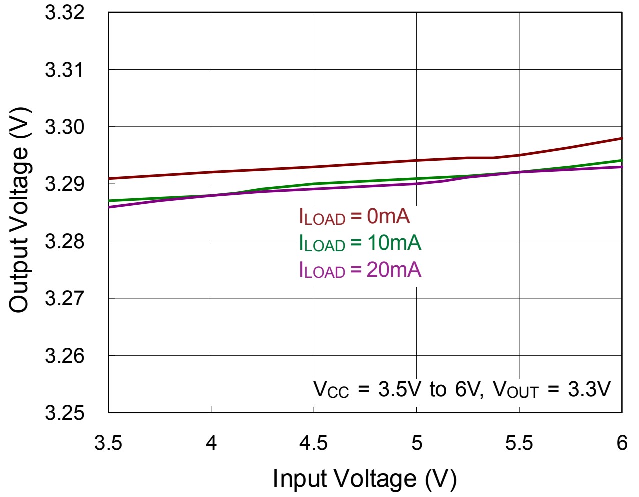
Output Voltage vs. Temperature



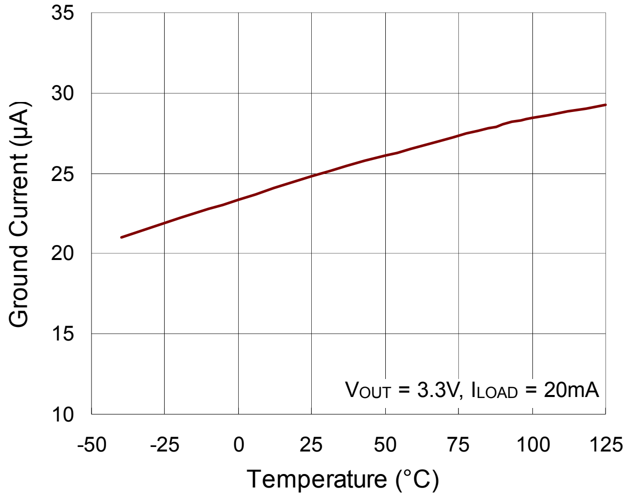
Output Voltage vs. Output Current



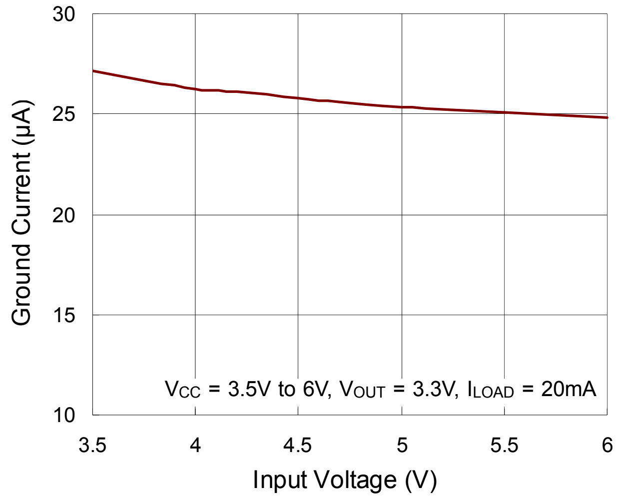
Output Voltage vs. Input Voltage



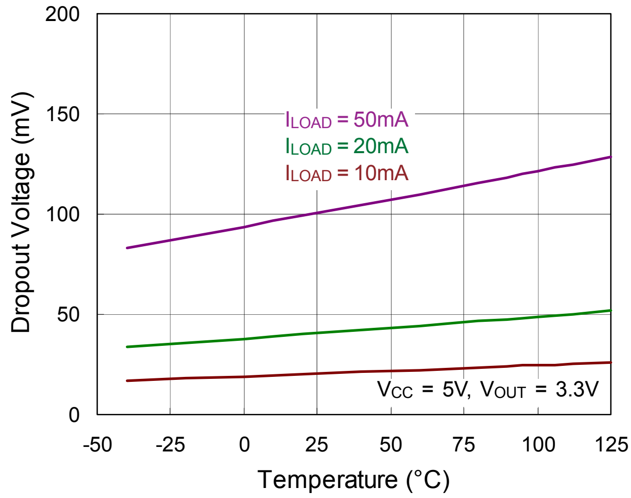
Quiescent Current vs. Temperature



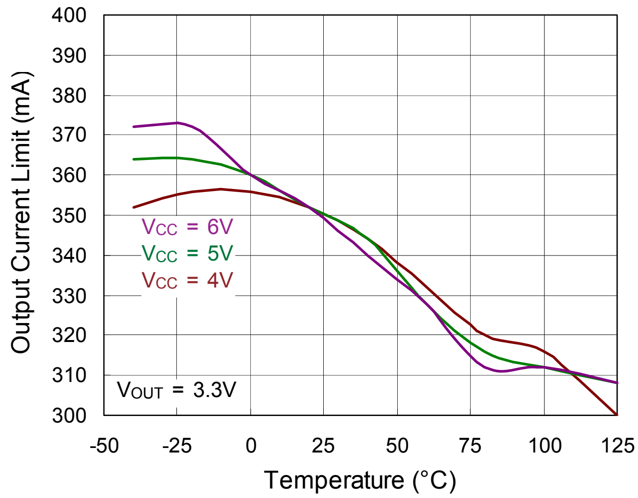
Quiescent Current vs. Input Voltage



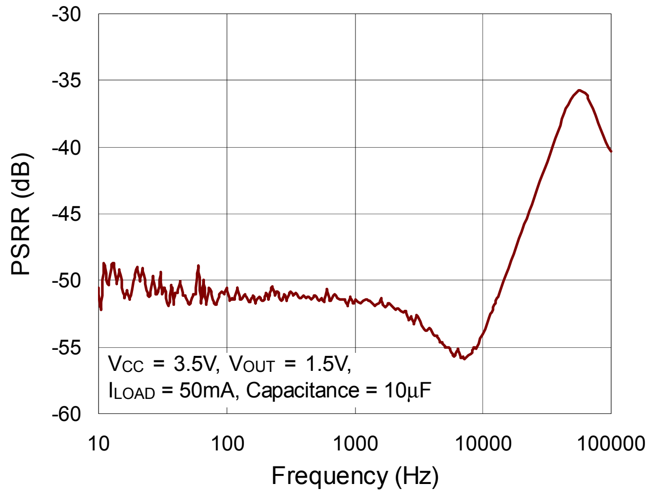
Dropout Voltage vs. Temperature



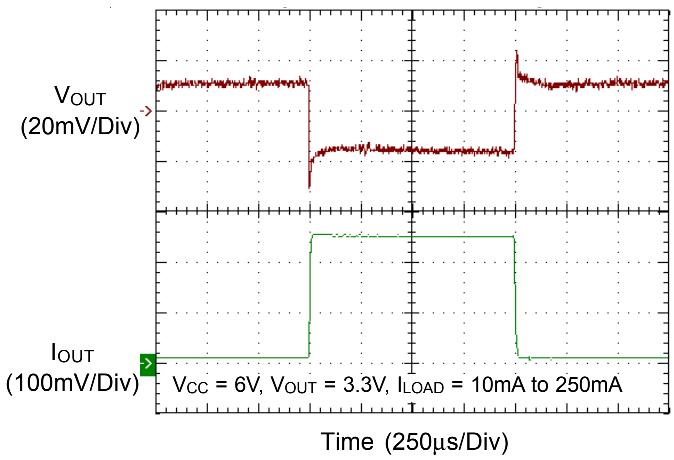
Output Current Limit vs. Temperature



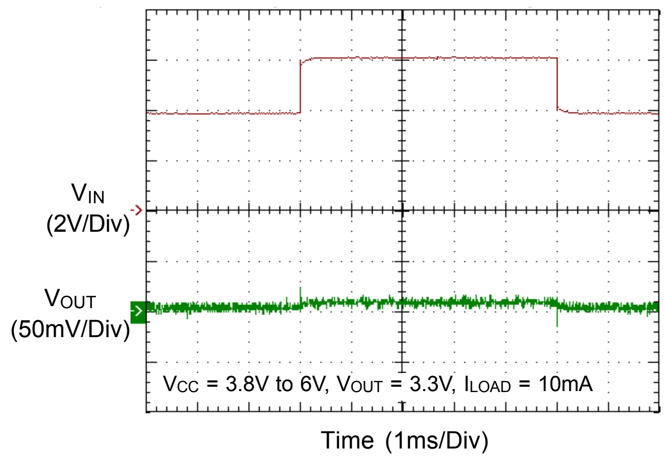
Power Supply Rejection Ratio



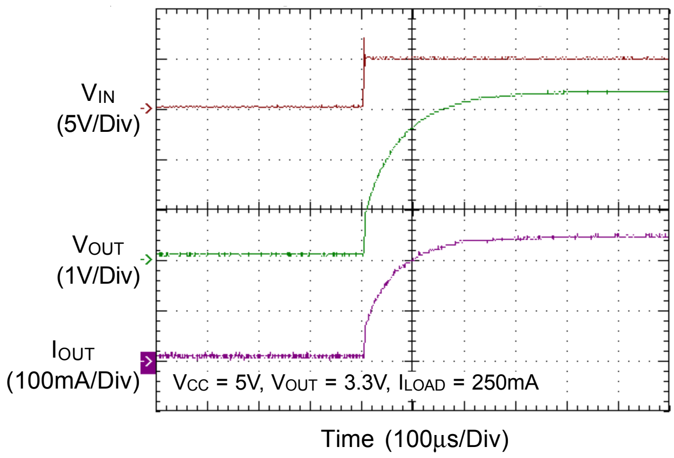
Load Transient Response



Line Transient Response



Power Up Response



Applications Information

Like any low dropout linear regulator, the RT9076's external input and output capacitors must be properly selected for stability and performance. Use a 1μF or larger input capacitor and place it close to the IC's VCC and GND pins.

Any output capacitor meeting the minimum 1mΩ ESR (Equivalent Series Resistance) and effective capacitance larger than 1μF requirement may be used. Place the output capacitor close to the IC's VOUT and GND pins. Increasing capacitance and decreasing ESR can improve the circuit's PSRR and line transient response.

Thermal Considerations

For continuous operation, do not exceed absolute the maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and the allowed difference between the junction and ambient temperatures. The maximum power dissipation can be calculated by the following formula :

$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance.

The recommended operating conditions specify a maximum junction temperature is 125°C. The junction to ambient thermal resistance, θ_{JA}, is layout dependent. On a standard JEDEC 51-7 four-layer thermal test board, the thermal resistance, θ_{JA}, of the SOT-23-3 package is 243.3C/W. The maximum power dissipation at T_A = 25°C can be calculated by the following formula :

$P_{D(MAX)}$ = (125°C − 25°C) / (243.3°C/W) = 0.41W for SOT-23-3 package

For a fixed $T_{J(MAX)}$ of 125°C, the maximum power dissipation depends on the operating ambient temperature and the package's thermal resistance, θ_{JA}. The derating curve in Figure 1 shows the effect of rising ambient temperature on the maximum recommended power dissipation.

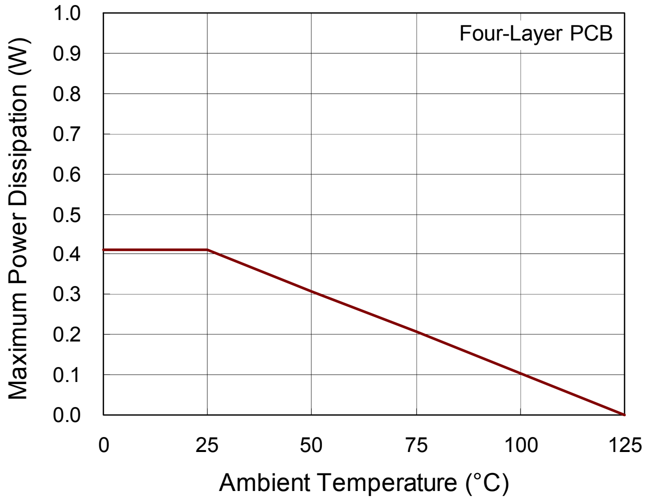
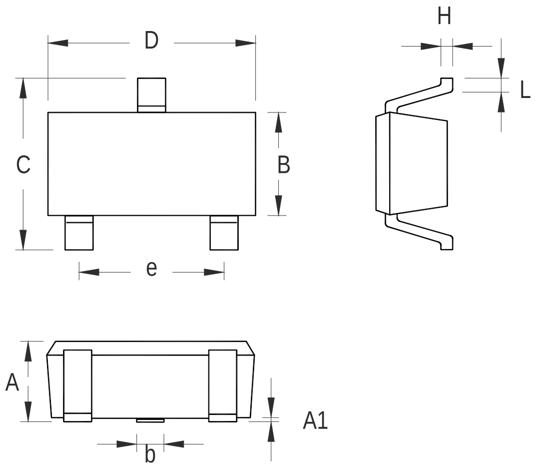


Figure 1. Derating Curve of Maximum Power Dissipation

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.035	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.356	0.508	0.014	0.020
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	1.803	2.007	0.071	0.079
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

SOT-23-3 Surface Mount Package

Richtek Technology Corporation

14F, No. 8, Tai Yuen 1st Street, Chupei City

Hsinchu, Taiwan, R.O.C.

Tel: (8863)5526789