ITE9905

40V, 300mA Fast Transient Low Dropout Voltage Regulator

Features

- Output current up to 300mA
- Low dropout voltage typically 450mV at 100mA output current application
- Low quiescent current: 2.1μA
- Operating Input voltage range: 3.0V to 40V
- 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
- Green Product RoHS Compliant and Halogen Free

Applications

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

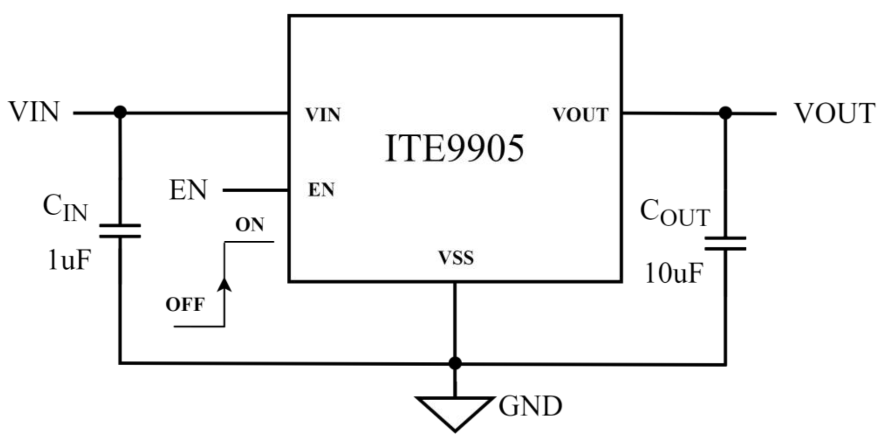
Package Type: SOT-23-3L, SOT89-3L and SOT23-5L

Description

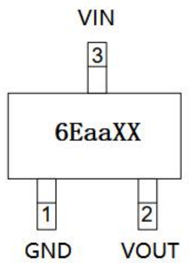
The ITE9905 is a 300mA low dropout linear voltage regulator with a 2.1μA low quiescent current, operating input voltage up to 40V, and offering fixed output voltage ranges from 1.5V to 5.0V. The device is designed for use in applications requiring high input voltage in the EN pin to enable and disable the linear regulator.

The ITE9905 Integrates many functions, providing high power supply rejection, and 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. Additionally, the device also features thermal shutdown, over current protection and short-circuit protection to protect the device against thermal and current overload conditions. The ITE9905 is a commonly used solution in different applications due to its wide variety of fixed output voltage options.

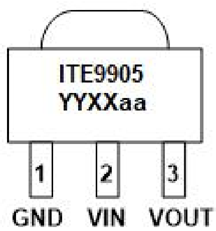
Typical Application



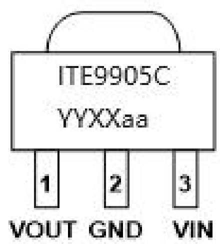
Marking Information



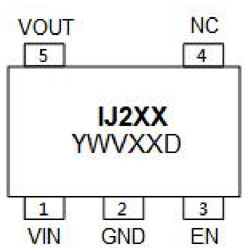
As shown in the left figure：
First row：
6E: Model code
aa: Output voltage（33: VOUT = 3.3V）
XX: Production cycle



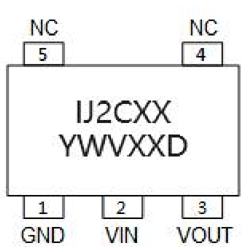
As shown in the left figure：
First row：
ITE9905: Model code
Second row：
YYXX: Production cycle
aa: Output voltage（33: VOUT = 3.3V）



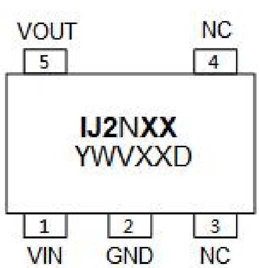
As shown in the left figure：
First row：
ITE9905C: Model code
Second row：
YYXX: Production cycle
aa: Output voltage（33: VOUT = 3.3V）



As shown in the left figure：
First row：
IJ2: Model code
Second row：
YWV: Production cycle
XX: Output voltage（33: VOUT = 3.3V）
D: Version

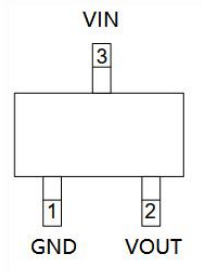


As shown in the left figure：
First row：
IJ2C: Model code
Second row：
YWV: Production cycle
XX: Output voltage（33: VOUT = 3.3V）
D: Version

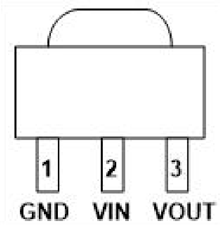


As shown in the left figure：
First row：
IJ2N: Model code
Second row：
YWV: Production cycle
XX: Output voltage（33: VOUT = 3.3V）
D: Version

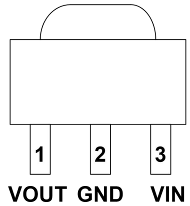
Pin Configuration



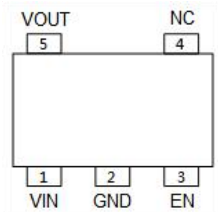
SOT23-3L
ITE9905AXXL3M



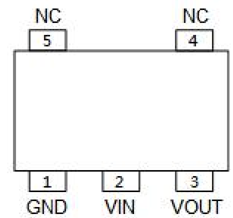
SOT89-3L
ITE9905AXXP3M



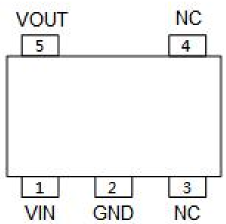
SOT89-3L
ITE9905AXXP3C



SOT23-5L
ITE9905AXXL5M



SOT23-5L
ITE9905AXXL5C



SOT23-5L
ITE9905AXXL5N

Pin Description

NAME	DESCRIPTION
VIN	Supply input voltage. A 1μF ceramic capacitor is recommended at this pin.
GND	IC ground.
EN	Enable control input(Active High), don't left this pin open.
NC	Not connected.
VOUT	Output voltage. Power output of the device, a 10μF ceramic capacitor is recommended at this pin.

Model Description

ITE	9905	A	XX	L	5	X	A
①	②	③	④	⑤	⑥	⑦	⑧

①： Brand abbreviation

②： Model category

③： Version

④： Output voltage abbreviation (33: V_{OUT}=3.3V)

⑤： Encapsulation code（see Pin Configuration）

⑥： Number of pins

⑦： Foot position sequence code（see Pin Configuration）

⑧： Precision code(A: ±1%, note: If there is no such letter, it is 2%)

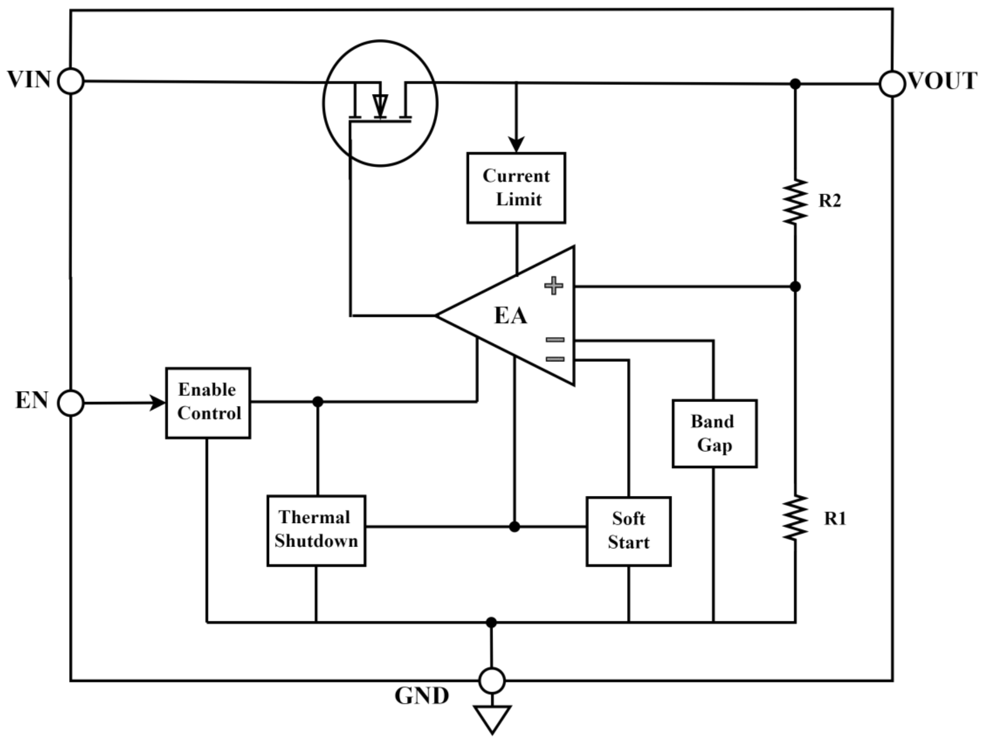
Absolute Maximum Ratings (Note 1)

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{IN}	Supply Voltage	-0.3	45	V
V_{out}	Output Voltage	-0.3	6	V
V_{EN}	Enable Voltage	-0.3	45	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 3)

SYMBOL	PARAMETER	LIMITS	UNIT
V_{IN}	Supply Voltage	3 to 40	V
EN	Enable Voltage	1.2 to 40	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



Electrical Characteristics

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

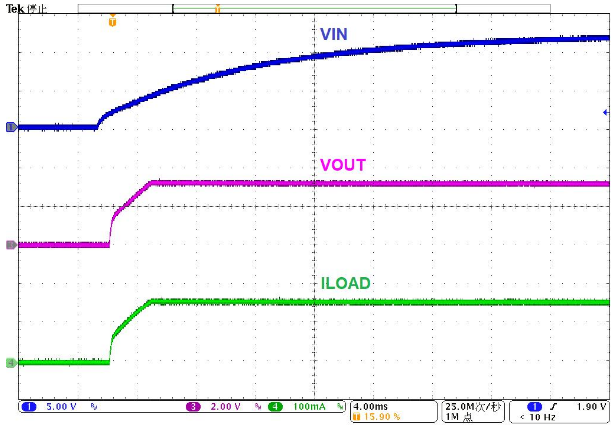
SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage						
V_{IN}	Input Voltage	V_{IN} Input Range ,$V_{OUT} = V_{FB}$	3		40	V
I_{GND}	Quiescent Current	V_{IN} = 12V, I_{OUT} = 0A		2.1		μA
Output Voltage						
V_{OUT}	Output Voltage Accuracy	V_{IN} = 12V, I_{OUT} = 10mA （ITE9905AXXXXX）	-2		+2	%
		V_{IN} = 12V, I_{OUT} = 10mA （ITE9905AXXXXXX）	-1		+1	%
$\triangle V_{LOAD}$	Load Regulation	V_{IN} = 12V, 1mA ≤ I_{OUT} ≤ 100mA		0.02		%/mA
$\triangle V_{LINE\_VIN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 40V, I_{OUT} = 1mA		0.01		%/V
V_{DROP}	Dropout Voltage (Note 4)	V_{OUT} = 3.3V, I_{OUT} = 10mA		40		mV
Soft Start						
T_{SS}	Soft Start Time	V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 10mA		200		μs
Enable						
I_{EN}	EN Input Bias Current	$V_{IN} = V_{EN}$ = 12V			1	μA
V_{ENH}	EN Input Voltage High	V_{IN} = 12V, I_{OUT} = 10mA	1.2			V
V_{ENL}	EN Input Voltage Low	V_{IN} = 12V, I_{OUT} = 10mA			0.4	V
PSRR						
PSRR	Power Supply Rejection Ratio	V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 10mA, F = 1kHz		90		dB
Output Current Protection						
$IOUT_{MAX}$	Output Current	V_{IN} = 12V		300		mA
I_{OCP}	Limit Current	V_{IN} = 12V		500		mA
I_{SHORT}	Short Current	V_{IN} = 12V, V_{OUT} < 0.2V		250		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 dropout voltage is defined as V_{IN} - V_{OUT}, which is measured when V_{OUT} is 98%*V_{OUT}.

Typical Performance Characteristics

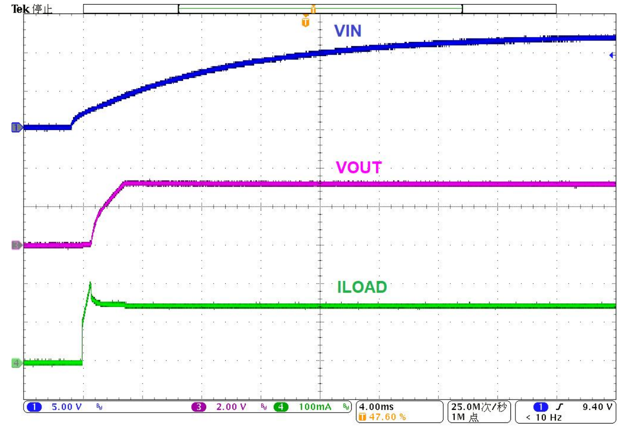
(T_A = 25°C, C_{IN} = 1.0μF, C_{OUT} = 10μF, unless otherwise specified)

Power On from V_{IN} With 22ohm LOAD



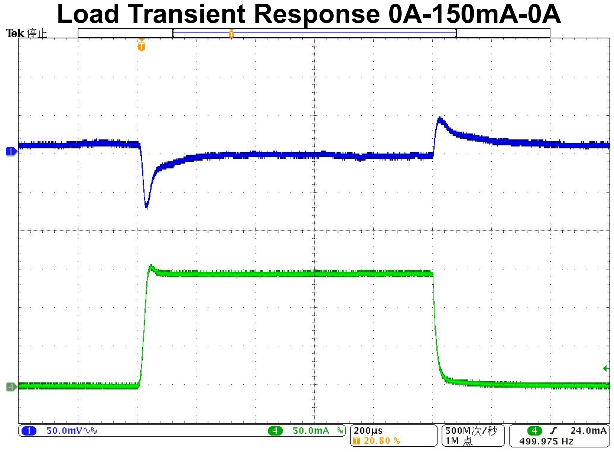
V_{IN} = 12V, V_{OUT} = 3.3V, R_{LOAD} = 22ohm

Power On from V_{IN} With 150mA LOAD



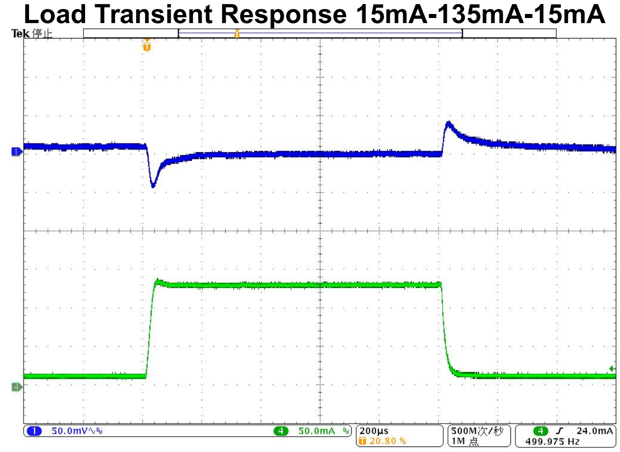
V_{IN} = 12V, V_{OUT} = 3.3V, I_{LOAD} = 150mA

Load Transient Response 0A-150mA-0A



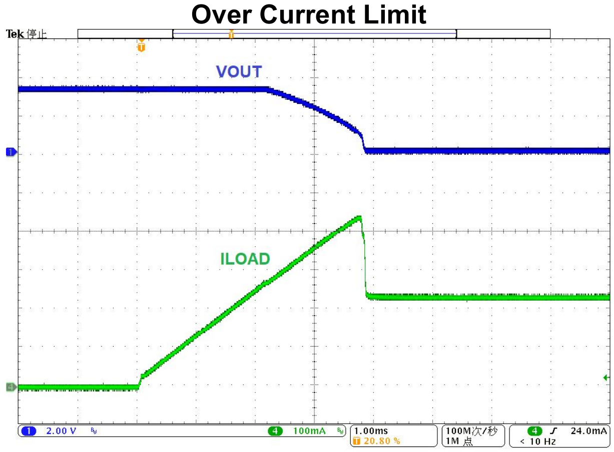
V_{IN} = 5.0V, V_{OUT} = 3.3V, I_{LOAD} = 0A-150mA-0A

Load Transient Response 15mA-135mA-15mA



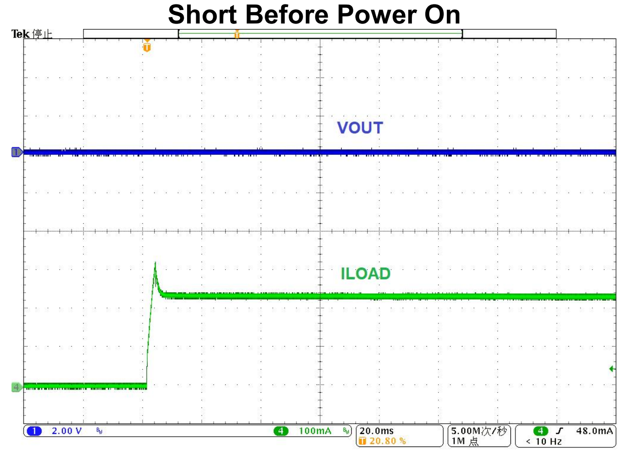
V_{IN} = 5.0V, V_{OUT} = 3.3V, I_{LOAD} = 15mA-135mA-15mA

Over Current Limit



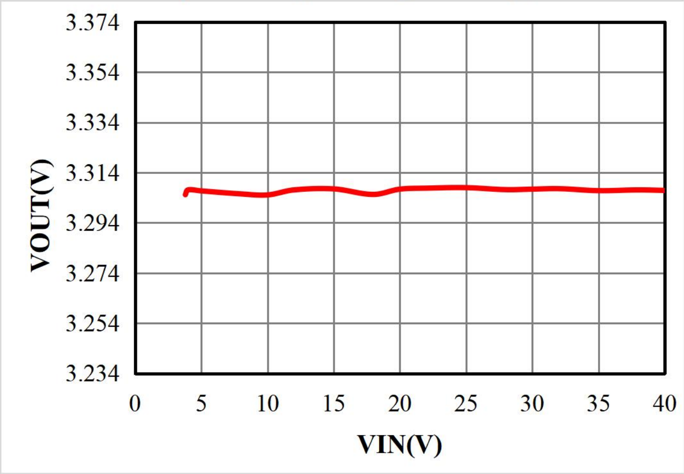
V_{IN} = 5.0V, V_{OUT} = 3.3V

Short Before Power On



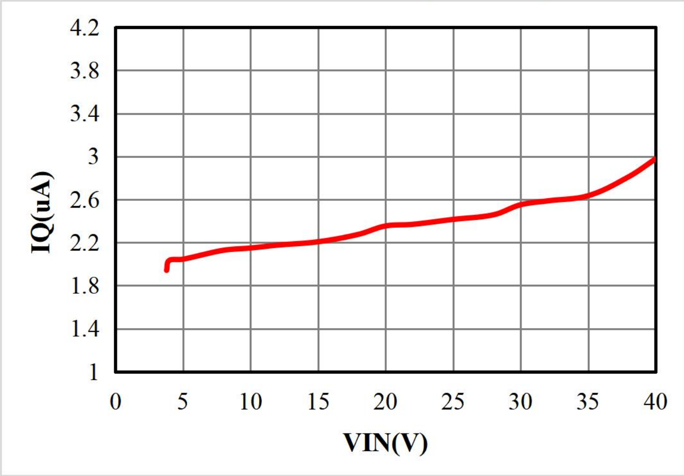
V_{IN} = 5.0V, V_{OUT} = 0V

Output Voltage vs. Input Voltage



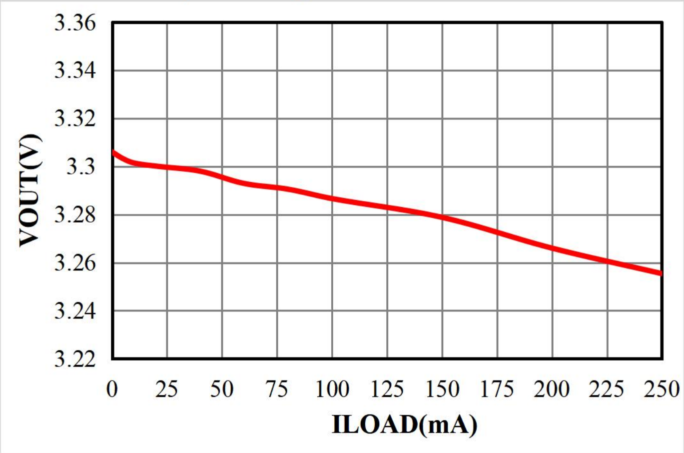
V_{IN} = 3.8V - 40V, V_{OUT} = 3.3V, I_{LOAD} = 0A

Quiescent Current vs. Input Voltage



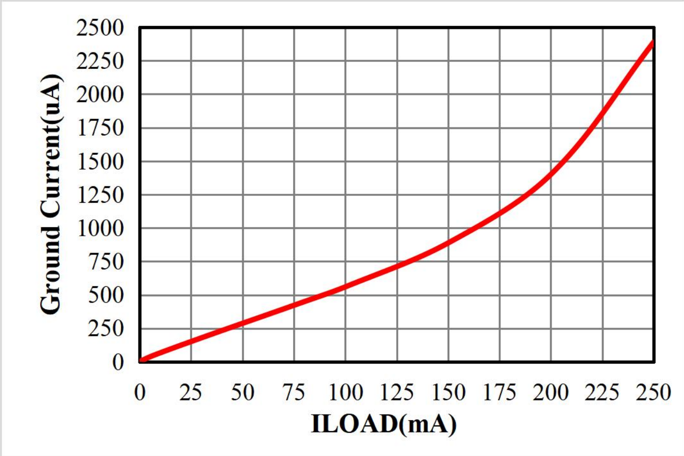
V_{IN} = 3.8V - 40V, V_{OUT} = 3.3V, I_{LOAD} = 0A

Output Voltage vs. Load Current



V_{IN} = 5.0V, V_{OUT} = 3.3V, I_{LOAD} = 0A-250mA

Load Current vs. Ground Current



V_{IN} = 5.0V, V_{OUT} = 3.3V, ILOAD = 0A-250mA

Application Information

Input Capacitor

Good bypassing capacitor is recommended from input to ground to help improve AC performance. Bypass VIN to ground with a 1μF or greater capacitor is recommended 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 and 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 ITE9905 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's ESR should be less than 50mohm.

Current Limit

The ITE9905 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 500mA. 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 and clamp the output current at a pre-designed level to prevent over current stress and thermal damage.

Build-In Soft-Start

The ITE9905 contains an internal soft-start function that controls the rise rate of the output voltage to limit the current surge during start-up. In a typical application with VIN = 12V, VOUT = 3.3V, the soft-start interval is about 450μs.

OTP Protection

A Thermal shutdown protection circuit disables the ITE9905 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 overheating power dissipation due to some application failure and it is not intended to be used as a normal working function.

Enable

The ITE9905 uses the dedicated EN pin to enable its operation. If the EN pin voltage is < 0.4V, the regulator will be turned off. If the EN pin voltage is > 1.2V, the regulator will be turned on and undergoes a new soft-start cycle. The EN pin can take 40V input voltage, connected the EN pin with V_{IN} to maintain the regulator in operating mode. Do not leave the EN pin floating when this pin is not used.

Power Dissipation

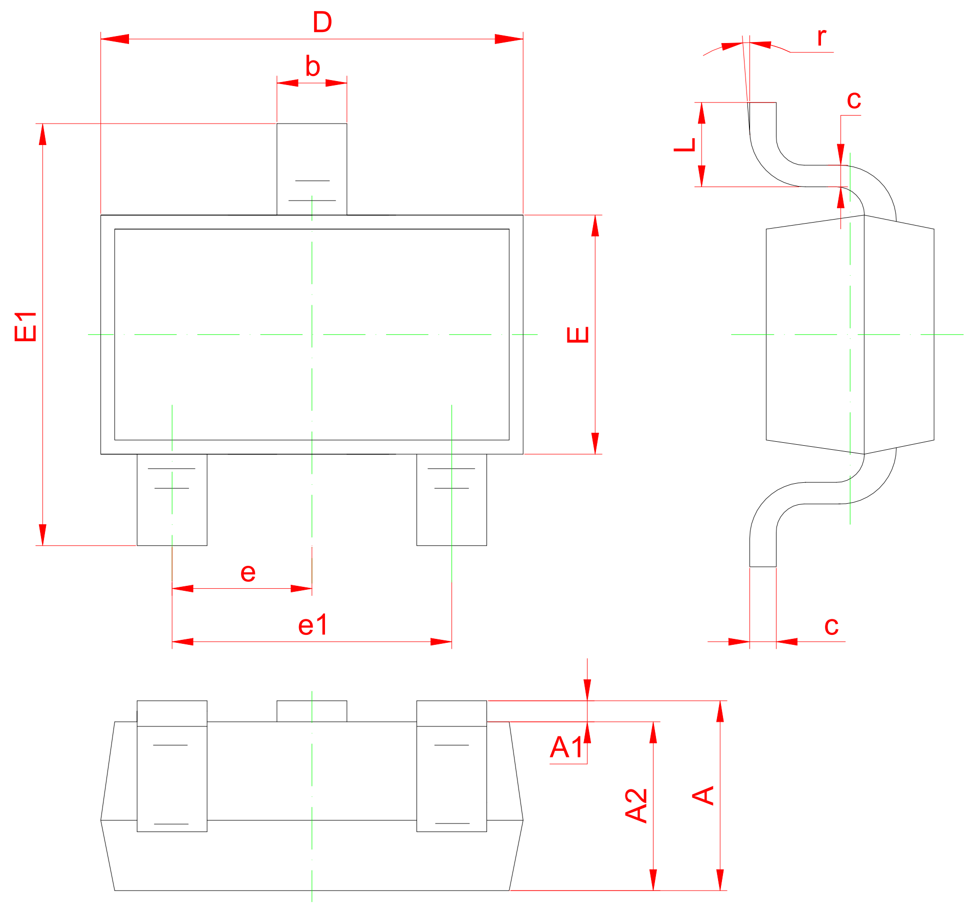
Power dissipation caused by voltage drop across the LDO and by the output current flowing through the device needs to be dissipated out from the chip. The maximum power dissipation is dependent on the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature.

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

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

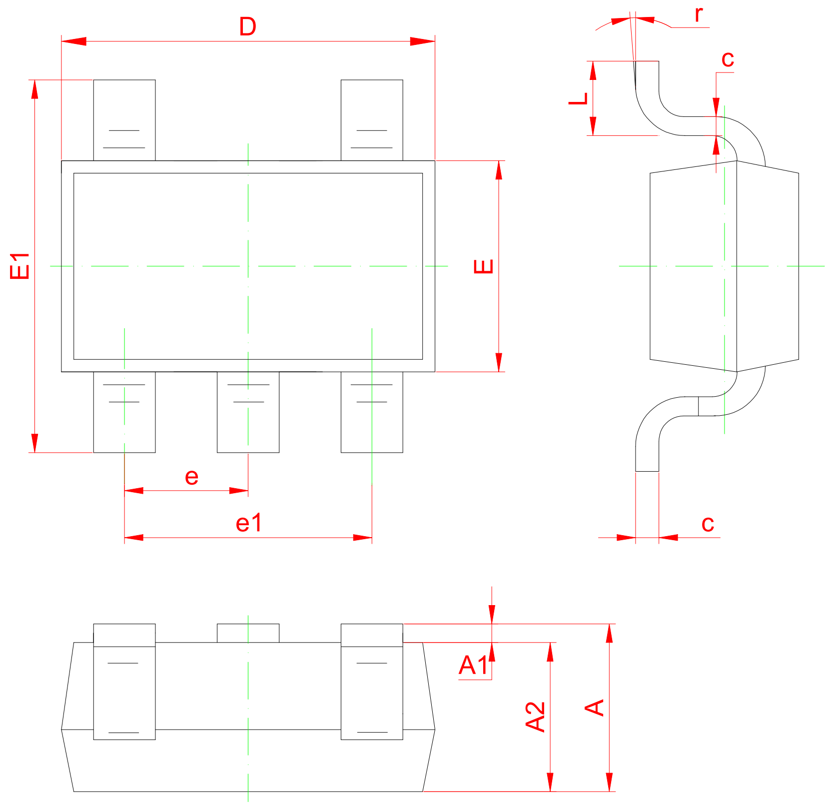
Power dissipation can be minimized, and thus greater efficiency achieved, by proper selection of the system voltage rails. To avoid thermally overloading the ITE9905, refrain from exceeding the absolute maximum junction temperature rating of 150°C under continuous operating condition. Over-stressing 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



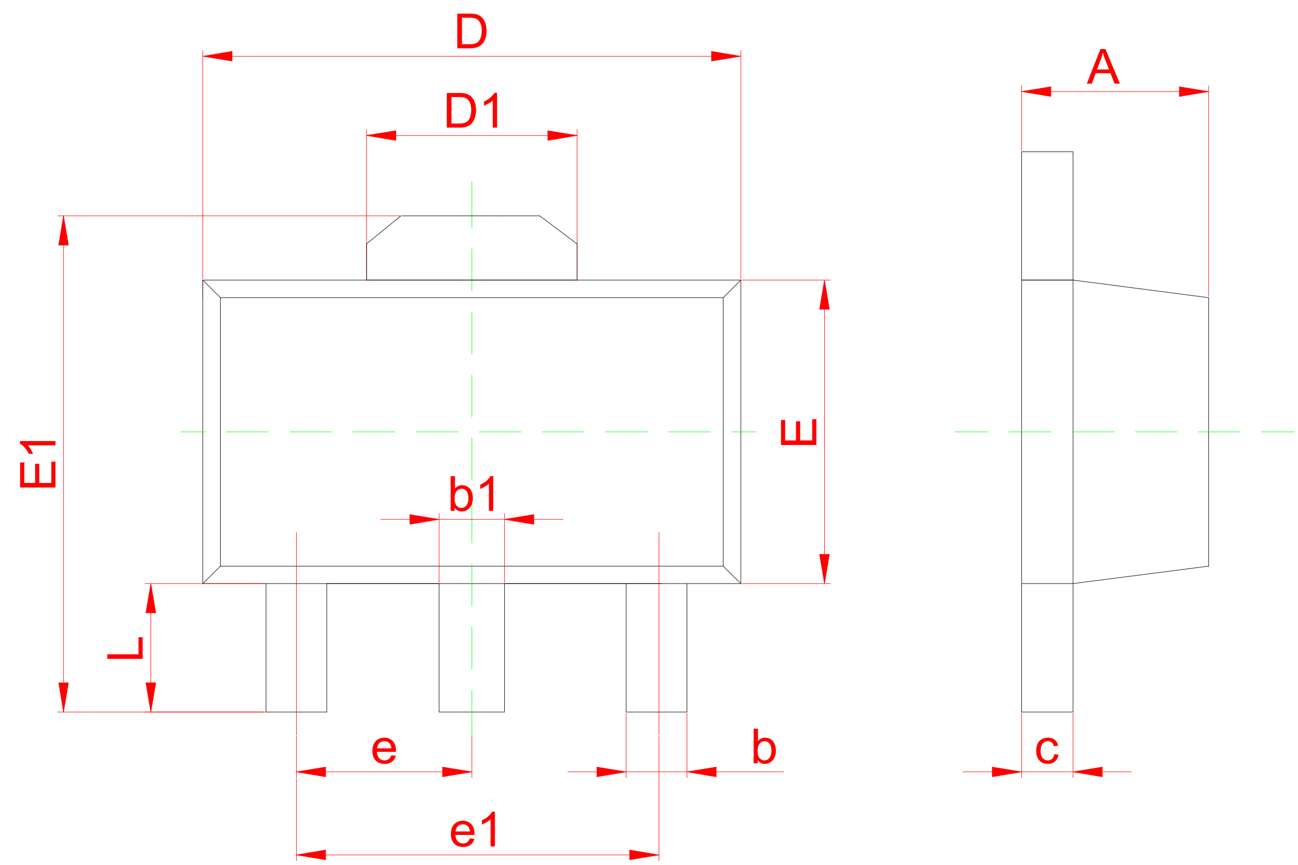
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 (BSC)		0.037 (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-23-5L



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	0º	8º	0º	8º

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