500mA Low Noise LDO Voltage Regulator

General Description

The iD9520 is a positive voltage regulator with a low dropout voltage and low noise output. In addition, this device offers a very low ground current of 300μA at 100mA output. The iD9520 has an initial tolerance of less than 2% max and a logic compatible ON/OFF switched input. When disabled, power consumption drops to nearly zero. Other key features include current limit, and thermal shutdown. The iD9520 includes a reference bypass pin for optimal low noise output performance. With its very low output temperature coefficient, this device also makes a superior low power voltage reference.

The iD9520 is an excellent choice for use in battery-powered applications such as cordless telephones, radio control systems, and portable computers. It is available in fixed voltage – 3.3V and 5.0V output. This device is offered in SOT-23-5 package.

Features

- Output Voltage Accuracy: 3%
- Low Dropout: 350mV at Full Load (V_{OUT}=5V)
- Low Quiescent Current
- Fixed Output: 3.3V, 5.0V
- Available in RoHS Compliant, Lead Free Packages: SOT-23-5

Applications

- Battery Powered Systems
- Cordless Phones
- Radio Control Systems
- Portable/Palm Top/Notebook Computers
- Portable Consumer Equipment
- Portable Instrumentation
- Bar Code Scanners
- SMPS Post Regulators

Ordering Information

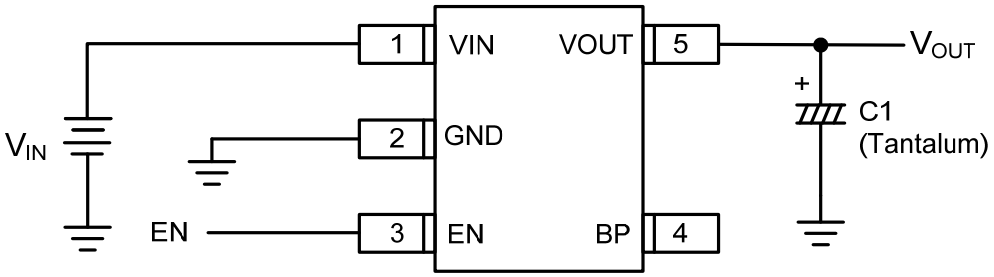
iD9520 - □□ □□□□ □

Packing
R: Tape and Reel

Package:
A50:SOT-23-5

Output Voltage	Voltage Code
3.3	33
5.0	50

Typical Application Circuit



Enable may be tied directly to V_{IN}

Absolute Maximum Ratings (Note1)

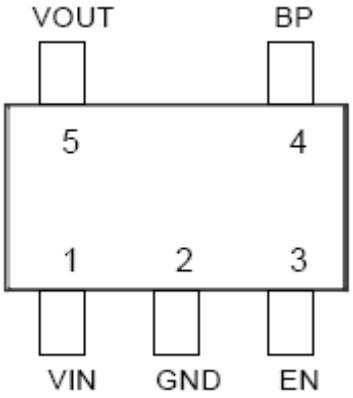
Supply Voltage V_{IN}	14V
Power Dissipation, P_D @ T_A=25°C	
SOT-23-5	400mW
Thermal Resistance, θ_{JA}	
SOT-23-5	250°C/W
Lead Temperature	260 °C
Storage Temperature	-65°C to 150°C
ESD Susceptibility	
HBM (Human Body Mode)	2kV
MM (Machine Mode)	200V

Recommended Operating Conditions

Input Voltage V_{IN}	5.5V to 12V
Junction Temperature Range	-40°C to 125°C
Ambient Operating Temperature	-40°C to 85°C

Pin Configurations

(Top View)

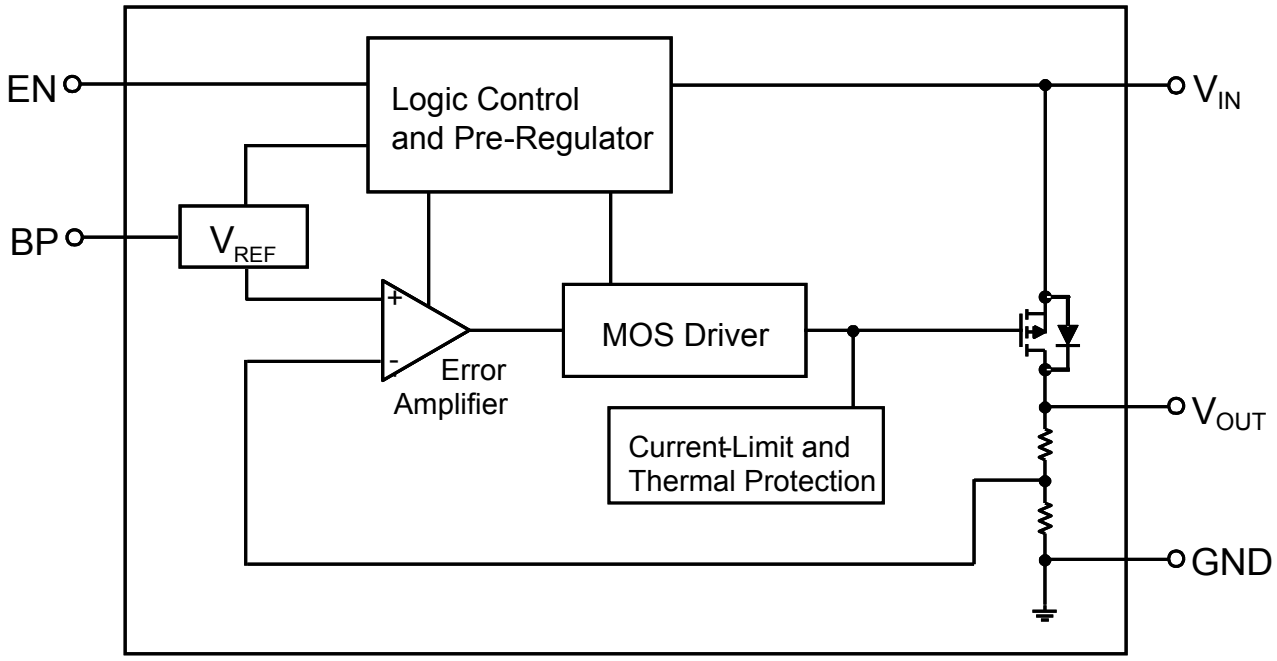


SOT-23-5

Pin Description

SOT-23-5	Name	Description
1	VIN	Supply Input
2	GND	Ground
3	EN	Enable(input). CMOS compatible control input. Logic high = enable; logic low or open = shutdown.
4	BP	Reference Noise Bypass
5	VOUT	Regulator Output

Function Block Diagram



Electrical Characteristics (Unless otherwise specified $V_{IN}=V_{OUT}+1V$, $T_A=25^{\circ}C$)

Parameters		Symbol	Condition		Min	Typ	Max	Units
Operating Voltage Range (Note 2)		V_{IN}					12	V
Supply Current Limit		I_{LIMIT}	V_{OUT} = 0.0V			800		mA
Standby Current		I_{SBY}	V_{EN} = GND,Shutdown			0.01	1	μA
Quiescent Current		I_Q	1mA < I_{OUT} < 500mA			300	400	μA
Dropout Voltage (Note 3)		V_{DROP}	I_{OUT} = 50mA	V_{OUT} = 3.3V		550	650	mV
				V_{OUT} = 5.0V		50	150	mV
			I_{OUT} = 150mA	V_{OUT} = 3.3V		650	850	mV
				V_{OUT} = 5.0V		150	300	mV
			I_{OUT} = 500mA	V_{OUT} = 3.3V		1100	1250	mV
				V_{OUT} = 5.0V		350	550	mV
Line Regulation		ΔV_{LINE}	V_{IN} = (V_{OUT} +1V) to 7V I_{OUT} = 1mA				10	mV/V
Load Regulation		ΔV_{LOAD}	1mA < I_{OUT} < 500mA			15	25	mV
Output Noise Voltage		eNO	10Hz to 100kHz,I_{OUT} = 10mA C_{OUT} = 1μF, C_{IN} = 1μF			300		μV_{RMS}
Thermal Shutdown Temperature		T_{SD}				165		°C
Thermal Shutdown Temperature Hysteresis		ΔT_{SD}				30		°C
Output Voltage Accuracy		ΔV_{OUT}	I_{OUT} =1mA		-3		+3	%
EN Threshold	Logic-Low V	V_{IL}	V_{IN} = 6V to 12V,Shutdown				0.4	V
	Logic-High V	V_{IH}	V_{IN} = 6V to 12V,Start-up		1.2			V
Power Supply Rejection Rate		PSRR				-70		dB

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.

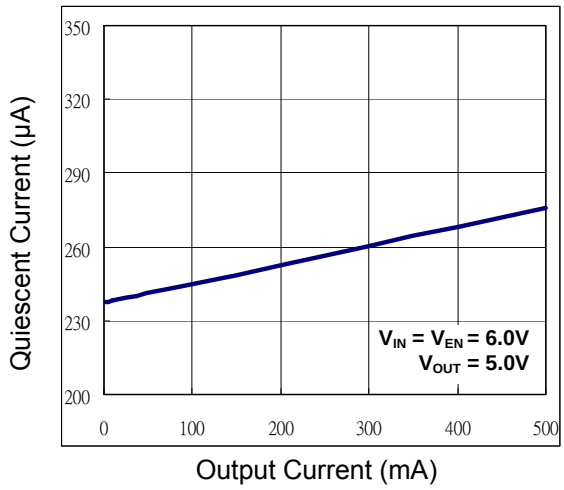
Note 2: $V_{IN\ (MIN)} = V_{OUT}+V_{DROPOUT}$

Note 3: The dropout voltage is defined as (V_{IN}-V_{OUT}) when V_{OUT} is 100mV below the target value of V_{OUT}.

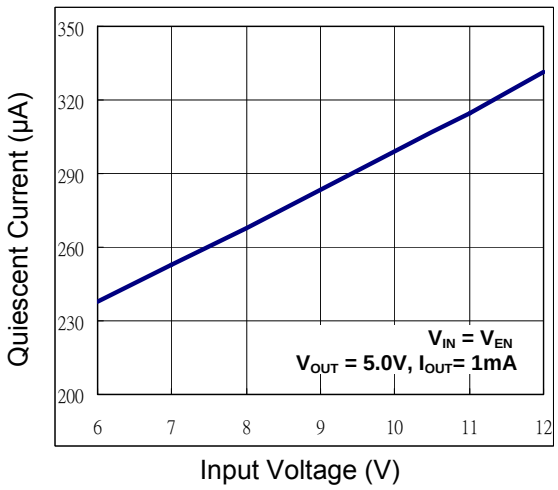
Typical Operating Characteristics

Unless otherwise specified V_{IN}=V_{OUT}+1V, C_{IN}=NC, C_{OUT}=1μF(Tantalum), T_A=25°C

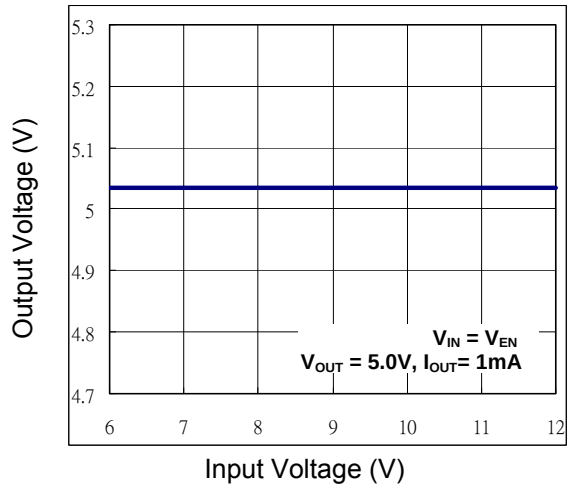
Quiescent Current vs. Output Current



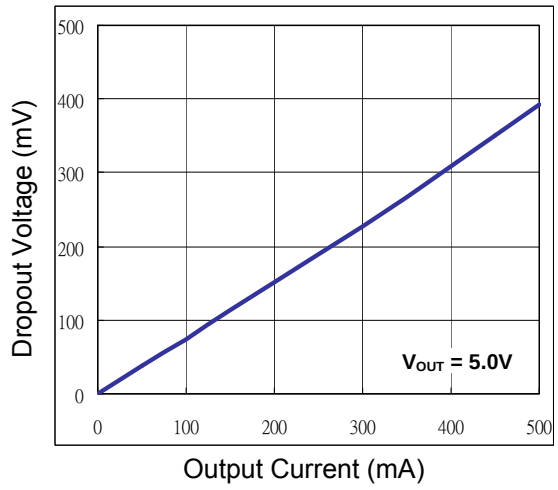
Quiescent Current vs. Input Voltage



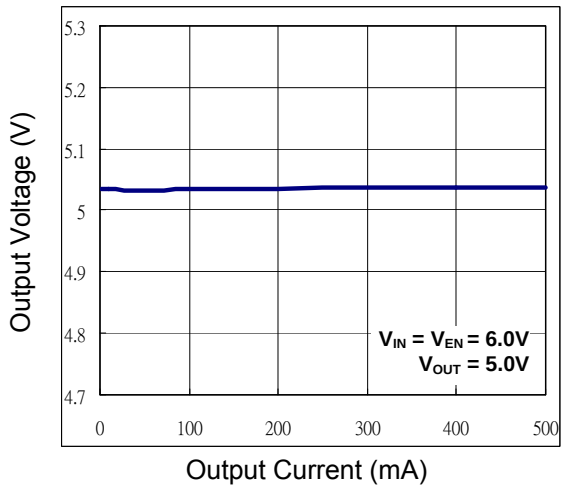
Line Regulation



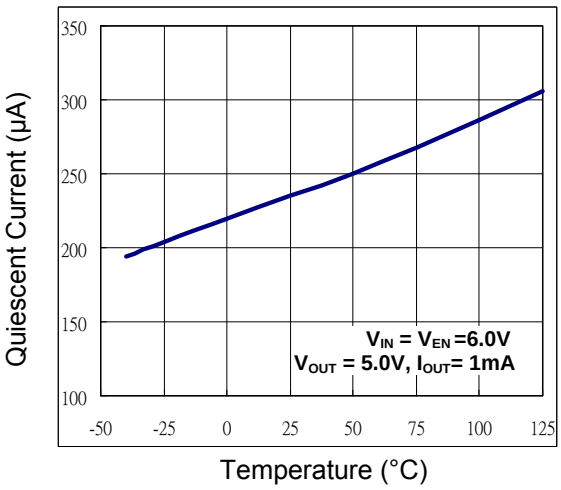
Dropout Voltage vs. Output Current



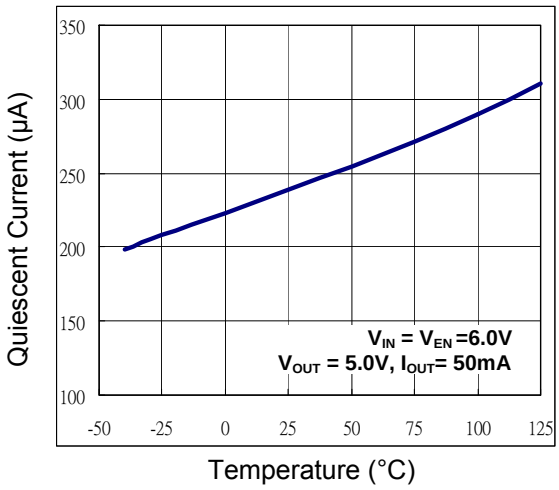
Load Regulation



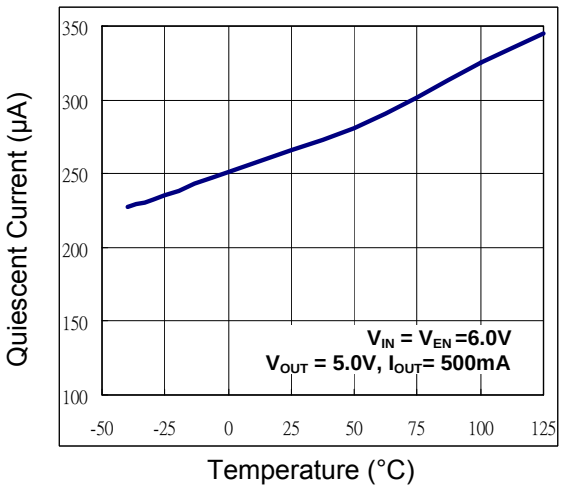
Quiescent Current vs. Temperature



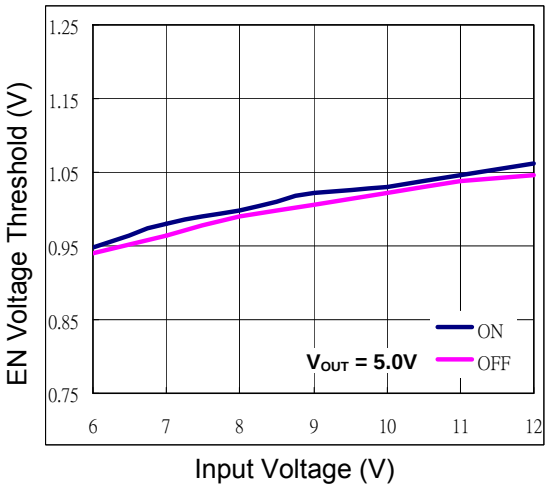
Quiescent Current vs. Temperature



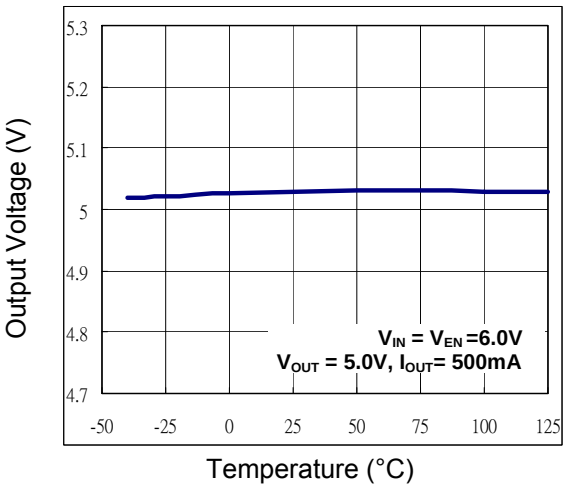
Quiescent Current vs. Temperature



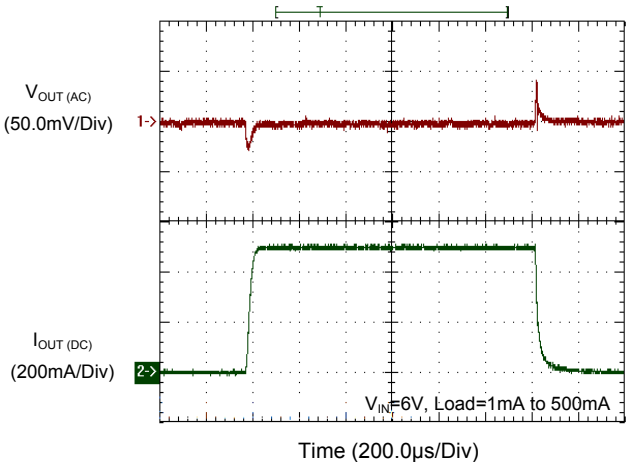
EN Voltage Threshold vs. Input Voltage



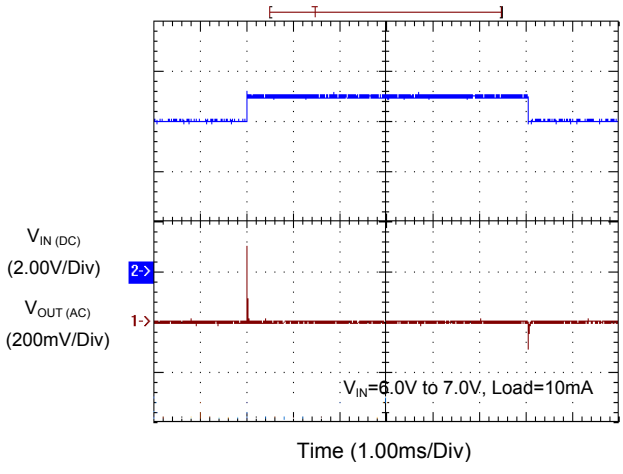
Output Voltage vs. Temperature



Load Transient Response



Line Transient Response



Application Information

The iD9520 requires an output capacitor for device stability. Its value depends upon the application circuit. In general, linear regulator stability decreases with higher output currents. In applications where the iD9520 is sourcing less current, a lower output capacitance may be sufficient. For example, a regulator outputting only 10mA, requires approximately half the capacitance as the same regulator sourcing 150mA.

Bench testing is the best method for determining the proper type and value of the capacitor since the high frequency characteristics of electrolytic capacitors vary widely, depending on type and manufacturer. A high quality 2.2μF aluminum electrolytic capacitor works in most application circuits, but the same stability often can be obtained with a 1μF tantalum electrolytic.

Typical Applications Circuits

A 10nF capacitor on the BP pin will significantly reduce output noise, but it may be left unconnected if the output noise is not a major concern. The iD9520 start-up speed is inversely proportional to the size of the BP capacitor. Applications requiring a slow ramp-up of the output voltage should use a larger C_{BP}. However, if a rapid turn-on is necessary, the BP capacitor can be omitted. The iD9520's internal reference is available through the BP pin. Figure 1 represents a iD9520 standard application circuit. The EN (enable) pin is pulled high (>1.2V) to enable the regulator. To disable the regulator, EN < 0.4V.

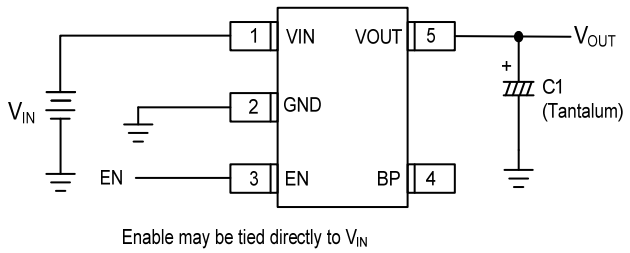


Fig.1 Standard Application Circuit

Operating Region and Power Dissipation

Since the iD9520 is a linear regulator, its power dissipation is always given by $P = I_{OUT} (V_{IN} – V_{OUT})$. The maximum power dissipation is given by: $P_{D(MAX)} = (T_J–T_A) /\theta_{JA}$ = (125°C -25°C) / 250°C / W = 400mW Where $(T_J–T_A)$ is the temperature difference the iD9520 die and the ambient air, θ_{JA} is the thermal resistance of the chosen package to the ambient air. For surface mount device, heat sinking is accomplished by using the heat spreading capabilities of the PC board and its copper traces. In the case of a SOT-23-5 package, the thermal resistance is typically 240°C /Watt. Refer to Figure 2 & 3 for the iD9520 valid operating region (Safe Operating Area) and refer to Figure 4 for maximum power dissipation information of SOT-23-5. The die attachment area of the iD9520 lead frame is connected to pin 2, which is the GND pin. Therefore, the GND pin of iD9520 can dissipate the heat from the die very effectively. To improve the maximum power providing capability, connect the GND pin to ground using a large ground plane near the GND pin.

Safe Operation Area of I_{OUT}=150mA
[Power Dissipation Limit]

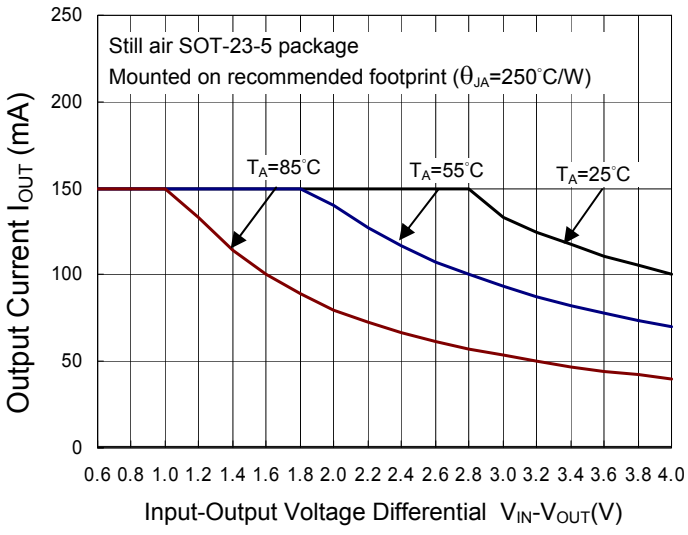


Fig. 2

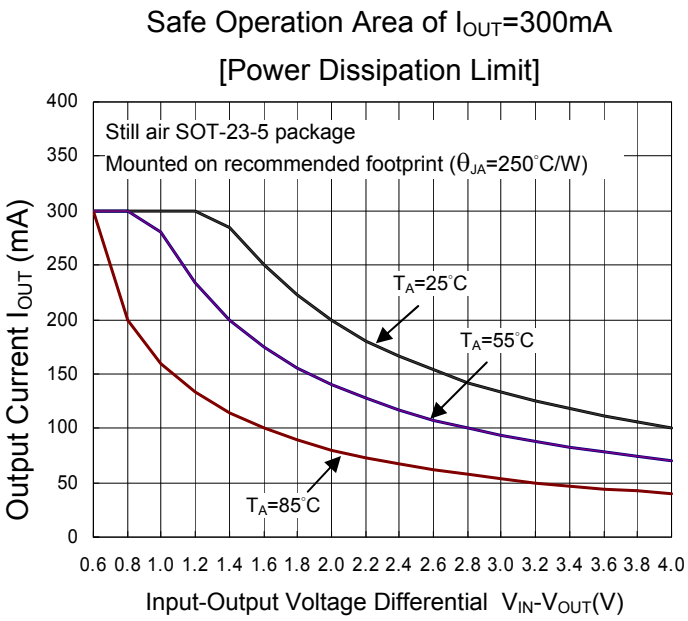

Safe Operation Area of I_{OUT}=300mA
[Power Dissipation Limit]
Still air SOT-23-5 package
Mounted on recommended footprint (θ_{JA}=250°C/W)
T_A=25°C
T_A=55°C
T_A=85°C
Output Current I_{OUT} (mA)
400
350
300
250
200
150
100
50
0
0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0
Input-Output Voltage Differential V_{IN}-V_{OUT}(V)

Fig. 3

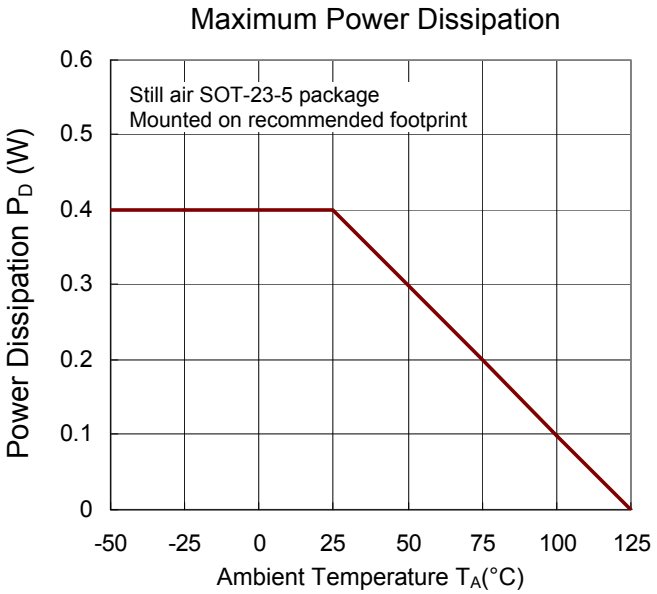
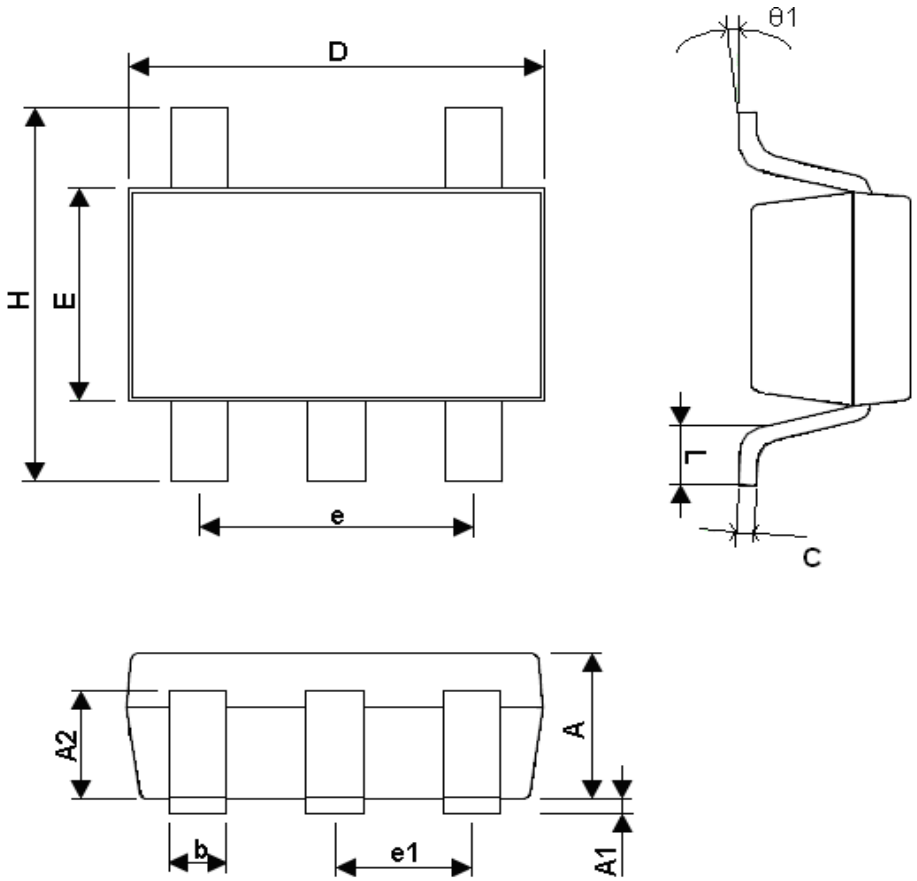

Maximum Power Dissipation
Still air SOT-23-5 package
Mounted on recommended footprint
Power Dissipation P_D (W)
0.6
0.5
0.4
0.3
0.2
0.1
0
-50 -25 0 25 50 75 100 125
Ambient Temperature T_A(°C)

Fig. 4

Packaging

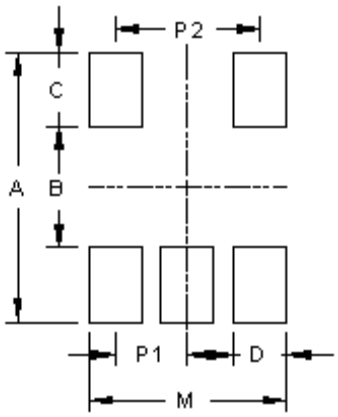
SOT-23-5



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.10	1.30	0.039	0.043	0.051
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.80	0.90	0.027	0.031	0.035
b	0.35	0.40	0.50	0.013	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.001
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.50	1.60	1.80	0.059	0.063	0.071
e	---	1.90(TYP)	---	---	0.075	---
H	2.60	2.80	3.00	0.102	0.110	0.118
L	0.370	---	---	0.015	---	---
Θ1	1°	5°	9°	1°	5°	9°
e1	---	0.95(TYP)	---	---	0.037	---

Footprints

SOT-23-5



Package	Number of Pin	Footprint Dimension (mm)							Tolerance
		P1	P2	A	B	C	D	M	
SOT-23-5	5	0.95	1.90	3.60	1.60	1.00	0.70	2.60	±0.10