LP3991

Low Power Consumption LDO

Features

- Ultra-low current consumption: 5μA (Typ)
- Wide input voltage range: 1.5V to 5.5V
- Fixed output voltages:
  - 3.3V
- High output voltage accuracy: ±1.5%(Typ)
- Low dropout voltage:
  - 80mV (Typ) at 50mA (V_{OUT} = 3.3V)
  - 170mV (Typ) at 100mA (V_{OUT} = 3.3V)
- Current limit and short circuit protection
- Thermal shutdown protection
- EN logic compatible with 1.2V
- Robust ESD capability:
  - Human Body Model: 2000V
  - Charged Device Model: 500V
- Available in small packages:
  - SOT23
  - TDFN-4

Applications

- Wearable Devices
- Portable Medical Equipment
- PDAs, Mobile Phones GPS devices

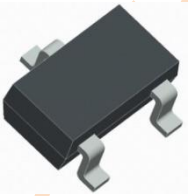
Description

The LP3991 is a low-dropout voltage regulator with low quiescent current and ultra-small packages. The LP3991 can deliver output current up to 250mA. The device offers different fixed output voltages without external resistors, for the nominal output voltage.

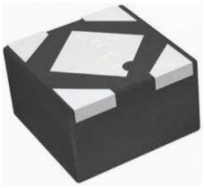
The LP3991 integrated current limit protection and short circuit protection and thermal shutdown protection in order to protect system abnormal.

The output capacitor as small as 0.1μF is available for LP3991 application.

The LP3991 is available in SOT23 package and ultra-small TDFN-4 package with only 1mm × 1mm size.



SOT23



TDFN-4

Ordering Information

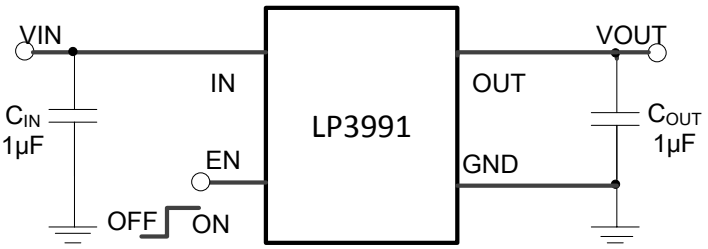
LP3991 - □□ □□ □

- F: Pb-Free
- Package Type
  - QV: TDFN-4
  - B3: SOT23
- Output Voltage
  - 33: 3.3V

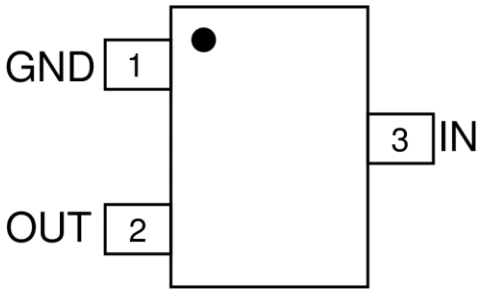
Marking Information

Device	Vout	Marking	Package	Shipping
LP3991-33B3F	3.3V	LPS 9EYWX	SOT23	3K/Reel
LP3991-33QVF	3.3V	9EX	TDFN-4	4K/Reel
Marking indication: Y: Production year, W: Production week, X: Production batch				

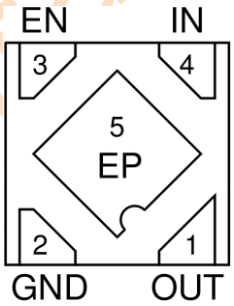
Application Diagram



Pin Configuration



SOT23 (Top View)

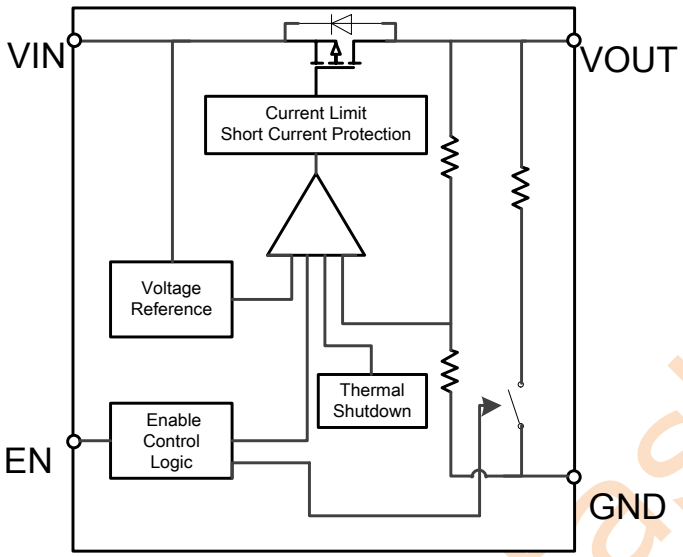


TDFN-4 (Bottom View)

Pin Description

Pin No. SOT23	Name	Description
1	GND	Ground.
2	OUT	Regulated output. A minimum 0.1μF ceramic capacitor is needed from the pin to ground.
3	IN	Input and power source. A small capacitor is recommended from the pin to ground.
Pin No. TDFN-4		
1	OUT	Regulated output. A minimum 0.1μF ceramic capacitor is needed from the pin to ground.
2	GND	Ground.
3	EN	Active-high enable pin. 1: enable the device. 0 or floating: disable the device.
4	IN	Input and power source. A small capacitor is recommended from this pin to ground.
5	EP	Exposed Pad for thermal dissipation. Need to be tied to ground.

Functional Block Diagram



Absolute Maximum Ratings (Note 1)

- IN to GND ---------- -0.3V to 6.5V
- OUT to GND ---------- -0.3V to (V_{IN} + 0.3V) or 6.5V
- EN to GND ---------- -0.3V to 6.5V
- Output Current ---------- 300mA
- Maximum Junction Temperature (T_J) ---------- 150°C
- Maximum Soldering Temperature (At leads, 10 sec) ---------- 260°C

*Note 1: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and 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 affect device reliability.

Thermal Information

- Maximum Power Dissipation (SOT-3, P_D, T_A <= 25℃) ---------- 420mW
- Thermal Resistance (SOT23-3, θ_{JA}) (Note 2) ---------- 240 °C/W
- Maximum Power Dissipation (TDFN-4, P_D, T_A <= 25℃) ---------- 390mW
- Thermal Resistance (TDFN-4, θ_{JA}) (Note 2) ---------- 256 °C/W

*Note 2: Measured using 2S2P JEDEC standard PCB with ambient temperature < 25°C

Electro-Static Discharge and Latch-up

- HBM (Human Body Model, JEDEC JS-001) ---------- 2000V
- CDM (Charged Device Model, JEDEC JS-002) ---------- 500V

Recommended Operating Conditions

- Input and supply voltage on IN ---------- 1.5V to 5.5V
- Output DC current ---------- Up to 250mA
- Output capacitor ---------- ≥ 0.1μF
- Operating ambient temperature ---------- -40°C to 85°C

Electrical Characteristics

The parameters are specified under conditions: V_{IN} is equal to the greater value between $V_{OUT(NOM)}$ + 0.5V and 2.0V, -40°C ≤ T_J ≤ 85°C, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1μF, unless otherwise noted. Typical values are at T_J = 25°C.

Parameter	Symbol	Test Conditions	Min	Typ.	Max	Units
Output voltage accuracy		T_J = 25°C	-1.5		1.5	%
Output voltage accuracy over temperature		-40°C ≤ T_J ≤ 85°C	-3		3	%
Input quiescent current	I_Q	V_{IN} = 1.5V to 5.5V, V_{EN} = V_{IN}, no load		5		μA
Input shutdown current	I_{SHDN}	V_{IN} = 1.5V to 5.5V, V_{EN} = 0V, no load		0.1		μA
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	I_{OUT} = 20mA, V_{IN} = ($V_{OUT(NOM)}$ + 1V) to 6V		0.02	0.05	%/V
Load regulation	ΔV_{LOAD}	I_{OUT} = 1mA to 100mA, V_{IN} = $V_{OUT(NOM)}$ + 1.5V, -40°C ≤ T_J ≤ 85°C		15	40	mV
Dropout voltage (3)	V_{DROP}	I_{OUT} = 100mA, T_A = 25 °C		0.17	0.33	V
Output current limit	I_{LIM}	V_{IN} = $V_{OUT(NOM)}$ + 1.0V, V_{OUT} = 0.9 × $V_{OUT(NOM)}$		300		mA
Short circuit protection	I_{SHORT}	V_{IN} = $V_{OUT(NOM)}$ + 1.0V, V_{OUT} = 0V		50		mA
Output voltage noise	V_{NOISE}	BW = 10Hz to 100kHz, I_{OUT} = 30mA		230		μV_{RMS}
EN logic high voltage level	V_{IH}		1.2			V
EN logic low voltage level	V_{IL}				0.3	V
EN pin leakage current	I_{EN}			30		nA
Output discharge resistance	R_{DIS}	V_{EN} = 0V		1		kΩ

***Note 3: Dropout voltage is measured under condition V_{IN} = $V_{OUT(NOM)}$ – 0.1V.**

Detailed Description

Overview

The LP3991 is a Low dropout voltage regulator with ultra-low current consumption. It has fixed output voltage with good transient performance. The product is available in ultra-small package 1mm x 1mm TDFN-4.

Selectable output voltage

The product will output fixed voltage 3.3V as long as the input voltage is higher than VOUT(NOM) + VDROP. The device can source up to 250mA loading current.

Enable function

The EN pin is an active high logic input pin which is compatible with 1.2V control logic. The internal power element is turned off when EN pin is pulled low.

When the EN pin is pulled high, the LP3991 will be activated and output voltage according to setting.

Auto discharge

The LP3991 integrated a quick discharge function. When the device is disabled by pulling down EN pin, a resistor between OUT and GND will discharge the output capacitor energy. The resistance is 1kΩ (typical).

Over current protection

The device features a current limit function when the over current event is detected to reach 300mA (typical) and output voltage will drop accordingly. On the heavy load condition, the current limit value will be reduced along with output voltage drops. If the output is shorted to ground, the current limit value will foldback to 50mA(typical), as showed in the *Electrical Characteristics Table*.

Application Information

Capacitor consideration

External capacitors on IN and OUT are recommended in application, 0.1μF for C_{OUT} and 1μF for C_{IN} at least. Closer placement of the capacitors to the device, both IN and OUT, would be better for stability.

Power Dissipation

The internal power dissipation from the power MOSFET, when it is turned on, is the main source of junction temperature rising. In this case, the power dissipation and the junction temperature in conducting mode can be calculated as following:

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

P_D: Power Dissipation (W)

V_{IN}: Input voltage (V)

V_{OUT}: Output voltage (V)

I_{OUT}: Output current (A)

$$T_J = P_D \times \theta_{JA} + T_A$$

T_J: Junction temperature (°C)

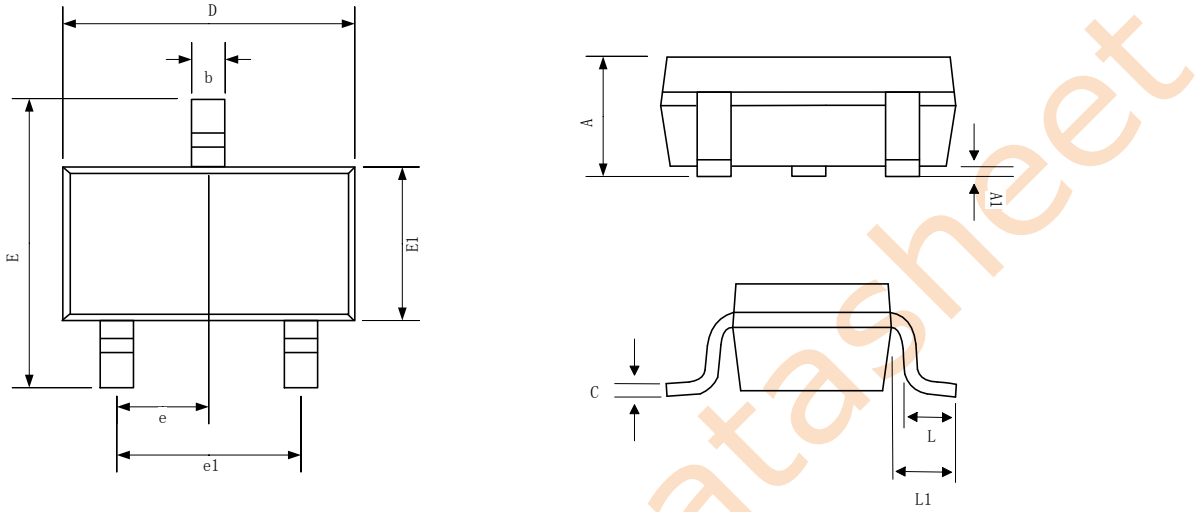
θ_{JA}: Package thermal resistance (°C /W) (Note 4)

T_A: Ambient temperature (°C)

***Note 4: The calculation base on thermal resistance is only valid in Lab condition. The value of θ_{JA} could change in customer PCB environment.**

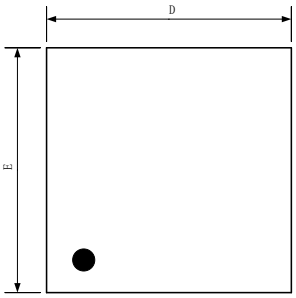
Package Information

SOT23

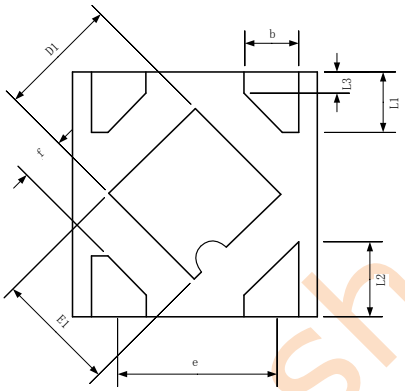


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.900		1.200
A1	0.000	0.050	0.100
b	0.300	0.400	0.500
c	0.008	0.120	0.150
D	2.800	2.900	3.000
E	2.250	2.400	2.550
E1	1.200	1.300	1.400
e	0.950BSC		
e1	1.900BSC		
L	0.200	0.350	0.500
L1	0.550REF		

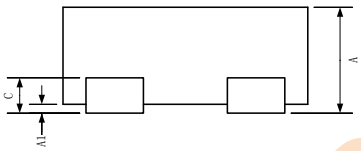
TDFN-4



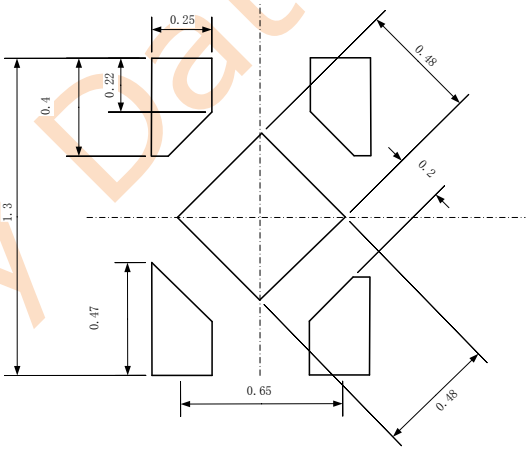
TOP VIEW



BOTTOM VIEW



SIDE VIEW



Recommended Land Pattern

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.35	-	0.40
A1	0.00	0.02	0.05
b	0.20	0.25	0.30
c	0.07	0.12	0.17
D	0.95	1.00	1.05
D1	0.43	0.48	0.55
E	0.95	1.00	1.05
E1	0.43	0.48	0.55
e	0.65BSC		
L1	0.2	0.25	0.30
L2	0.27	0.32	0.37
L3	0.09REF		
f	0.18REF		