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

General Description

The HX9193 is designed for portable RF and wireless applications with demanding performance and space requirements. The HX9193 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 HX9193 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, critical in hand-held wireless devices. The HX9193 consumes less than 0.01μA in shutdown mode and has fast turn-on time less than 20μs. The other features include ultra low dropout voltage, high output accuracy, current limiting protection, and high ripple rejection ratio. It is available in the 5-lead of SOT23-5 packages.

Order Information

HX9193 □ □ □ □ □

- F: Pb-Free
- Package Type
  - B5: SOT23-5
- Output Type
  - 12: 1.2V
  - 15: 1.5V
  - 18: 1.8V
  - 25: 2.5V
  - 28: 2.8V
  - 30: 3.0V
  - 33: 3.3V
  - 36: 3.6V

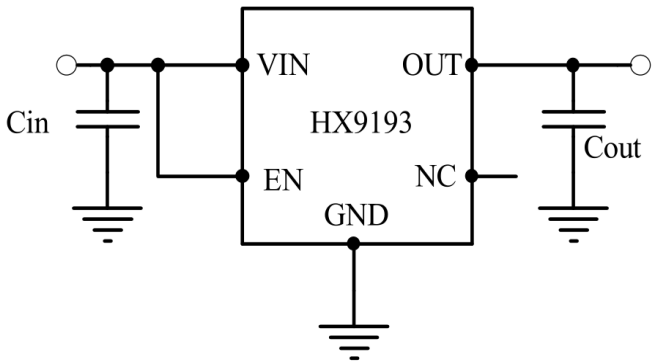
Features

- Ultra-Low-Noise for RF Application
- 2.5V- 6.0V Input Voltage Range
- Low Dropout : 360mV @ 600mA
- High PSSR:-65dB at 1KHz
- < 0.01uA Standby Current When Shutdown
- Ultra-Fast Response in Line/Load transient
- Current Limiting and Thermal Shutdown Protection

Applications

- Portable Media Players/MP3 players
- Cellular and Smart mobile phone
- Sensor Module, RF Module

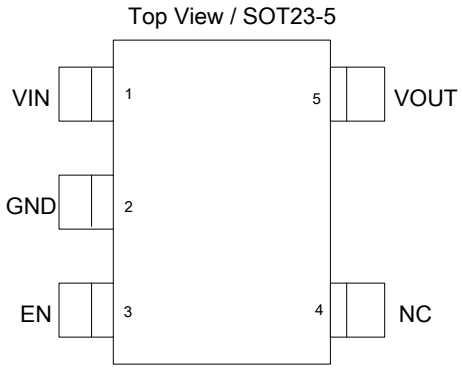
Typical Application Circuit



Marking Information

Device	Marking	Package	Shipping
HX9193		SOT23-5	3K/REEL

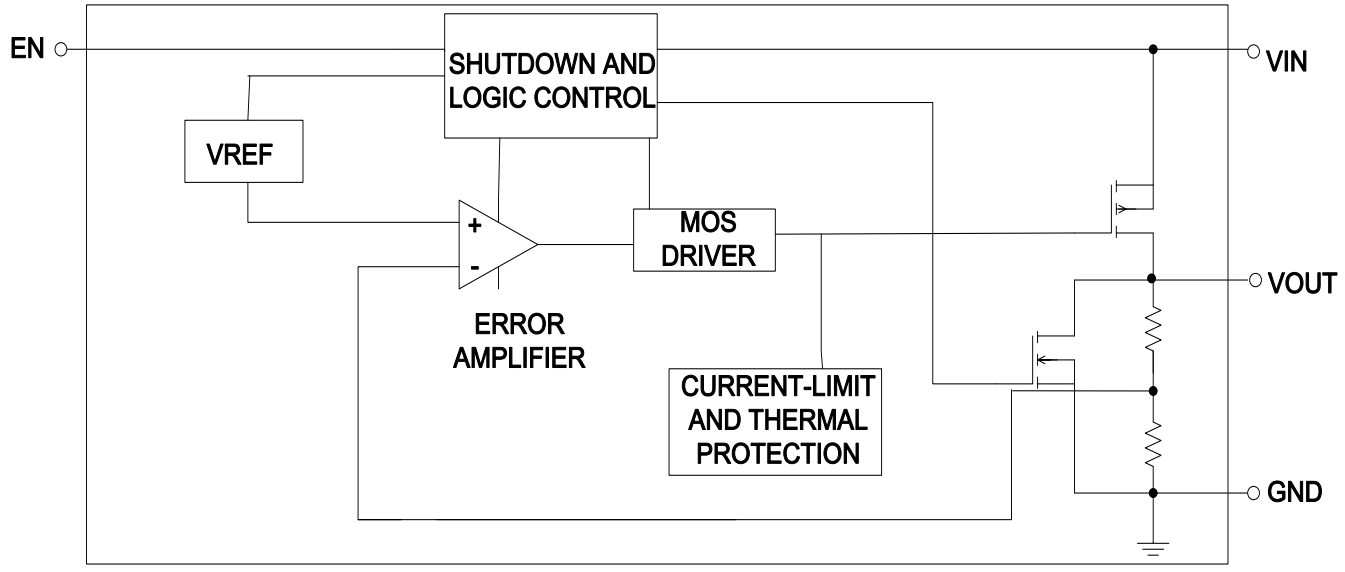
Functional Pin Description

Package Type	Pin Configurations
SOT23-5	

Pin Description

Pin	Name	Description
1	VIN	Power Input Voltage.
2	GND	Ground.
3	EN	Chip Enable (Active High). Note that this pin is high impedance. There is an integrated pull low 1MΩ resistor connected to GND when the control signal is floating.
4	NC	No connection.
5	VOUT	Output Voltage.

Function Diagram



Absolute Maximum Ratings

- ✧ Input Voltage to GND ---------- -0.3V to 6.5V
- ✧ Other pin to GND ---------- -0.3V to 6V

Power Dissipation, PD @ TA = 25°C

- ✧ Maximum Power Dissipation (PD,TA=25°C) ---------- 0.5W

Package Thermal Resistance

- ✧ Thermal Resistance (JA) ---------- 195℃/W
- ✧ Thermal Resistance (JC ---------- 60℃/W
- ✧ Maximum Junction Temperature ---------- 150°C
- ✧ Maximum Soldering Temperature (at leads, 10 sec) ---------- 260°C
- ✧ Storage Temperature Range ---------- −65°C to 165°C

ESD Susceptibility

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

Recommended Operating Conditions

- ✧ Supply Input Voltage ---------- 2.5V to 6V
- ✧ Operation Junction Temperature Range ---------- -40°C to 125°C
- ✧ Operation Ambient Temperature Range ---------- -40°C to 85°C

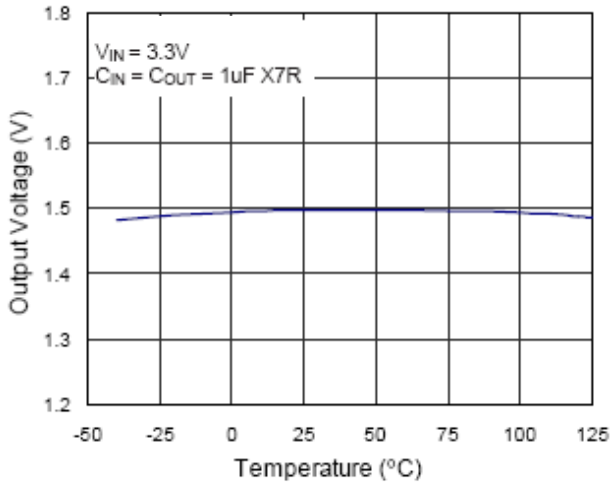
Electrical Characteristics

(VIN = VOUT + 0.8V, Cin = Cout = 1μF, TA = 25° C, unless otherwise specified)

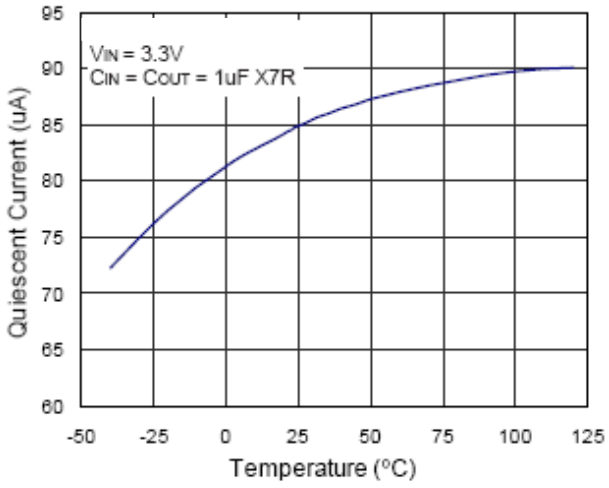
Parameter		Symbol	Test Conditions	Min	Typ.	Max	Units
Output Voltage Accuracy		ΔV_{OUT}	I_{OUT} = 1mA	−2	--	+2	%
Output Current		Iout	VEN=VIN, VIN>2.5V		600		mA
Current Limit		I_{LIM}	R_{LOAD} = 1Ω		800		mA
Quiescent Current		I_Q	VEN≥1.4V,Output floating		110	130	μA
Dropout Voltage		V_{DROP}	I_{OUT}=100mA,VOUT> 2.8V		60	80	mV
			I_{OUT}=600mA,VOUT> 2.8V		360	480	
Line Regulation		ΔV_{LINE}	VIN=(VOUT+1V) to 5.5V, I_{OUT} = 1mA			0.2	%
Load Regulation		ΔLOAD	1mA < I_{OUT} < 300mA			2	%
Standby Current		I_{STBY}	VEN = GND, Shutdown		0.01	1	μA
EN Input Bias Current		I_{IBSD}	VEN = 5V		4	6	μA
EN Threshold	Logic-Low Voltage	V_{IL}	VIN = 3V to 5.5V, Shutdown			0.4	V
	Logic-High Voltage	V_{IH}	VIN = 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 = 1kHz	PSRR	Cout = 1μF, I_{OUT} = 10mA		-65		dB
	f = 10kHz				-55		
Thermal Shutdown Temperature		T_{SD}			150		°C

Typical Operating Characteristics

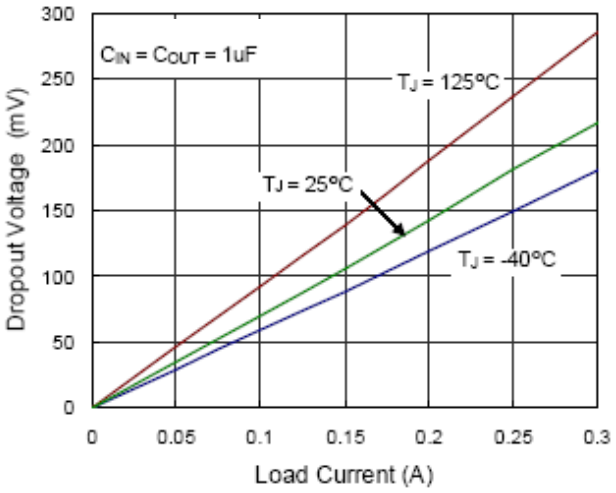
Output Voltage vs. Temperature



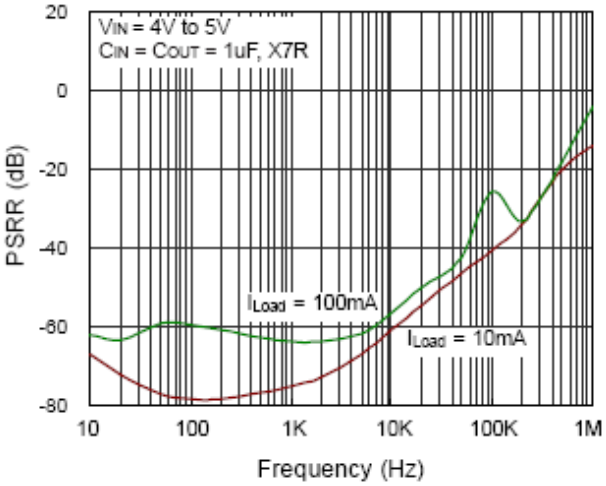
Quiescent Current vs. Temperature



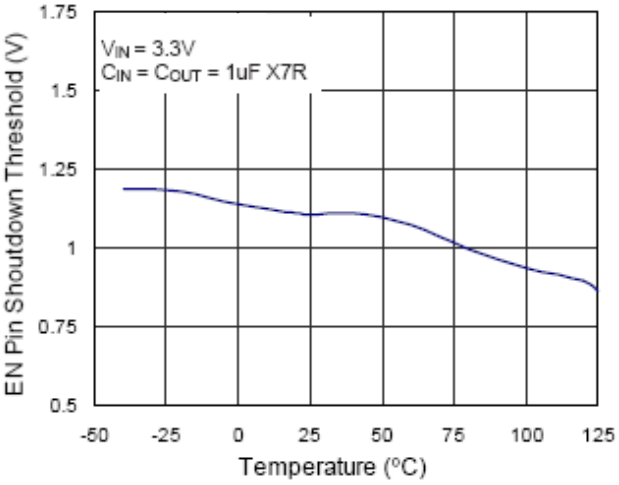
Dropout Voltage vs. Load Current



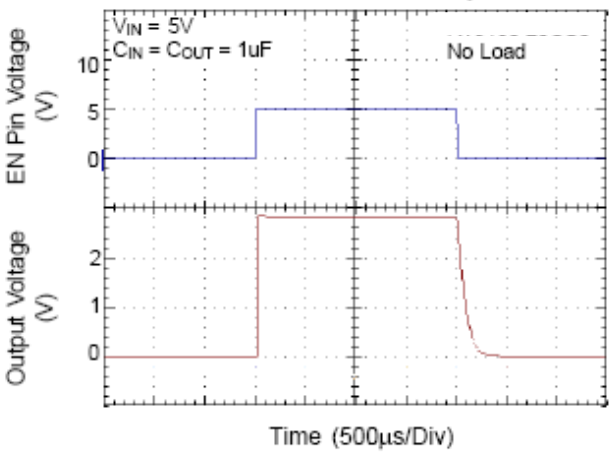
PSRR



EN Pin Shoutdown Threshold vs. Temperature



EN Pin Shutdown Response



Applications Information

Like any low-dropout regulator, the external capacitors used with the HX9193 must be carefully selected for regulator stability and performance. Using a capacitor whose value is > 1μF on the HX9193 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 HX9193 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 HX9193 output ensures stability. The HX9193 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 VOUT pin of the HX9193 and returned to a clean analog ground.

Thermal Considerations

Thermal protection limits power dissipation in HX9193 . 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 :

$$P_D = (VIN-VOUT) \times I_{OUT} + VIN \times I_Q$$

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 :

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

Where TJ(MAX) is the maximum operation junction temperature 125°C, TA is the ambient temperature and the θJA is the junction to ambient thermal resistance. For recommended operating conditions specification of HX9193 , where TJ(MAX) is the maximum junction temperature of the die

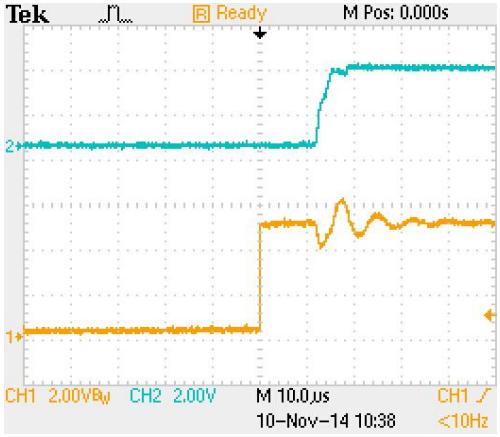
(125°C) and TA is the maximum ambient temperature. The junction to ambient thermal resistance (θJA is layout dependent) for SOT23-5 package is 195°C/W.

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

The maximum power dissipation depends on operating ambient temperature for fixed TJ(MAX) and thermal resistance θJA. When considering the thermal characteristic of PCB it may be larger than 500mW.

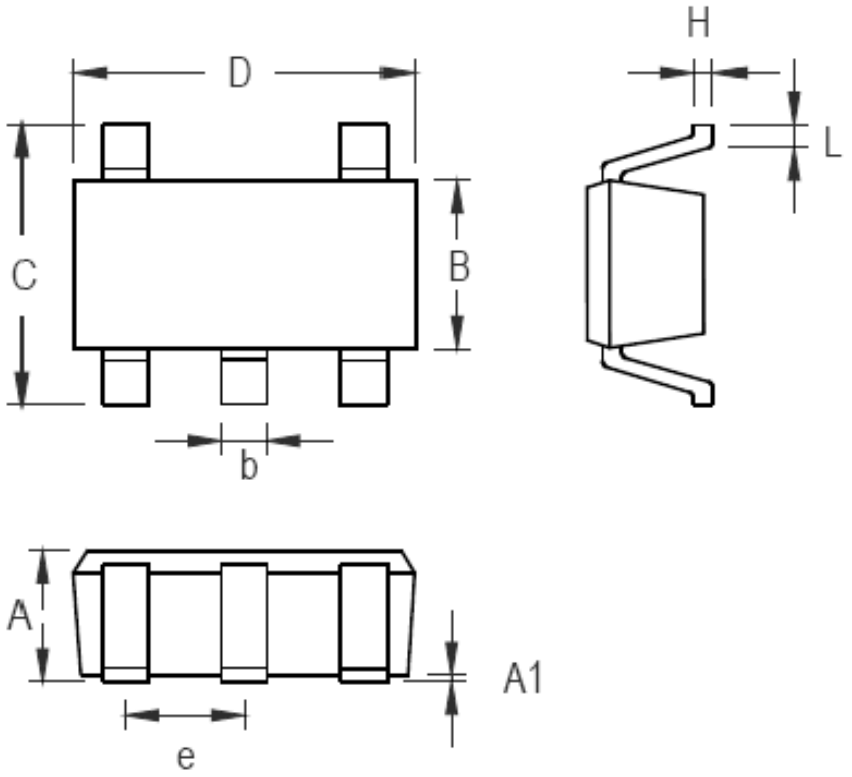
Start-up Function Enable Function

The HX9193 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. The LDO regulator will go into the shutdown mode when the voltage on the EN pin falls below 0.4 volts. For to protecting the system, the HX9193 have a quick-discharge function. If the enable function is not needed in a specific application, it may be tied to VIN to keep the LDO regulator in a continuously on state.



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