600mA,Ultra-low noise, Small Package, Ultra-Fast CMOS LDO Regulator

General Description

The LP3989 is designed for portable RF and wireless applications with demanding performance and space requirements. The LP3989 performance is optimized for battery-powered systems to deliver ultra low noise and low quiescent current. Regulator ground current increases only slightly in dropout, further prolonging the battery life. The LP3989 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, critical in hand-held wireless devices. The LP3989 consumes less than 0.1μA in shutdown mode and has fast turn-on time less than 50μs. The other features include ultra low dropout voltage, high feedback accuracy, current limiting protection, and high ripple rejection ratio. It is available in the 5-lead of SOT23-5 packages.

Features

- Ultra-Low-Noise for RF Application
- 2V- 6V Input Voltage Range
- Low Dropout : 280mV @ 400mA
- 600mA Output Current, 750mA Peak Current
- High PSRR: -68dB at 1KHz
- < 1uA Standby Current When Shutdown
- Available in SOT23-5 Package
- Ultra-Fast Response in Line/Load transient
- Current Limiting and Thermal Shutdown Protection

Applications

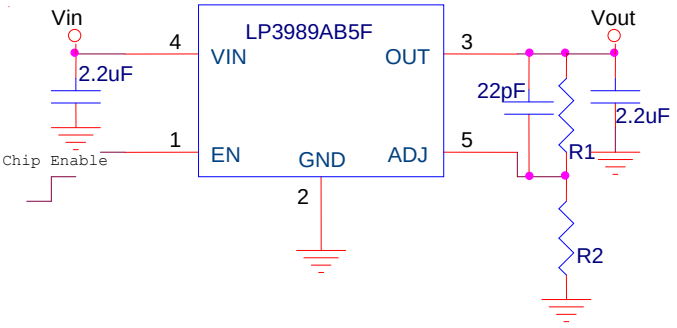
- Portable Media Players/MP3 players
- Cellular and Smart mobile phone
- LCD
- DSC Sensor
- Wireless Card

Order Information

LP3989 □ □ □ □ □

- F: Pb-Free
- Package Type
  - B5: SOT23-5
- Output Type
  - A : Adjustable

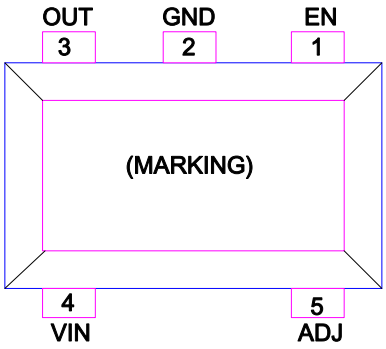
Typical Application Circuit



Marking Information

Device	Marking	Package	Shipping
LP3989AB5F		SOT23-5	3K/REEL

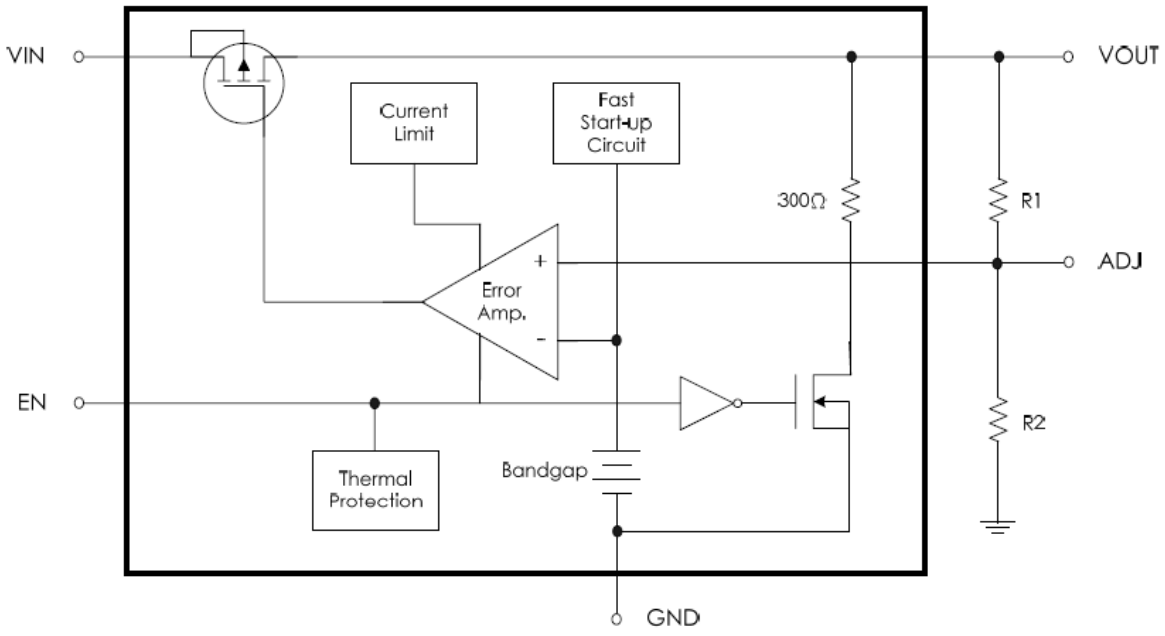
Functional Pin Description

Package Type	Pin Configurations
SOT23-5	 SOT23-5

Pin Description

Pin	Name	Description
1	EN	Chip Enable (Active High). There is an integrated pull low 1MΩ resistor connected to GND when the EN pin is floating.
2	GND	Ground.
3	VOUT	Output Voltage. $V_{out}=V_{FB}$ × (1+R1/R2) , which V_{FB} = 0.8V
4	VIN	Power Input Voltage.
5	ADJ	Feedback pin. The reference voltage is 0.8V.

Function Diagram



Absolute Maximum Ratings

- ✧ Supply Input Voltage ---------- -0.3V to 6.5V
- ✧ EN Pin Voltage ---------- -0.3V to Vin+0.3V

Power Dissipation, PD @ TA = 25°C

- ✧ SOT23-5 ---------- 500mW

Package Thermal Resistance

- ✧ SOT23-5, θJA ---------- 195°C/W
- ✧ Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- ✧ Storage Temperature Range ---------- −40°C to 165°C

ESD Susceptibility

- ✧ HBM (Human Body Mode) ---------- 2kV
- ✧ MM(Machine-Mode) ---------- 200V

Recommended Operating Conditions

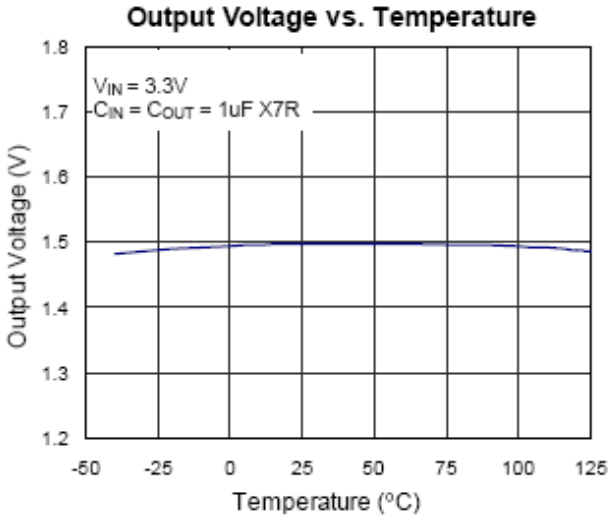
- ✧ Supply Input Voltage ---------- 2V to 6V
- ✧ Operation Ambient Temperature Range ---------- -20°C to 85°C

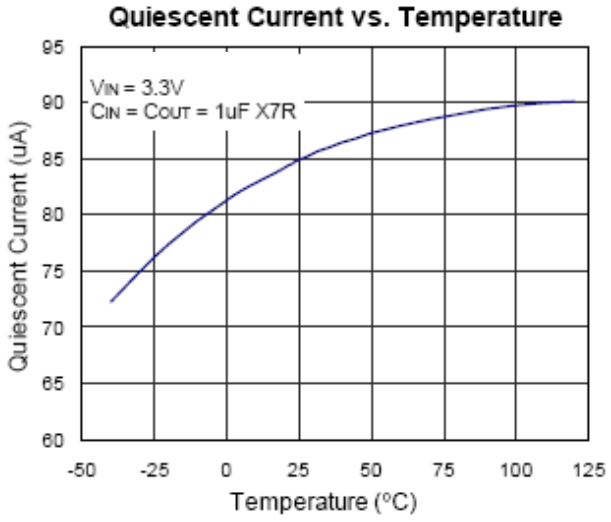
Electrical Characteristics

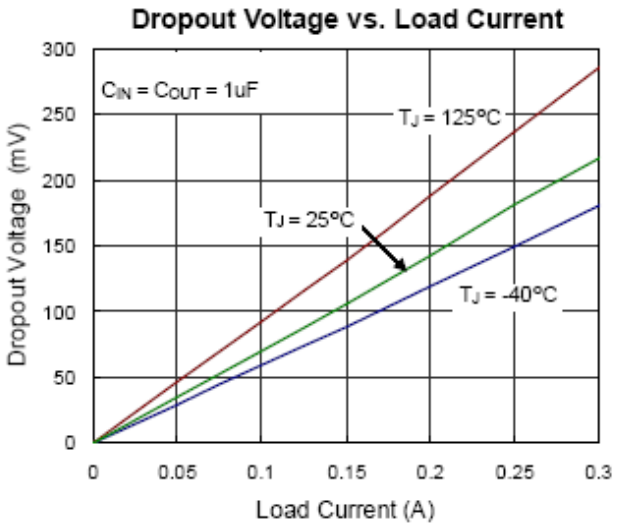
(V_{IN} = V_{OUT} + 1V, C_{IN} = C_{OUT} =2.2μF, C_{FB} = 22pF, T_A = 25° C, unless otherwise specified)

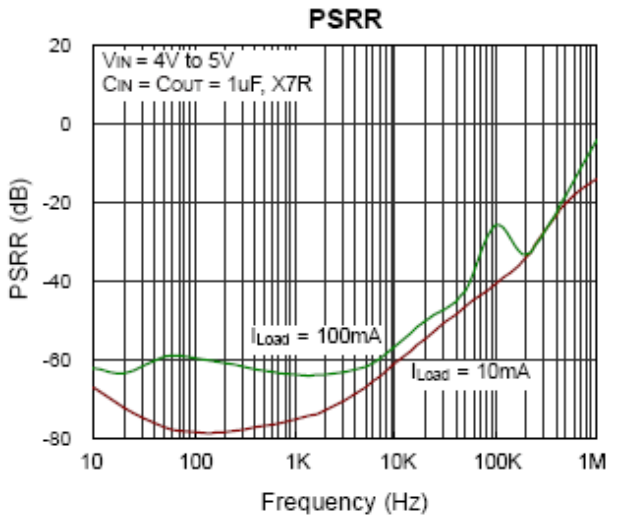
Parameter		Symbol	Test Conditions	Min	Typ.	Max	Units
Output Loading Current		I_{LOAD}	V_{EN}=V_{IN},V_{IN}>2.5V		600		mA
Current Limit		I_{LIM}	R_{LOAD} = 1Ω		750		mA
Adjustable voltage reference		V_{FB}	I_{OUT}=1mA	0.784	0.8	0.816	V
Quiescent Current		I_Q	V_{EN} ≥ 1.4V, I_{OUT} = 0mA		90	130	μA
Dropout Voltage		V_{DROP}	I_{OUT} = 200mA, V_{OUT} >2.8V		140	160	mV
			I_{OUT} = 400mA, V_{OUT} >2.8V		280	320	
			I_{OUT} = 600mA, V_{OUT} >2.8V		420	480	
Line Regulation		ΔV_{LINE}	V_{IN} = (V_{OUT} + 1V) to 5.5V, I_{OUT} = 1mA			0.3	%
Load Regulation		Δ_{LOAD}	1mA < I_{OUT} < 400mA			2	%
Standby Current		I_{STBY}	V_{EN} = GND, Shutdown		0.1	1	μA
EN Input Bias Current		I_{EN}	V_{EN} = 1V or 5V	0.8		5.3	μA
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	1.4		VIN+ 0.3	
Output Noise Voltage			10Hz to 100kHz, I_{OUT}=200mA, Cout=1μF		100		uVRMS
Power Supply Rejection Rate	f = 100Hz	PSRR	C_{OUT} = 1μF, I_{OUT} = 10mA		−76		dB
	f = 1kHz				−68		
Thermal Shutdown Temperature		T_{SD}			150		°C

Typical Operating Characteristics







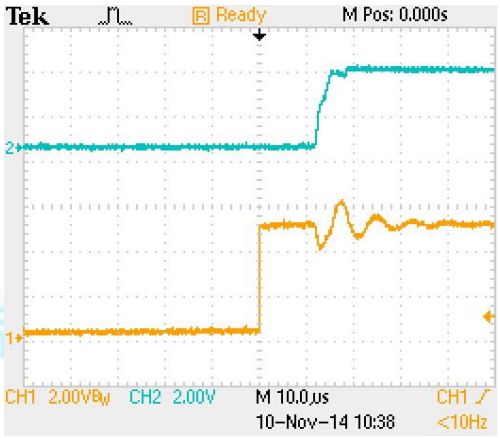


Applications Information

Like any low-dropout regulator, the external capacitors used with the LP3989 must be carefully selected for regulator stability and performance. Using a capacitor whose value is > 2μF on the LP3989 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. There is a special attention which is the input capacitance should not be less than output capacitance. 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 LP3989 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 1μF with ESR is > 25mΩ on the LP3989 output ensures stability. The LP3989 still works well with output capacitor of other types due to the wide stable ESR range. 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 LP3989 and returned to a clean analog ground.

Start-up Function Enable Function

The LP3989 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 1.4 volts but not above Vin+0.3V. The LDO regulator will go into the shutdown mode when the voltage on the EN pin falls below 0.4 volts. For protecting the system, the LP3989 have a quick-discharge function. 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.



Feedback Capacitor and Voltage

For adjustable version, connecting a 22pF between output pin and FB pin significantly reduces output voltage ripple, it is critical that the capacitor connection should be direct and PCB traces should be as short as possible.

The output voltage of LDO could be set by the formula below:

$$V_{out}=V_{FB} \times (1+R1/R2)$$

which V_{FB} = 0.8V

VOUT(V)	R2(KΩ)	R1(KΩ)
1.2	51	25.5
1.5	51	44.6
1.8	51	63.8
2	47	70.5
2.5	47	99.9
2.8	47	117.5
3	33	90.8
3.3	33	103.1
3.5	33	111.4
4	33	132.0
4.2	33	140.3
4.5	33	152.6

Considering the practical application, we may add a small capacitor with R1 in parallel which could be 22pF or 47pF.

Thermal Considerations(for SOT23-5)

Thermal protection limits power dissipation in LP3989. When the operation junction temperature exceeds 150°C, the OTP circuit starts the thermal shutdown function turn the pass element off. The pass element turns on again after the junction temperature cools by 25°C. For continue operation, do not exceed absolute maximum operation junction temperature 125°C.

The power dissipation definition in device is:

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

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction and ambient.

The maximum power dissipation can be calculated by following formula:

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

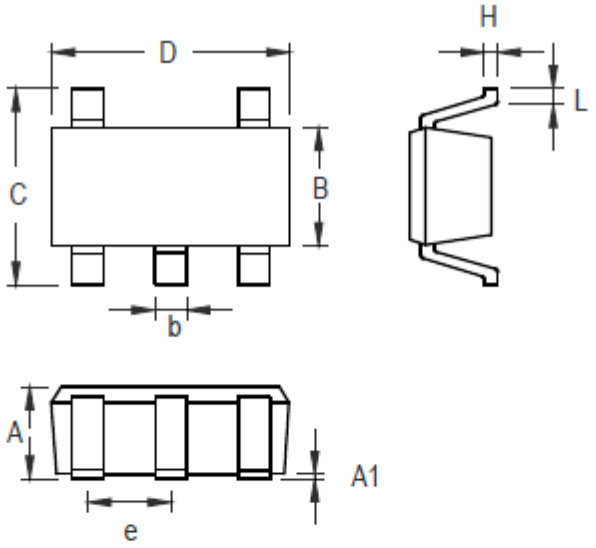
Where $T_{J(MAX)}$ is the maximum operation junction temperature 125°C, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance. For recommended operating conditions specification of LP3989, where $T_{J(MAX)}$ is the maximum junction temperature of the die (125°C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA} is layout dependent) for SOT23-5 package is 195°C/W.

$$P_{D(MAX)} = (125°C-25°C) / 195 = 500mW \text{ (SOT23-5)}$$

The maximum power dissipation depends on operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance θ_{JA}. Considering the PCB thermal feather, the $P_{D(MAX)}$ may be higher than 500mW.

Packaging Information

SOT23-5



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