ITE9903

24V/150mA/2.1uA IQ/Fast Transient Low Dropout Voltage Regulator

Features

- Output current up to 150mA
- Low dropout voltage typically 500mV at 100mA output current application
- Low quiescent current: 2.1μA
- Operating input voltage range: 3.0V to 24V
- Fixed output voltage options: 1.5V to 5.0V
- ±2% initial voltage accuracy
- Fast transient response over line and load transient
- High PSRR: 90dB at 1kHz
- Built-in soft-start
- Over current protection and short-circuit protection
- Over-temperature protection
- SOT23-3 and SOT89-3 packages available
- Green product RoHS Compliant and Halogen Free

Applications

- Vehicular Equipment
- Battery-Powered Equipment
- Telecom Infrastructure
- Microprocessor and Chipset Supplies
- Home Applications
- Industrial Automation Supplies
- Servers Device Applications

Description

The ITE9903 is a 150mA low dropout linear voltage regulator with a 2.1μA low quiescent current, sourcing input voltage up to 24V, and offering fixed output voltage ranges from 1.5V to 5.0V.

Integrating many functions, the ITE9903 provides high power supply rejection, and owns excellent line and load transient response with only a small 1μF to 10μF ceramic output capacitor. Built-in soft-start minimizes stress on the input power source by reducing capacitive inrush current during start-up. The functions of thermal shutdown, over current and short-circuit protection to protect the device against thermal and current over-loads. A wide variety of fixed output voltage options, making the ITE9903 a very common solution in different applications.

The ITE9903 is available in SOT23-3L and SOT89-3L packages.

Typical Application

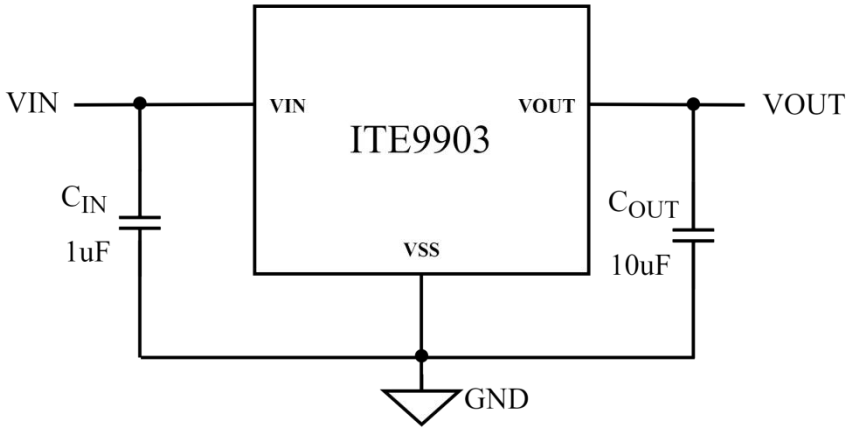
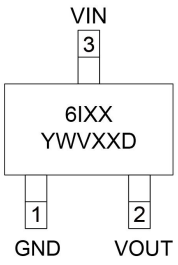
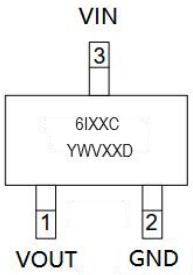


Figure 1. Typical Application

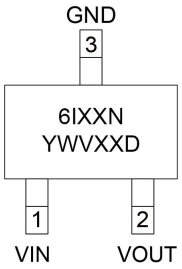
Pin Configuration



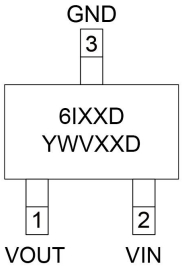
ITE9903AXXL3M



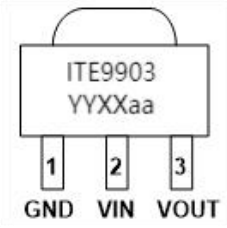
ITE9903AXXL3C



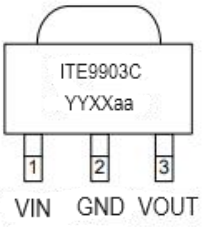
ITE9903AXXL3N



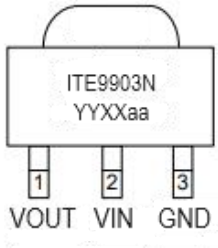
ITE9903AXXL3D



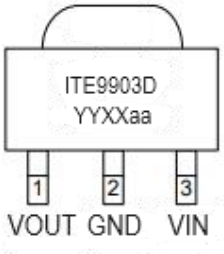
ITE9903AXXP3M



ITE9903AXXP3C



ITE9903AXXP3N



ITE9903AXXP3D

Pin Description

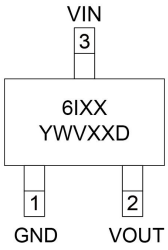
SOT23-3L

NAME	NO.				DESCRIPTION
	ITE9903AXXL3M	ITE9903AXXL3C	ITE9903AXXL3N	ITE9903AXXL3D	
VIN	3	3	1	2	Supply input voltage. A 1μF ceramic capacitor is recommended at this pin.
GND	1	2	3	3	IC Ground.
VOUT	2	1	2	1	Output Voltage. Power output of the device, a 10μF ceramic capacitor is recommended at this pin.

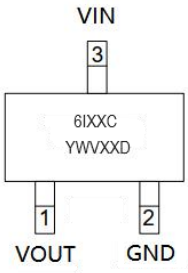
SOT89-3L

NAME	NO.				DESCRIPTION
	ITE9903AXXP3M	ITE9903AXXP3C	ITE9903AXXP3N	ITE9903AXXP3D	
VIN	2	1	2	3	Supply input voltage. A 1μF ceramic capacitor is recommended at this pin.
GND	1	2	3	2	IC Ground.
VOUT	3	3	1	1	Output Voltage. Power output of the device, a 10μF ceramic capacitor is recommended at this pin.

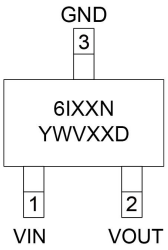
Marking Information



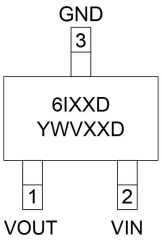
As shown in the left figure:
First row:
6I: Model code
XX: Output voltage（33: VOUT = 3.3V）
Second row:
YW: Year code, week code
V: Version code
XXD: Batch number



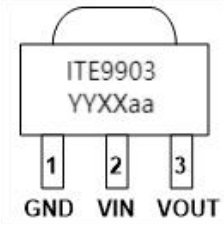
As shown in the left figure:
First row:
6IC: Model code
XX: Output voltage（33: VOUT = 3.3V）
Second row:
YW: Year code, week code
V: Version code
XXD: Batch number



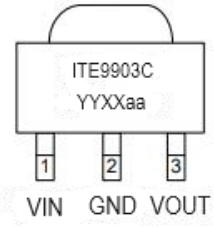
As shown in the left figure:
First row:
6IN: Model code
XX: Output voltage（33: VOUT = 3.3V）
Second row:
YW: Year code, week code
V: Version code
XXD: Batch number



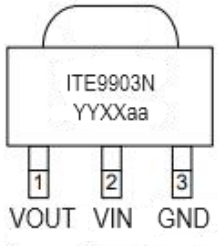
As shown in the left figure:
First row:
6ID: Model code
XX: Output voltage（33: VOUT = 3.3V）
Second row:
YW: Year code, week code
V: Version code
XXD: Batch number



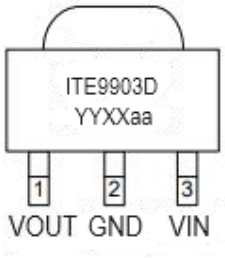
As shown in the left figure:
First row:
ITE9903: Model code
Second row:
YYXX: Production cycle
aa: Output voltage（33: VOUT = 3.3V）



As shown in the left figure:
First row:
ITE9903: Model code
Second row:
YYXX: Production cycle
aa: Output voltage（33: VOUT = 3.3V）



As shown in the left figure：
First row：
ITE9903N: Model code
Second row：
YYXX: Production cycle
aa: Output voltage（33: VOUT = 3.3V）



As shown in the left figure：
First row：
ITE9903D: Model code
Second row：
YYXX: Production cycle
aa: Output voltage（33: VOUT = 3.3V）

Absolute Maximum Ratings (Note 1)

PARAMETER	SYMBOL	MIN	MAX	UNIT
V_{IN}	Supply Voltage	-0.3	32	V
V_{out}	Output Voltage	-0.3	6	V
T_J	Junction Temperature	-40	150	°C
T_{STG}	Storage Temperature	-65	150	°C
T_{LEAD}	Lead Temperature Soldering Time		260,10s	°C
V_{ESD_HBM}	ESD (Human Body Model) (Note 2)		2000	V
V_{ESD_MM}	ESD (Machine Model) (Note 2)		200	V

Recommended Operating Conditions (Note 2)

SYMBOL	PARAMETER	LIMITS	UNIT
V_{IN}	Supply Voltage	3 to 24	V
V_{OUT}	Output Voltage	1.5 to 5	V
T_J	Junction Temperature	- 40 to 125	°C
T_A	Operating Temperature Range	-40 to 85	°C

Functional Block Diagram

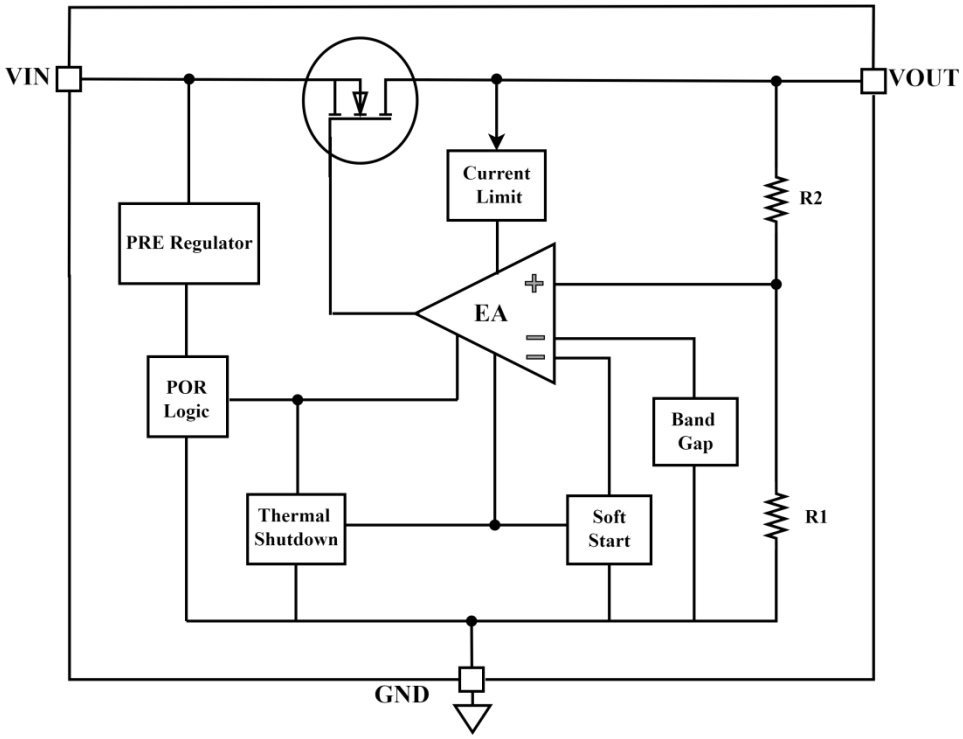


Figure 3. Functional Block Diagram

Electrical Characteristics

V_{IN} = $V_{OUT(NOM)}$ + 1 V, C_{IN} =1.0μF, C_{OUT} = 10 μF, T_A = 25°C for typical specifications, unless otherwise noted.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage						
V_{IN}	Input Voltage	V_{IN} Input Range ,V_{OUT} = V_{FB}	3		24	V
I_{GND}	Quiescent Current	V_{IN} = 12V, I_{OUT} = 0A		2.1		uA
Output Voltage						
V_{OUT}	Output Voltage Accuracy	V_{IN} = 12V, I_{OUT} = 10mA	-2		+2	%
$\triangle V_{LOAD}$	Load Regulation	V_{IN} = 12V,1mA ≤ I_{OUT} ≤ 100mA		0.02		%/mA
$\triangle V_{LINE\_VIN}$	Line Regulation	Set VOUT + 0.5V≤ V_{IN} ≤ 24V, I_{OUT} = 1mA		0.01		%/V
V_{DROP}	Dropout Voltage (Note 6)	V_{OUT} = 3.3V, I_{OUT} = 10mA		50		mV
PSRR						
PSRR	Ripple Rejection	V_{IN}= 12V, V_{OUT} = 3.3V, I_{OUT} = 10mA, F = 1KHz		90		dB
Output Current Protection						
$IOUT_{MAX}$	Output Current	V_{IN} = 12V	150			mA
I_{OCP}	Limit Current	V_{IN} = 12V		300		mA
I_{SHORT}	Short Current	V_{IN} = 12V, V_{OUT} < 0.2V		150		mA
Thermal Shutdown						
T_{SD}	Thermal Shutdown Temperature	T_J Rising		150		°C
T_{SR}	Thermal Shutdown Returned Temperature			130		°C

Note 1. Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. 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.

Note 2. Devices are ESD sensitive. Handling precaution is recommended.

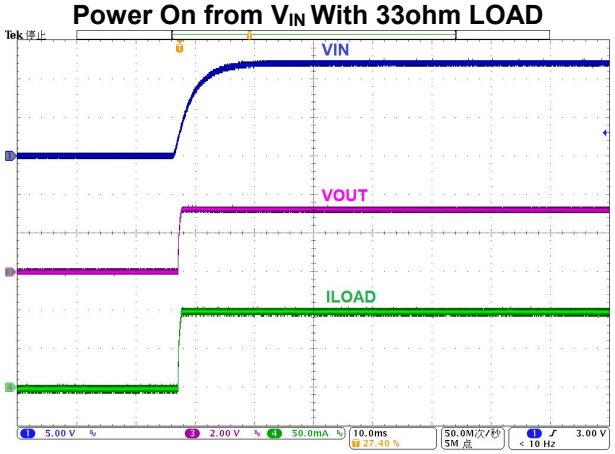
Note 3. The device is not guaranteed to function outside its operating conditions.

Note 4. The output current can be at least this value. Due to restrictions on the package power dissipation, this value may not be satisfied. Attention should be paid to the power dissipation of the package when the output current is large.

Note 5. The dropout voltage is defined as V_{IN} - V_{OUT}, which is measured when V_{OUT} is 98%*V_{OUT}.

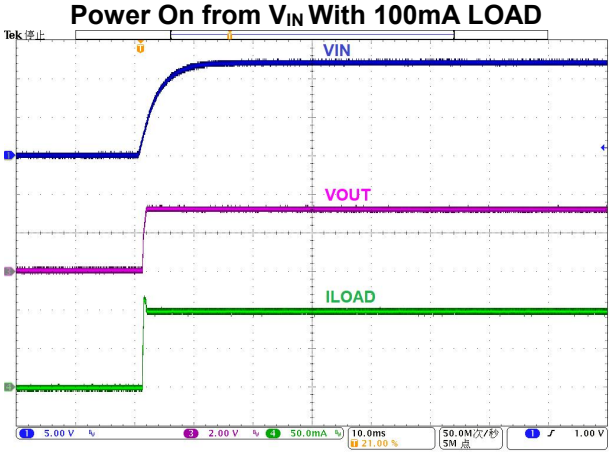
Typical Performance Characteristics (TBD)

Power On from V_{IN} With 33ohm LOAD



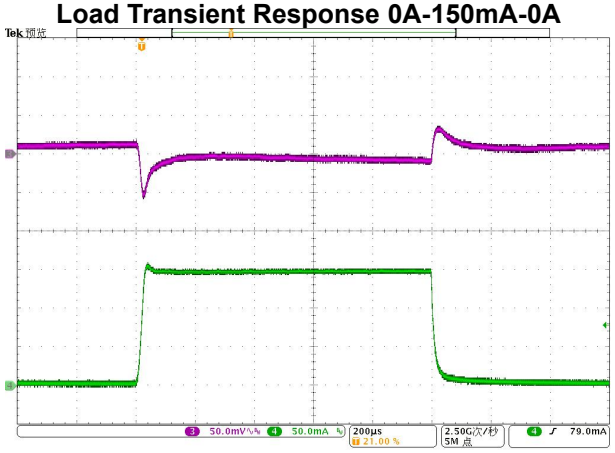
V_{IN} = 12V, V_{OUT} = 3.3V, R_{LOAD} = 33ohm

Power On from V_{IN} With 100mA LOAD



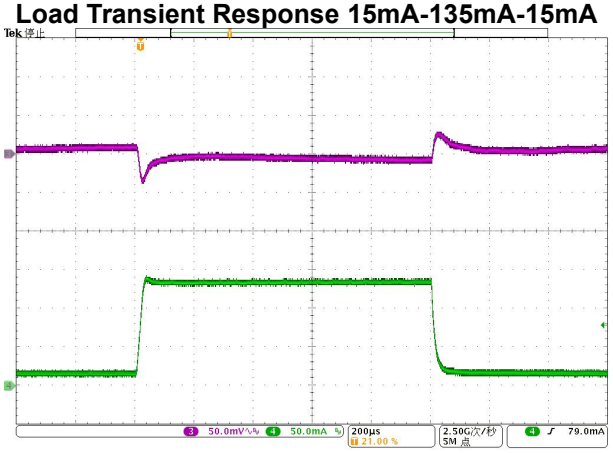
V_{IN} = 12V, V_{OUT} = 3.3V, I_{LOAD} = 100mA

Load Transient Response 0A-150mA-0A



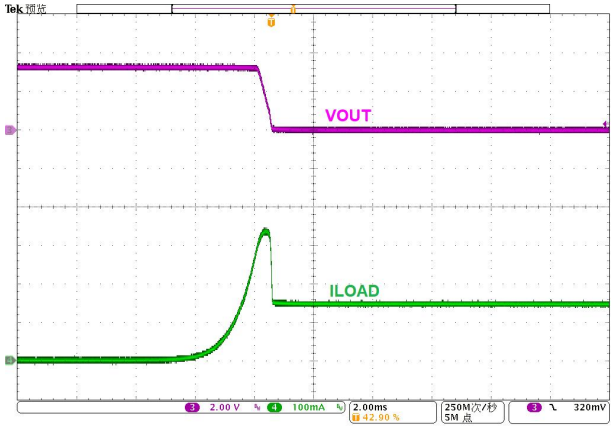
V_{IN} = 12V, V_{OUT} = 3.3V, I_{LOAD} = 0A-150mA-0A

Load Transient Response 15mA-135mA-15mA



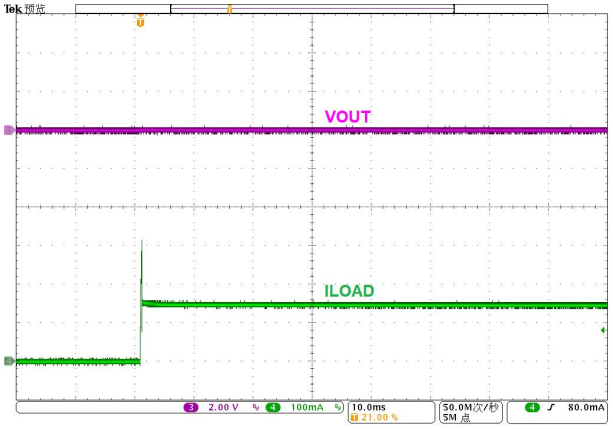
V_{IN} = 12V, V_{OUT} = 3.3V, I_{LOAD} = 15mA-135mA-15mA

Over Current Limit



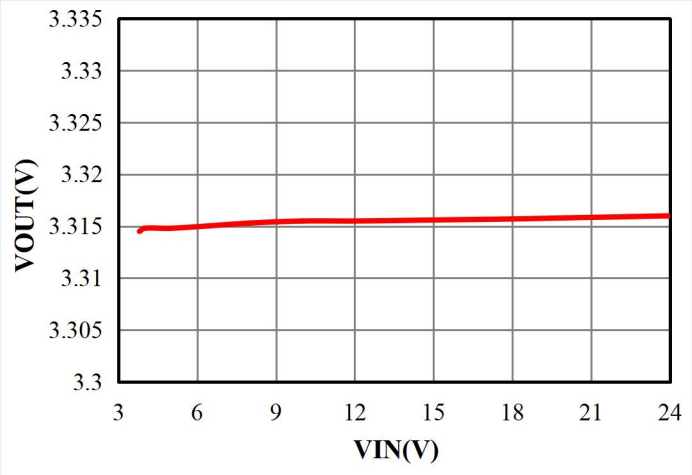
V_{IN} = 12V, V_{OUT} = 3.3V

Short Before Power On



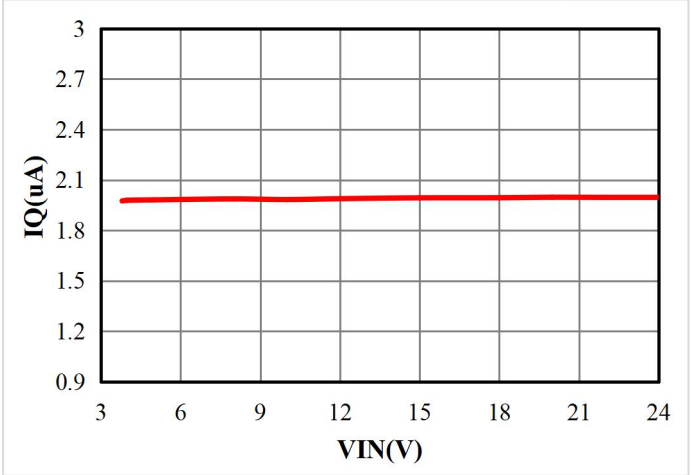
V_{IN} = 12V, V_{OUT} = 0V

Output Voltage vs. Input Voltage



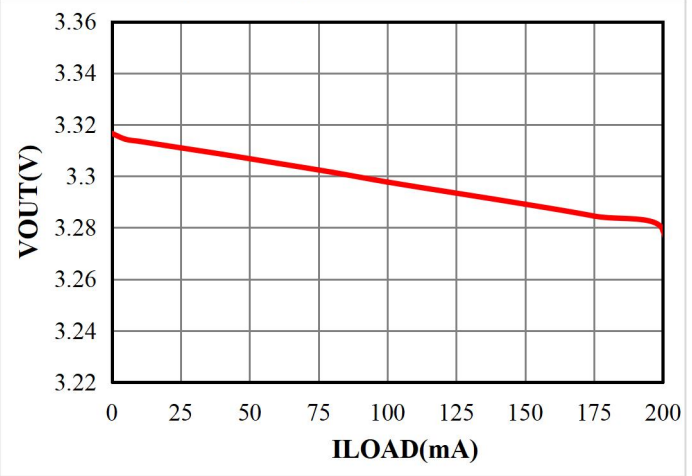
V_{IN} = 3.8V - 24V, V_{OUT} = 3.3V, I_{LOAD} = 0A

Quiescent Current vs. Input Voltage



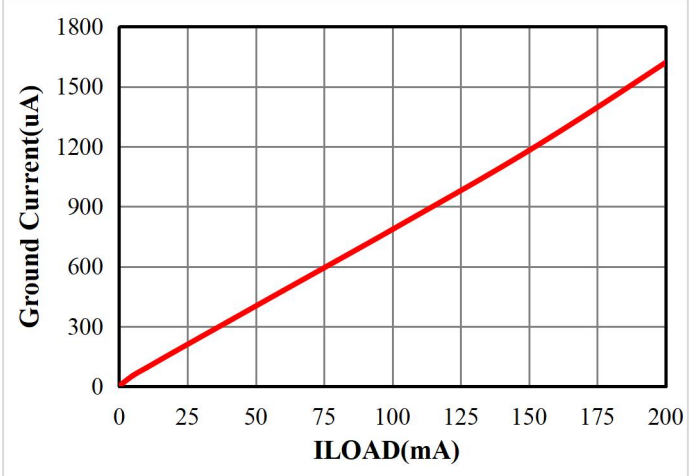
V_{IN} = 3.8V - 24V, V_{OUT} = 3.3V, I_{LOAD} = 0A

Output Voltage vs. Load Current



V_{IN} = 12V, V_{OUT} = 3.3V, I_{LOAD} = 0A-200mA

Load Current vs. Ground Current



V_{IN} = 12V, V_{OUT} = 3.3V, ILOAD = 0A-200mA

Application Information

Input Capacitor

Good bypassing capacitor is recommended from input to ground to help improve IC ac performance. Bypass VIN to ground with a 1μF or greater capacitor for normal operation in most applications. Place the capacitors physically as close as possible to the device with wide and direct PCB traces to supply current during stepping load transients to prevent the input voltage rail from dropping.

Output Capacitor

The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDO applications. The ITE9903 is specifically designed to employ ceramic output capacitors as low as 1μF.

The ceramic capacitors offer significant cost and space savings, along with high frequency noise filtering. Place the capacitors physically as close as possible to the device with wide and direct PCB traces. The capacitor ESR should be less than 50mohm.

Current Limit

The ITE9903 contains an independent current limit and short circuit current protection to prevent unexpected applications. The current limit monitors and controls the pass transistor’s gate voltage, allowing the output current to reach the value of 150mA. Then further decreases in the load resistance reduce both the load current and the load voltage. Once the output current is higher than current limit threshold, the current limit function will be triggered, clamping the output current at a pre-designed level to prevent over current stress and thermal damage.

Build-In Soft-Start

The ITE9903 features an internal soft-start function that controls rise rate of the output voltage to limit the current surge during start-up.

OTP Protection

A Thermal shutdown protection circuit disables the ITE9903 when the junction temperature of the pass transistor rises to 150°C (typical). Thermal shutdown hysteresis assures that the device resets (turns on) when the temperature falls to 130°C (typical).

The thermal shutdown feature provides protection against some application failure due to overheating power dissipation and it is not intended to be used as a normal working function.

Power Dissipation

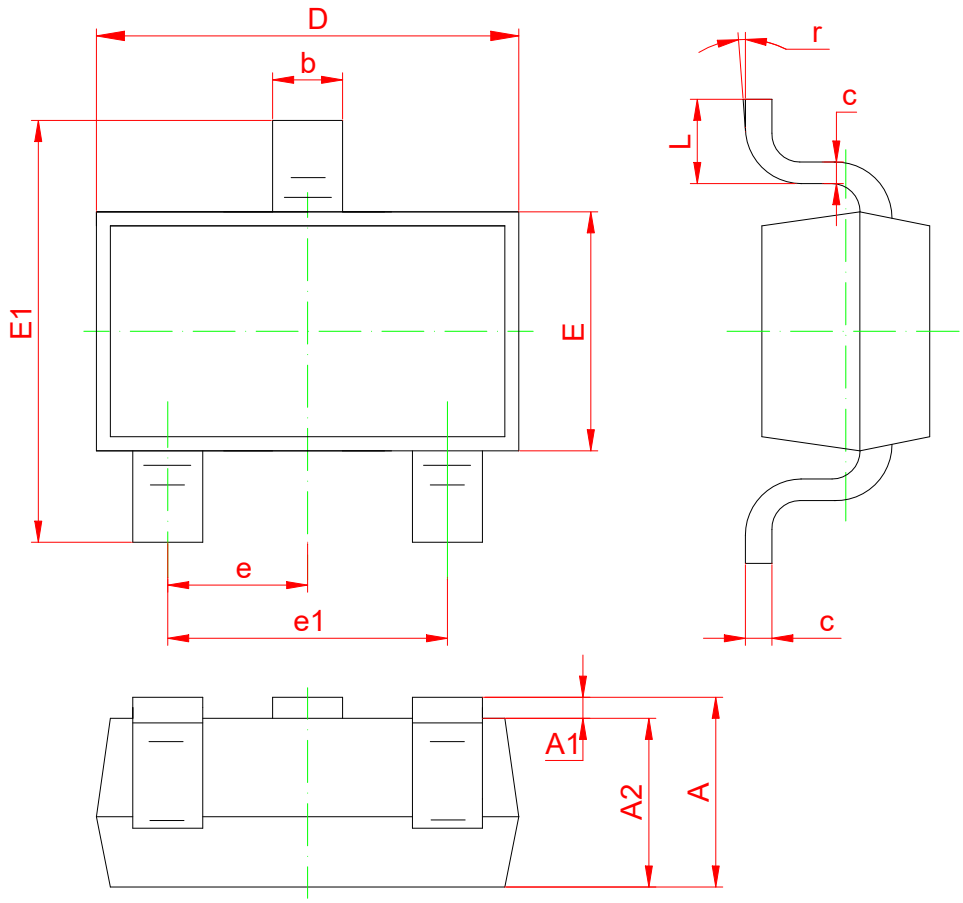
Power dissipation caused by voltage drop across the LDO and by the output current flowing through the device needs to be dissipated out from the chip. The maximum power dissipation is dependent on the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature.

Power dissipation in the regulator depends on the input-to-output voltage difference and load conditions.

$$PD = (VIN - VOUT) \times IOUT$$

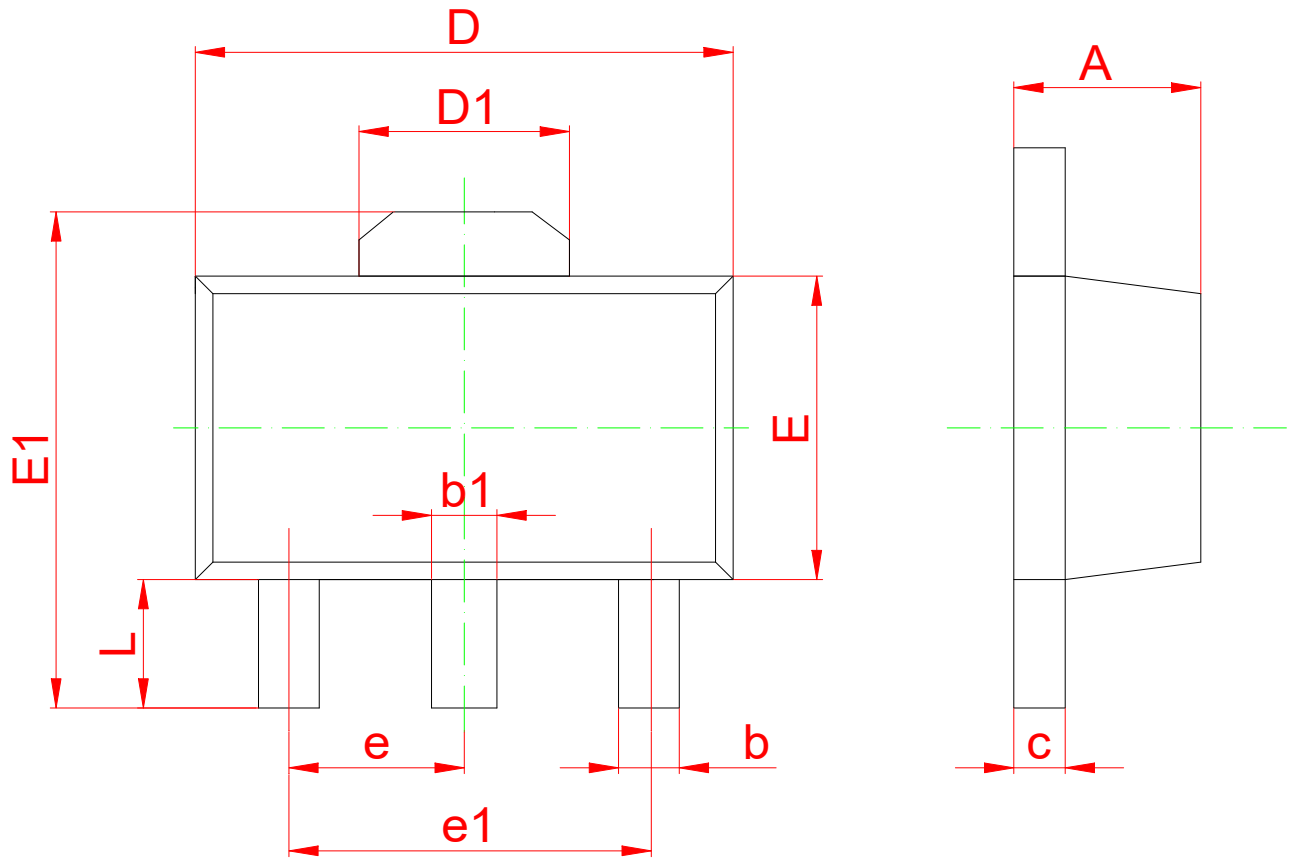
Power dissipation can be minimized, and thus greater efficiency achieved, by proper selection of the system voltage rails. To avoid thermally overloading the ITE9903, refrain from exceeding the absolute maximum junction temperature rating of 150°C under continuous operating condition. Over-stressing the regulator with high loading currents and elevated input-to-output differential voltages can increase the IC die temperature significantly.

Package Information: SOT-23-3L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 (BSC)		0.037 (BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
r	0°	8°	0°	8°

Package Information: SOT-89-3L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550REF.		0.061REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500TYP		0.060TYP	
e1	3.000TYP		0.118TYP	
L	0.900	1.200	0.035	0.047

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