

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 800µA at 100mA output. The iD9520 has an initial tolerance of less than 1% max and a logic compatible ON/OFF switched input. When disabled, power consumption drops to nearly zero. Other key features include reverse battery protection, 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 several fixed voltages -- 3.3V, 5.0V -- or with an adjustable output. This device is offered in SOT-23-5 package.

Features

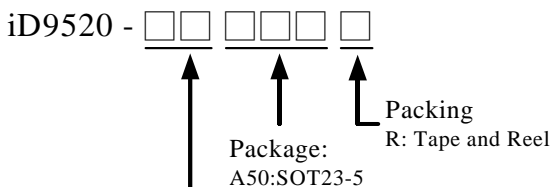
- Low Noise: 40µV Possible
- High Accuracy: 1%
- Reverse Battery Protection
- Low Dropout: 340mV at Full Load
- Low Quiescent Current: 90µA
- Zero Off-Mode Current
- Fixed Output: 3.3V, 5.0V. Adj. Output also available.
- Available in RoHS Compliant, Lead Free

Packages: SOT-23-5

Applications

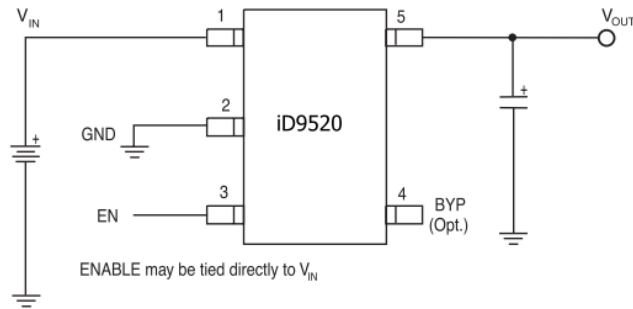
- Battery Powered Systems
- Cordless Phones
- Radio Control Systems
- Portable/Palm Top/Notebook Computers
- Portable Consumer Equipment
- Portable Instrumentation
- Bar Code Scanners
- SMPS Post Regulators

Ordering Information



Output Voltage	Voltage Code
3.3	33
5.0	50
Adjustable	AD

Typical Application Circuit



Absolute Maximum Ratings

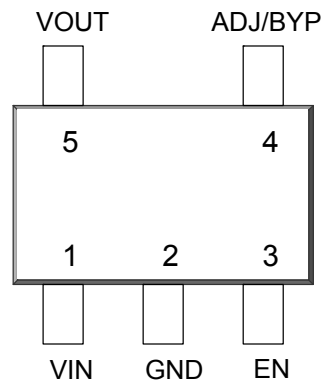
Supply Voltage V_{IN}	-20V to +20V
Power Dissipation, P_D @ $T_A=25^\circ\text{C}$	
SOT23-5	400mW
Thermal Resistance, θ_{JA}	
SOT23-5	250°C/W
Lead Temperature	260 °C
Storage Temperature	-65°C to 150°C
ESD Susceptibility	
HBM (Human Body Mode)	2kV
MM (Machine Mode)	200V

Recommended Operating Conditions

Input Voltage V_{IN}	+2.5V to +16V
Junction Temperature Range	-40°C to 125°C
Ambient Operating Temperature	-40°C to 85°C

Pin Configurations

(Top View)



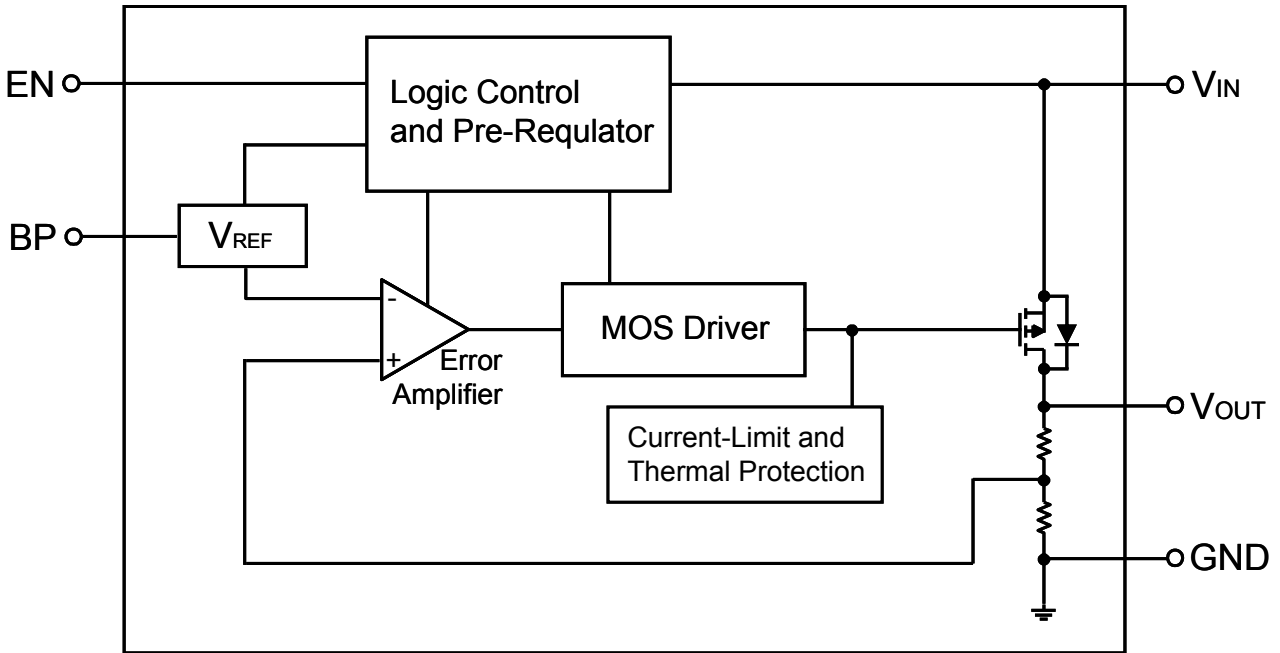
SOT23-5

Pin Description

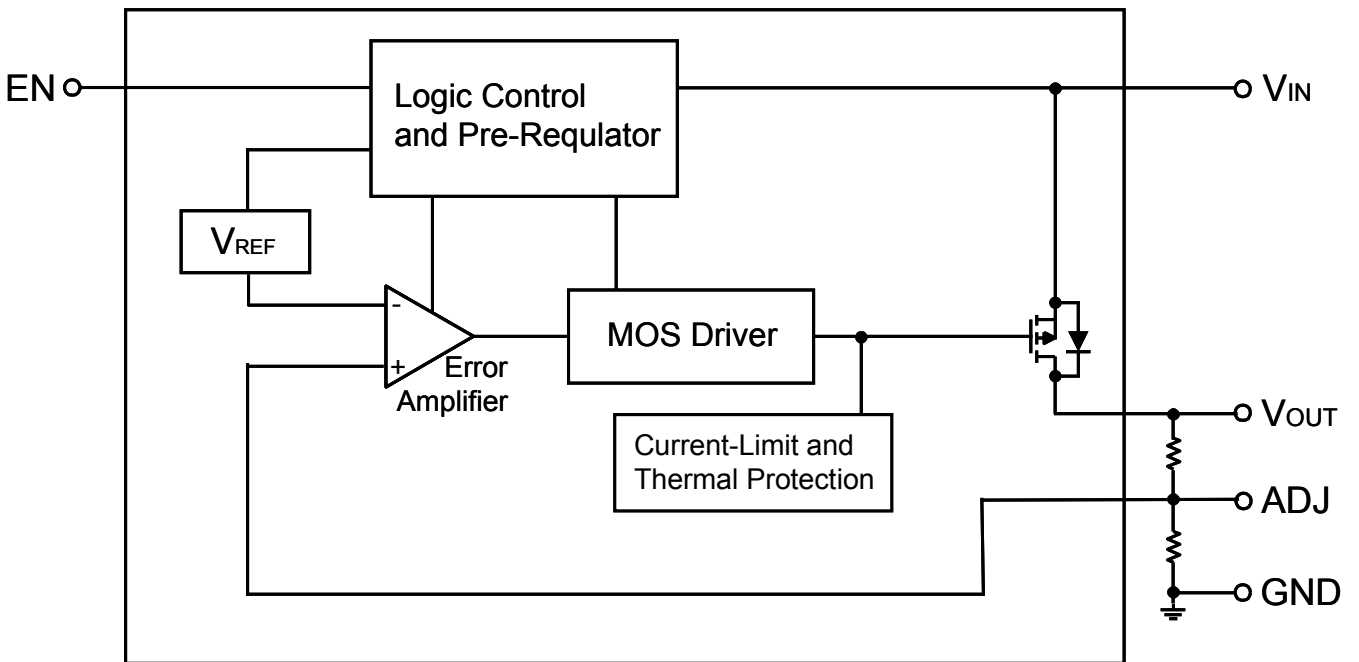
SOT-23-5	Name	Description
1	VIN	Supply Input
2	GND	Ground
3	EN	Enable(Input). CMOS compatible control Input. Logic high = enable; logic low or open = shutdown.
4	ADJ/BYP	Adjust(Input). Feedback Input. Connect to resistive voltage-divider network.
5	VOUT	Regulator Output

Function Block Diagram

BP Version



ADJ Version



Electrical Characteristics ($T_J=25^\circ\text{C}$, $V_{\text{OUT}} + 1\text{V}$, for 1.2V Option $V_{\text{IN}}=V_{\text{OUT}} + 1.2\text{V}$ $I_L=100\mu\text{A}$, $C_L=1\mu\text{F}$, and $V_{\text{ENABLE}} \geq 2.4\text{V}$. The \blacklozenge denotes the specifications which apply over full operating temperature range -40°C to $+85^\circ\text{C}$, unless otherwise specified.)

PARAMETER	MIN	TYP	MAX	UNITS	\blacklozenge	CONDITIONS
Output Voltage Tolerance	-2		+2	%	\blacklozenge	
Output Voltage Temperature Coef.		57		ppm/ $^\circ\text{C}$		
Line Regulation		0.04	0.1 0.2	%/V	\blacklozenge	$V_{\text{IN}} = V_{\text{OUT}} + 1$ to 16V and $V_{\text{EN}} \leq 8\text{V}$ $V_{\text{IN}} = V_{\text{EN}} = V_{\text{OUT}} + 1 \leq 6\text{V}$
			0.2			$V_{\text{IN}} = V_{\text{EN}} = V_{\text{OUT}} + 1$ to 16V $T_a = 25^\circ\text{C}$ to 85°C
Load Regulation		0.05	0.4	%		$I_L = 0.1\text{mA}$ to 500mA
Dropout Voltage ($V_{\text{IN}}-V_{\text{O}}$)		10	60 80	mV	\blacklozenge	$I_L = 100\mu\text{A}$
		125	175 250	mV	\blacklozenge	$I_L = 50\text{mA}$
		180	350 450	mV	\blacklozenge	$I_L = 150\text{mA}$
		340	550 700	mV	\blacklozenge	$I_L = 500\text{mA}$
Quiescent Current (I_{GND})		0.05	3 8	μA	\blacklozenge	$V_{\text{ENABLE}} \leq 0.4\text{V}$ $V_{\text{ENABLE}} \leq 0.25\text{V}$
Ground Pin Current (I_{GND})		90	150 190	μA	\blacklozenge	$I_L = 100\mu\text{A}$
		250	650 900	μA	\blacklozenge	$I_L = 50\text{mA}$
		1.0	2.0 2.5	mA	\blacklozenge	$I_L = 150\text{mA}$
		6.5	25.0 30.0	mA	\blacklozenge	$I_L = 500\text{mA}$
Ripple Rejection (PSRR)		70		dB		
Current Limit (I_{LIMIT})		800	950	mA	\blacklozenge	$V_{\text{OUT}} = 0.0\text{V}$
Output Noise (e_{NO})		300		μV_{RMS}		$I_L=10\text{mA}$, $C_L=1.0\mu\text{F}$, $C_{\text{IN}}=1\mu\text{F}$, (10Hz-100kHz)
		40		μV_{RMS}		$I_L=10\text{mA}$, $C_L=10\mu\text{F}$, $C_{\text{BYP}}=1\mu\text{F}$, $C_{\text{IN}}=1\mu\text{F}$, (10Hz-100kHz)

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 2.2 μ F aluminum electrolytic capacitor works in most application circuits, but the same stability often can be obtained with a 1 μ F tantalum electrolytic.

With the iD9520 adjustable version, the mini-mum value of output capacitance is a function of the output voltage. The value decreases with higher output voltages, since closed loop gain is increased.

Typical Applications Circuits

A 10nF capacitor on the BYP 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 BYP capacitor. Applications requiring a slow ramp-up of the output voltage should use a larger C_{BYP} . However, if a rapid turn-on is necessary, the BYP capacitor can be omitted. The iD9520's internal reference is available through the BYP pin. Figure 1 represents a iD9520 standard application circuit. The EN (enable) pin is pulled high (>2.0V) to enable the regulator. To disable the regulator, $EN < 0.4V$.

The iD9520 in Figure 2 illustrates a typical adjustable output voltage configuration. Two resistors (R 1 and R 2) set the output voltage. The output voltage is calculated using the formula:

$$V_{OUT} = 1.235V \times [1 + R_1/R_2]$$

R_2 must be $> 10k\Omega$ and for best results, R_2 should be between 22 k Ω and 47k Ω .

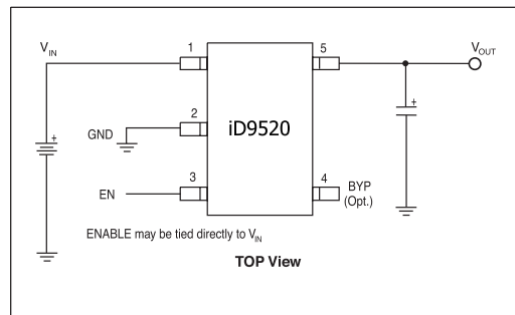


Figure1. Standard Application Circuit

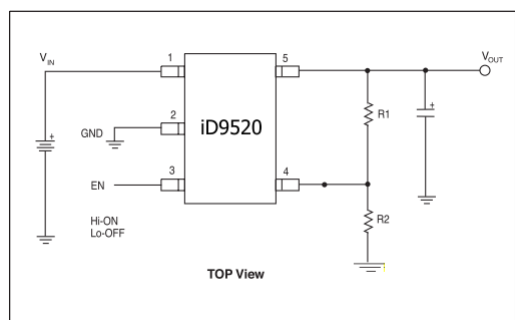


Figure2. Typical Adjustable Output Voltage Configuration

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: $P_{D(MAX)} = (T_J - T_A) / \theta_{JA} = (125^\circ C - 25^\circ C) / 250^\circ C / W = 400mW$ 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 SOT23-5 package, the thermal resistance is typically 240 $^\circ C / Watt$. Refer to Figure 1 & 2 for the iD9520 valid operating region (Safe Operating Area) and refer to Figure 3 for maximum power dissipation information of SOT23-5. 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 $I_{OUT}=150\text{mA}$
[Power Dissipation Limit]

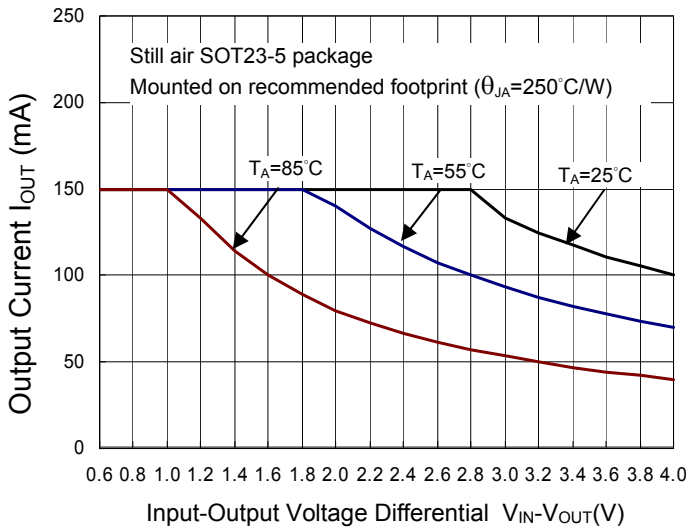


Fig 1

Maximum Power Dissipation

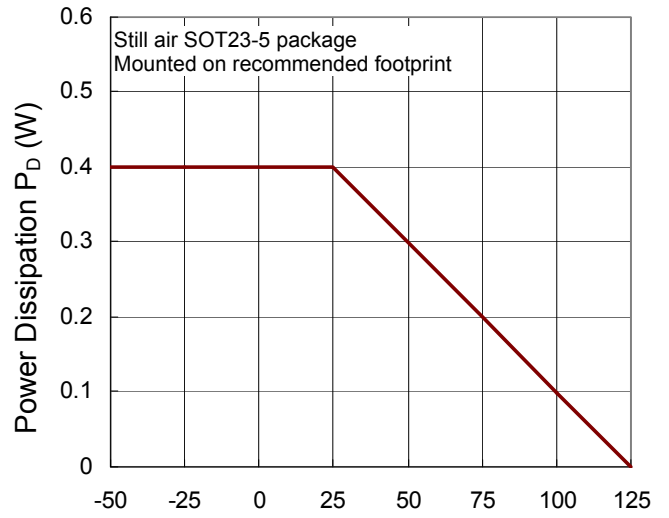


Fig 3

Safe Operation Area of $I_{OUT}=300\text{mA}$
[Power Dissipation Limit]

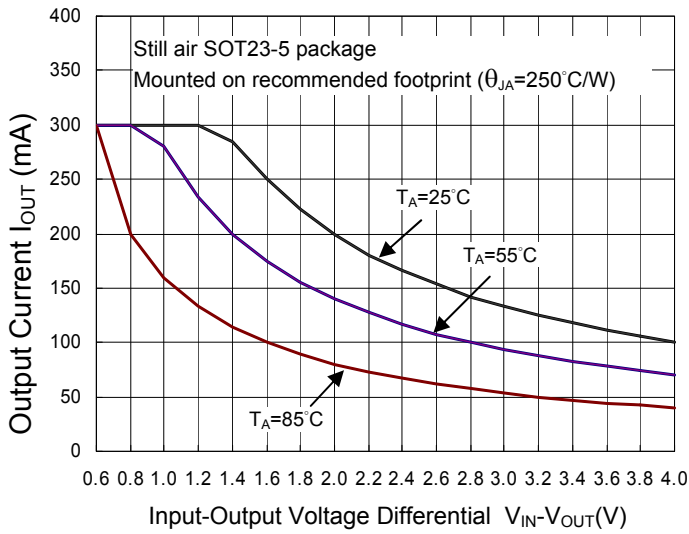
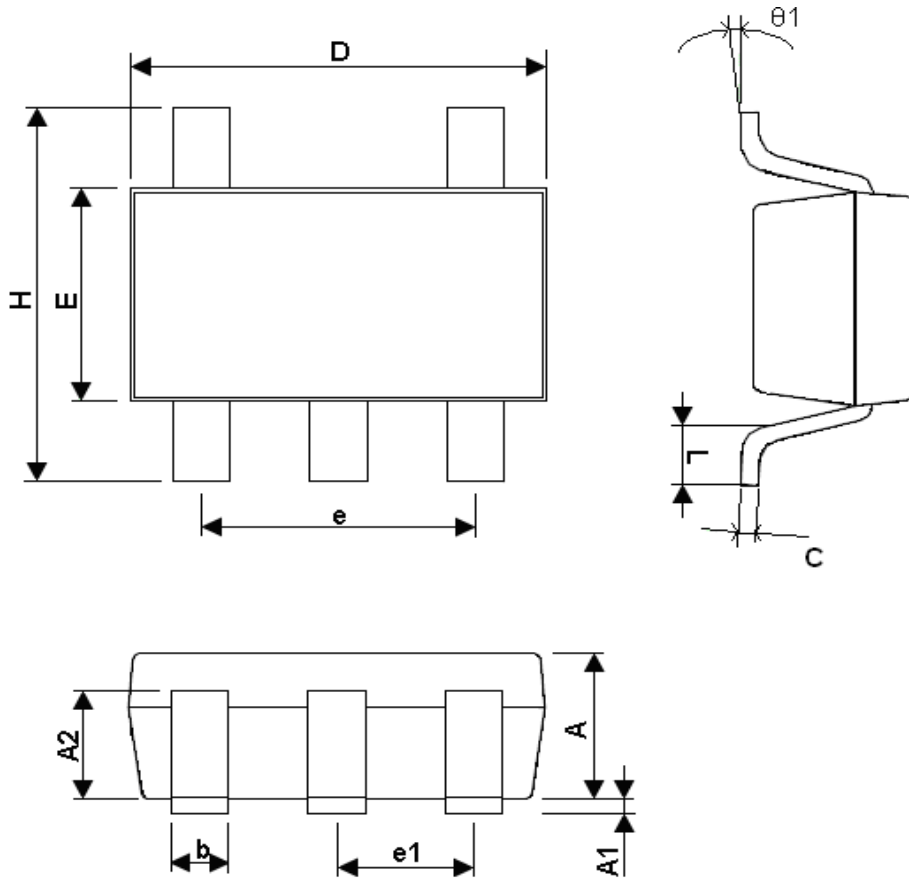


Fig 2

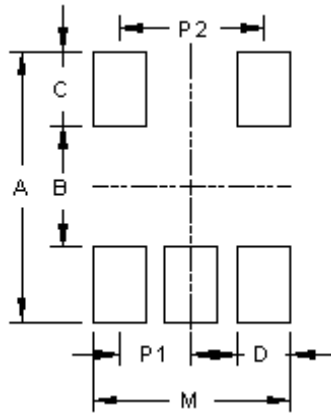
Packaging SOT23-5



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MAX	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

SOT23-5



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