

300mA, Ultra-Low Noise, Ultra-Fast CMOS LDO Regulator

General Description

The RP1208 is designed for portable RF and wireless applications with demanding performance and space requirements. The RP1208 performance is optimized for battery-powered systems to deliver ultra low noise and low quiescent current. A noise bypass pin is available for further reduction of output noise. Regulator ground current increases only slightly in dropout, further prolonging the battery life. The RP1208 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, critical in hand-held wireless devices. The RP1208 consumes less than 0.01uA in shutdown mode and has fast turn-on time less than 50us. The other features include ultra low dropout voltage, high output accuracy, current limiting protection, and high ripple rejection ratio. Available in the SOT-23-5 package.

Ordering Information

RP1208-□□□□	
□	Package Type B : SOT-23-5
□	Operating Temperature Range G : Green (Halogen Free with Commercial Standard)
□	Output Voltage 15 : 1.5V 16 : 1.6V : 49 : 4.9V 50 : 5.0V 1H : 1.85V 2H : 2.85V 4G : 4.75V

Note :

Richpower 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.

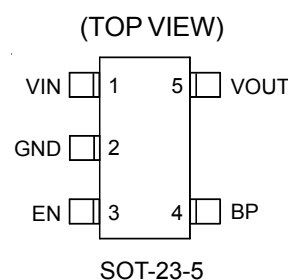
Features

- Ultra-Low-Noise for RF Application
- Ultra-Fast Response in Line/Load Transient
- Quick Start-Up (Typically 50us)
- < 0.01uA Standby Current When Shutdown
- Low Dropout : 220mV @ 300mA
- Wide Operating Voltage Ranges : 2.5V to 5.5V
- TTL-Logic-Controlled Shutdown Input
- Low Temperature Coefficient
- Current Limiting Protection
- Thermal Shutdown Protection
- Only 1uF Output Capacitor Required for Stability
- High Power Supply Rejection Ratio
- Custom Voltage Available
- RoHS Compliant and Halogen Free

Applications

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

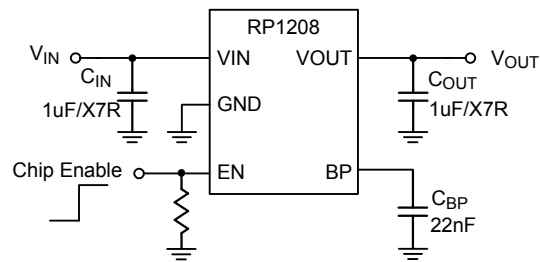
Pin Configurations



Marking Information

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

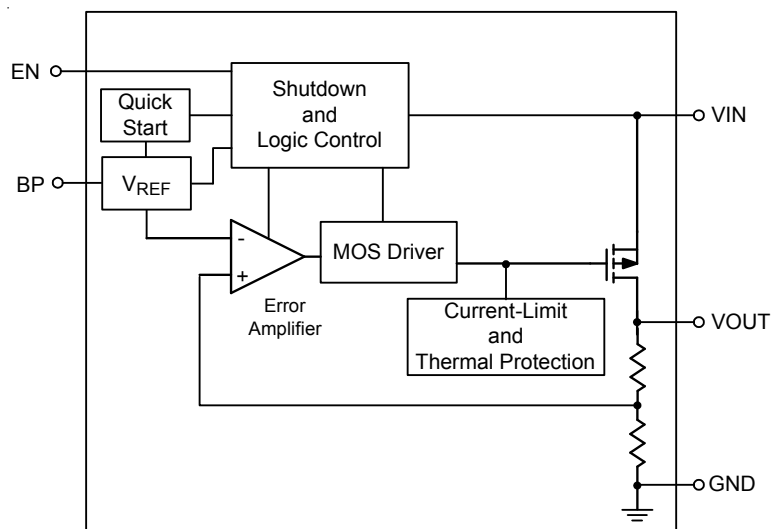
Typical Application Circuit



Functional Pin Description

Pin Name	Pin Function
EN	Chip Enable (Active High). Note that this pin is high impedance. There should be a pull low 100k Ω resistor connected to GND when the control signal is floating.
BP	Reference Noise Bypass.
GND	Ground .
VOUT	Output Voltage.
VIN	Power Input Voltage.

Function Block Diagram



Absolute Maximum Ratings (Note 1)

Supply Input Voltage	6V
Power Dissipation, P_D @ $T_A = 25^\circ\text{C}$	
SOT-23-5	400mW
Package Thermal Resistance (Note 4)	
SOT-23-5, θ_{JA}	250°C/W
Junction Temperature	150°C
Lead Temperature (Soldering, 10 sec.)	260°C
Storage Temperature Range	-65°C to 150°C
ESD Susceptibility (Note 2)	
HBM (Human Body Mode)	2kV
MM (Machine Mode)	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

($V_{IN} = V_{OUT} + 1V$, $C_{IN} = C_{OUT} = 1\mu F$, $C_{BP} = 22nF$, $T_A = 25^\circ\text{C}$, unless otherwise specified)

Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
Output Voltage Accuracy		ΔV_{OUT}	$I_{OUT} = 1mA$	-2	--	+2	%
Current Limit		I_{LIM}	$R_{LOAD} = 1\Omega$	360	400	--	mA
Quiescent Current		I_Q	$V_{EN} \geq 1.2V, I_{OUT} = 0mA$	--	90	130	uA
Dropout Voltage (Note 5)		V_{DROP}	$I_{OUT} = 200mA, V_{OUT} > 2.8V$		170	200	mV
			$I_{OUT} = 300mA, V_{OUT} > 2.8V$	--	220	300	
Line Regulation		ΔV_{LINE}	$V_{IN} = (V_{OUT} + 1V)$ to 5.5V, $I_{OUT} = 1mA$	--	--	0.3	%
Load Regulation		ΔV_{LOAD}	$1mA < I_{OUT} < 300mA$	--	--	0.6	%
Standby Current		I_{STBY}	$V_{EN} = GND$, Shutdown	--	0.01	1	uA
EN Input Bias Current		I_{IBSD}	$V_{EN} = GND$ or V_{IN}	--	0	100	nA
EN Threshold	Logic-Low Voltage	V_{IL}	$V_{IN} = 3V$ to 5.5V, Shutdown	--	--	0.4	V
	Logic-High Voltage	V_{IH}	$V_{IN} = 3V$ to 5.5V, Start-Up	1.2	--	--	
Output Noise Voltage		e_{NO}	10Hz to 100kHz, $I_{OUT} = 200mA$ $C_{OUT} = 1\mu F$	--	100	--	μV_{RMS}
Power Supply Rejection Rate	f = 100Hz	PSRR	$C_{OUT} = 1\mu F, I_{OUT} = 10mA$	--	-70	--	dB
	f = 10kHz			--	-50	--	
Thermal Shutdown Temperature		T_{SD}		--	165	--	°C
Thermal Shutdown Temperature Hysteresis		ΔT_{SD}		--	30	--	°C

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 is recommended.

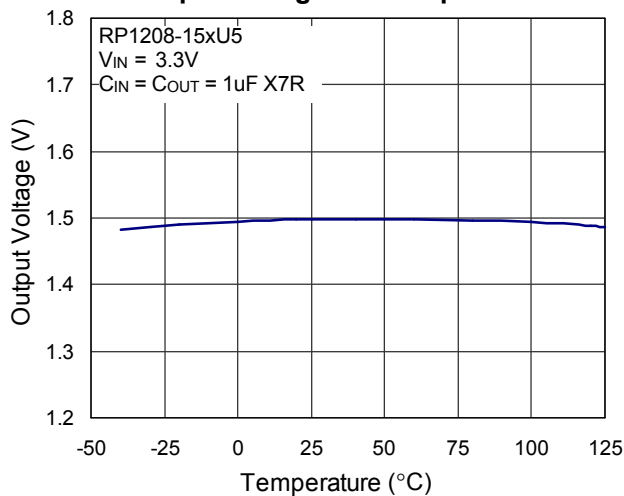
Note 3. The device is not guaranteed to function outside its operating conditions.

Note 4. θ_{JA} is measured in the natural convection at $T_A = 25^{\circ}\text{C}$ on a low effective thermal conductivity test board (Single Layer, 1S) of JEDEC 51-3 thermal measurement standard.

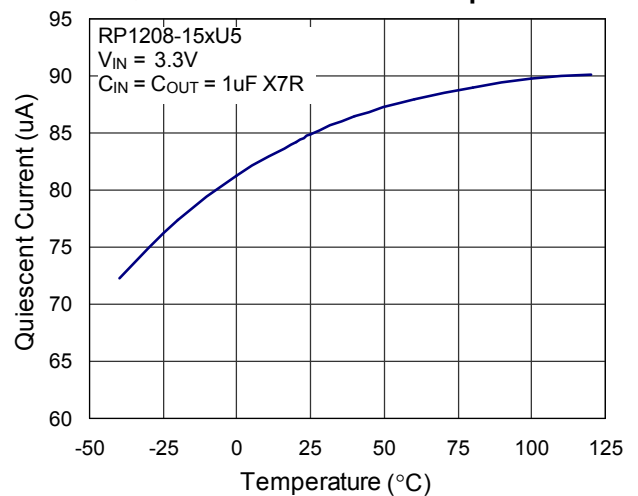
Note 5. The dropout voltage is defined as $V_{IN} - V_{OUT}$, which is measured when V_{OUT} is $V_{OUT(NORMAL)} - 100\text{mV}$.

Typical Operating Characteristics

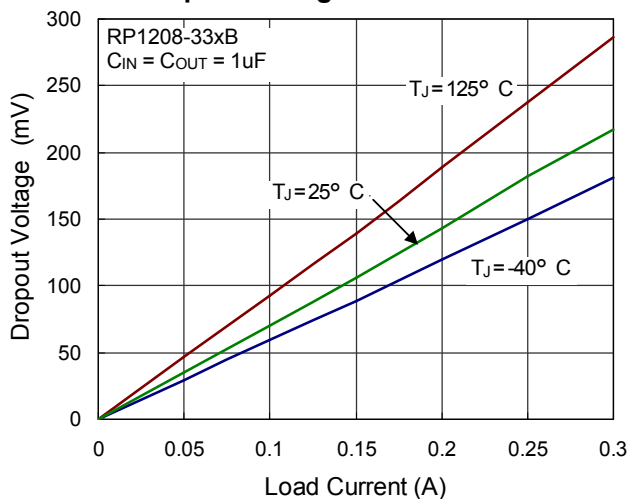
Output Voltage vs. Temperature



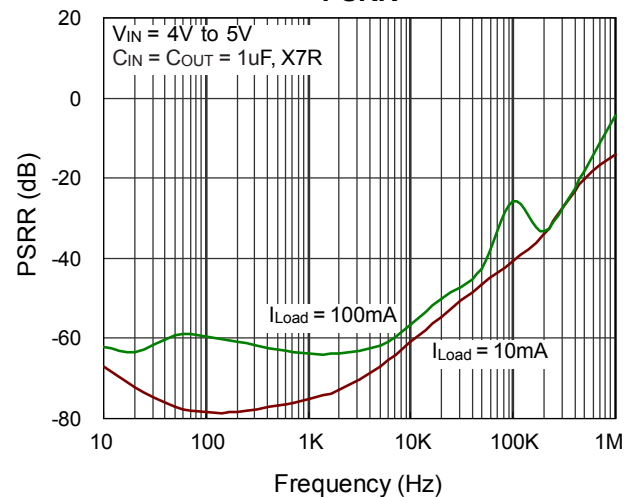
Quiescent Current vs. Temperature



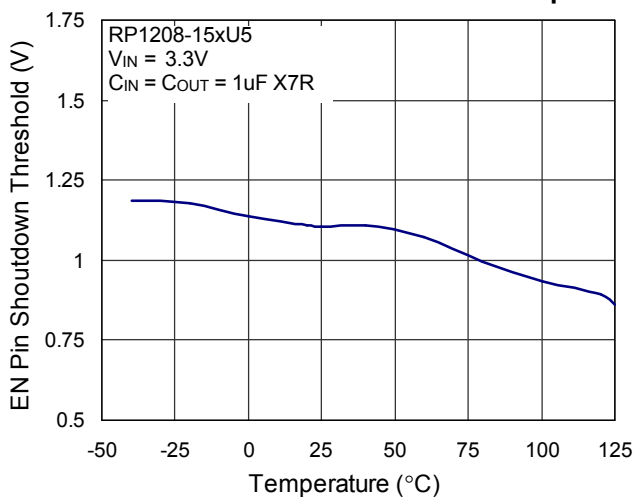
Dropout Voltage vs. Load Current



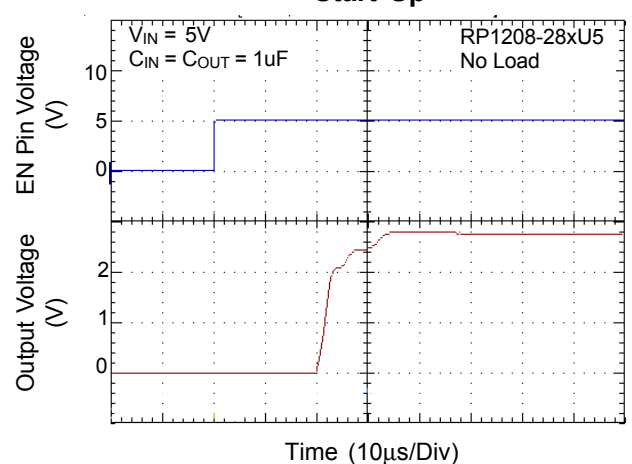
PSRR



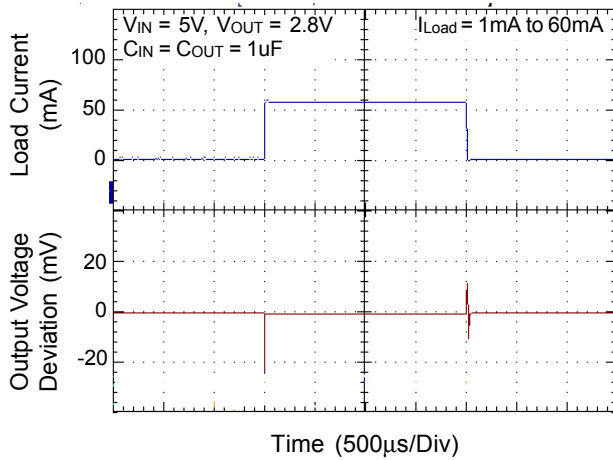
EN Pin Shutdown Threshold vs. Temperature



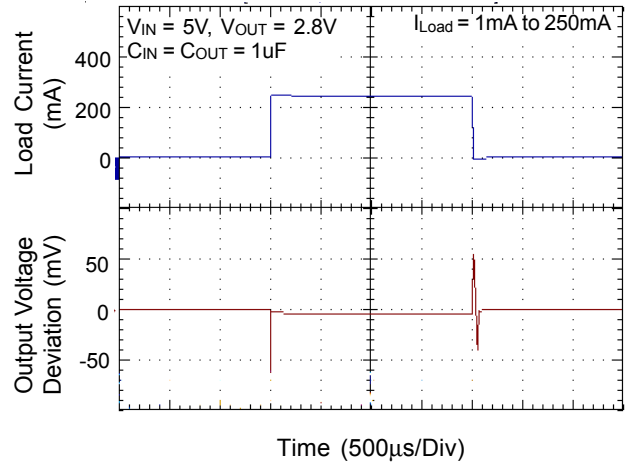
Start Up



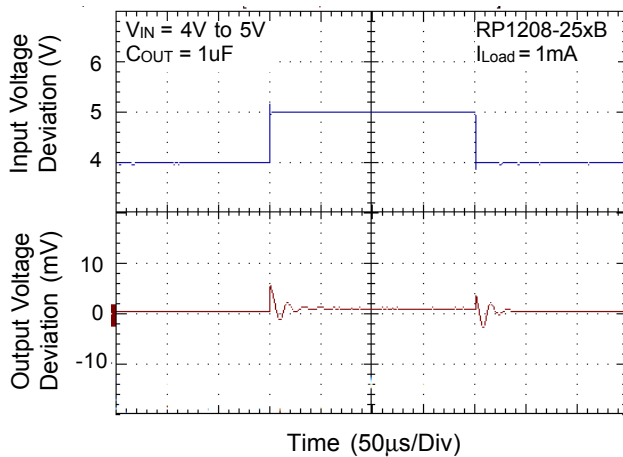
Load Transient Response



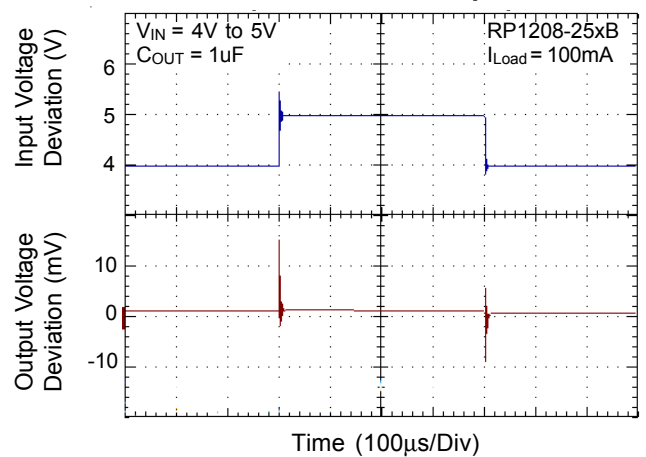
Load Transient Response



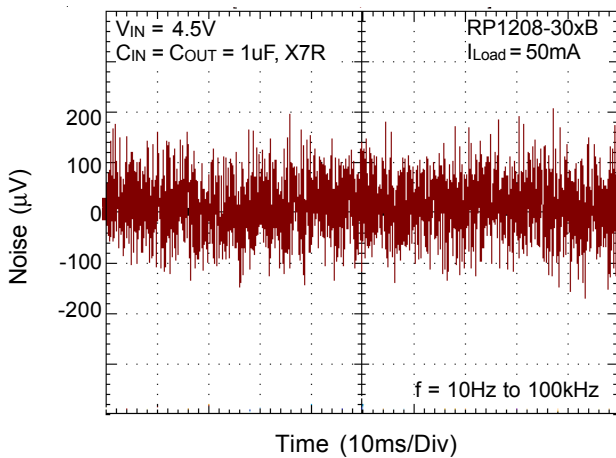
Line Transient Response



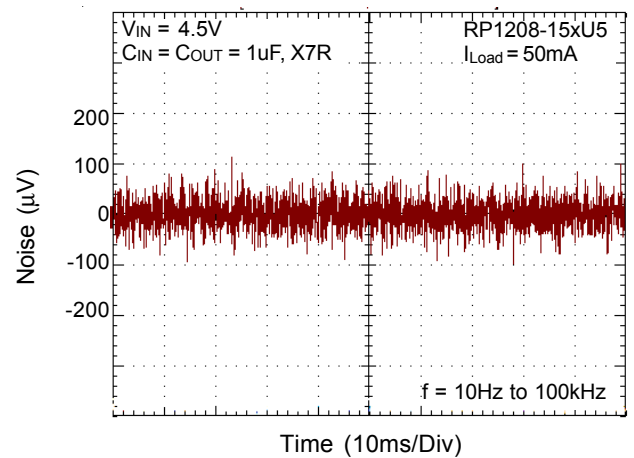
Line Transient Response



Noise

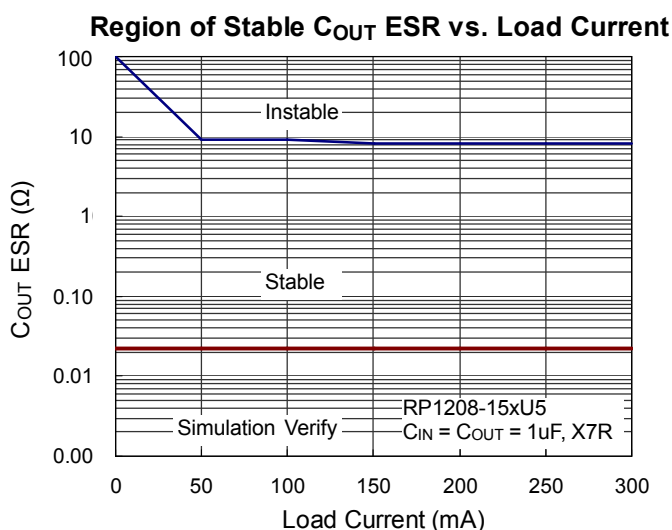


Noise



Applications Information

Like any low-dropout regulator, the external capacitors used with the RP1208 must be carefully selected for regulator stability and performance. Using a capacitor whose value is $> 1\mu\text{F}$ on the RP1208 input and the amount of capacitance can be increased without limit. The input capacitor must be located a distance of not more than 0.5 inch from the input pin of the IC and returned to a clean analog ground. Any good quality ceramic or tantalum can be used for this capacitor. The capacitor with larger value and lower ESR (equivalent series resistance) provides better PSRR and line-transient response. The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDOs application. The RP1208 is designed specifically to work with low ESR ceramic output capacitor in space-saving and performance consideration. Using a ceramic capacitor whose value is at least $1\mu\text{F}$ with ESR is $> 25\text{m}\Omega$ on the RP1208 output ensures stability. The RP1208 still works well with output capacitor of other types due to the wide stable ESR range. Figure 1 shows the curves of allowable ESR range as a function of load current for various output capacitor values. Output capacitor of larger capacitance can reduce noise and improve load transient response, stability, and PSRR. The output capacitor should be located not more than 0.5 inch from the V_{OUT} pin of the RP1208 and returned to a clean analog ground.



Bypass Capacitor and Low Noise

Connecting a 22nF between the BP pin and GND pin significantly reduces noise on the regulator output, it is critical that the capacitor connection between the BP pin and GND pin be direct and PCB traces should be as short as possible. There is a relationship between the bypass capacitor value and the LDO regulator turn on time. DC leakage on this pin can affect the LDO regulator output noise and voltage regulation performance.

Enable Function

The RP1208 features an LDO regulator enable/disable function. To assure the LDO regulator will switch on, the EN turn on control level must be greater than 1.2 volts. The LDO regulator will go into the shutdown mode when the voltage on the EN pin falls below 0.4 volts. If the enable function is not needed in a specific application, it may be tied to V_{IN} to keep the LDO regulator in a continuously on state.

Thermal Considerations

Thermal protection limits power dissipation in RP1208. When the operation junction temperature exceeds 165°C , the OTP circuit starts the thermal shutdown function turn the pass element off. The pass element turn on again after the junction temperature cools by 30°C .

For continue operation, do not exceed absolute maximum operation junction temperature 125°C . The power dissipation definition in device is :

$$P_D = (V_{\text{IN}} - V_{\text{OUT}}) \times I_{\text{OUT}} + V_{\text{IN}} \times I_Q$$

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula :

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

Where $T_{J(\text{MAX})}$ is the maximum operation junction temperature 125°C , T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance.

For recommended operating conditions specification of RP1208, where $T_{J(\text{MAX})}$ is the maximum junction temperature of the die (125°C) and T_A is the maximum

ambient temperature. The junction to ambient thermal resistance (θ_{JA} is layout dependent) for SOT-23-5 package is 250°C/W on standard JEDEC 51-3 thermal test board. The maximum power dissipation at $T_A = 25^\circ\text{C}$ can be calculated by following formula :

$$P_{D(\text{MAX})} = (125^\circ\text{C} - 25^\circ\text{C}) / 250 = 400\text{mW for SOT-23-5}$$

The maximum power dissipation depends on operating ambient temperature for fixed $T_{J(\text{MAX})}$ and thermal resistance θ_{JA} . For RP1208 packages, the Figure 2 of derating curves allows the designer to see the effect of rising ambient temperature on the maximum power allowed.

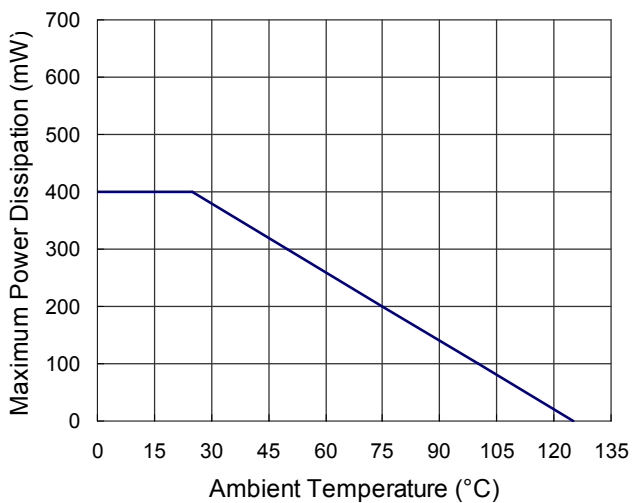
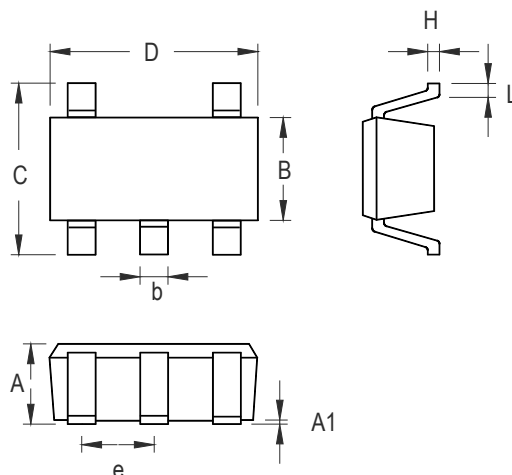


Figure 2. Derating Curve for Packages

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	0.559	0.014	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

SOT-23-5 Surface Mount Package

RICHPower MICROELECTRONICS CORP.

Headquarter

Room 2102, 1077 ZuChongZhi Road, Zhang Jiang Hi-TechPark, Pudong New Area, Shanghai, China

Tel: (8621)50277077 Fax: (8621)50276966

Information that is provided by Richpower Technology Corporation is believed to be accurate and reliable. Richpower reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. No third party intellectual property infringement of the applications should be guaranteed by users when integrating Richpower products into any application. No legal responsibility for any said applications is assumed by Richpower.