Features

- Output Current Up to 500mA
- Low Dropout Voltage Typically 1V at 500mA Output Current Application
- Low Quiescent Current: 2.5uA
- 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
- Build Internal 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 Applications
- Industrial Automation Supplies
- Servers Device Applications

Description

The ITE9913 is a 500mA low dropout linear voltage regulator with 2.5uA low quiescent current, operating input voltage up to 24V, and offering fixed output voltage ranges from 1.5V to 5.0V. Also, the device is designed for use in applications requiring high input voltage in the EN Pin to enable and disable the linear regulator.

Integrating many functions the ITE9913 provides high power supply rejection, and owns excellent line and load transient response with only a small 1uF~10uF ceramic output capacitor. Building internal soft-start minimizes stress on the input power source by reducing capacities inrush current during start-up time. The functions of thermal shutdown, over current and short-circuit protection to protect the device against thermal and current over-loads. A wide fixed output voltage options, making the ITE9913 a very common solution in different applications.

The ITE9913 is available in SOT23-3L, SOT23-5L, and SOT89-3L packages.

Typical Application

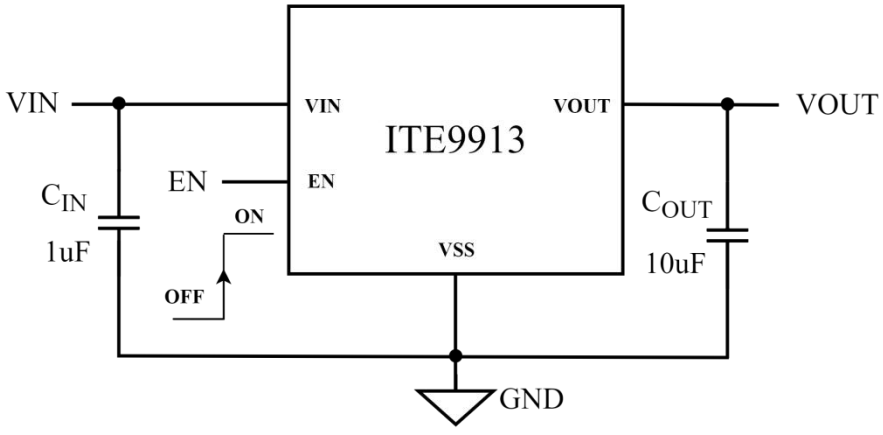
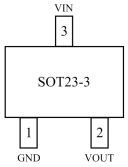
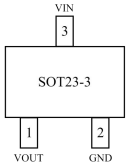


Figure 1. Typical Application

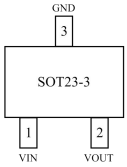
Pin Configuration



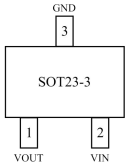
ITE9913AXXL3M



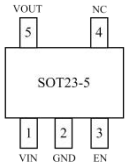
ITE9913AXXL3C



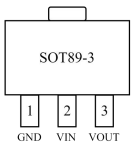
ITE9913AXXL3N



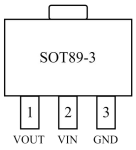
ITE9913AXXL3D



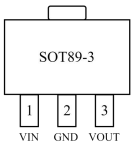
ITE9913AXXL5M



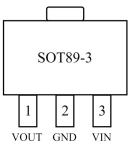
ITE9913AXXP3M



ITE9913AXXP3D



ITE9913AXXP3E



ITE9913AXXP3C

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. The power output of the device. A 10μF ceramic capacitor is recommended at this pin.

Universal Naming Convention

ITE	9913	A	XX	L3	M
①	②	③	④	⑤	⑥

①: Abbreviation of product company name

②: Series model

③: Version

④: Output voltage (example 33: VOUT=3.3V)

⑤: Package code

L3: SOT23-3L L5: SOT23-5L P3: SOT89-3L

⑥: Pin Distinguishing Code

Can view foot position instructions

Marking Information

MODEL	PACKAGE	PRINTING	FUNCTION
ITE9913AXXL3M ITE9913AXXL3C ITE9913AXXL3N ITE9913AXXL3D	SOT23-3L	PMaaYW	P : Model code M : package PIN pin code (See foot position definition) aa : Output voltage (33:VOUT=3.3V) Y : Age code W : Weekly code
ITE9913AXXL5M	SOT23-5L	PAYW	P : Model code A : Output voltage code (A: 5V B: 4.4V C: 3.6V D: 3.3V E: 3.0V F: 2.9V G: 2.8V H: 2.7V I: 2.5V J: 2.3V K: 2.0V L: 1.8V M: 1.5V) Y : Age code W : Weekly code
ITE9913AXXP3M	SOT89-3L	ITE9913 YYXXaa	First row: ITE9913 : Model code Second row: YY: Age and weekly code XX: Batch number code aa: Output voltage (33: VOUT=3.3V)
ITE9913AXXP3D ITE9913AXXP3E ITE9913AXXP3C	SOT89-3L	PaaE YWXXD	First row: P : Model code aa: Output voltage (33: VOUT=3.3V) E: Package PIN code (See foot position definition) Second row: Y: Age code W: Weekly code XX: Batch number code D: Factory code

Functional Block Diagram

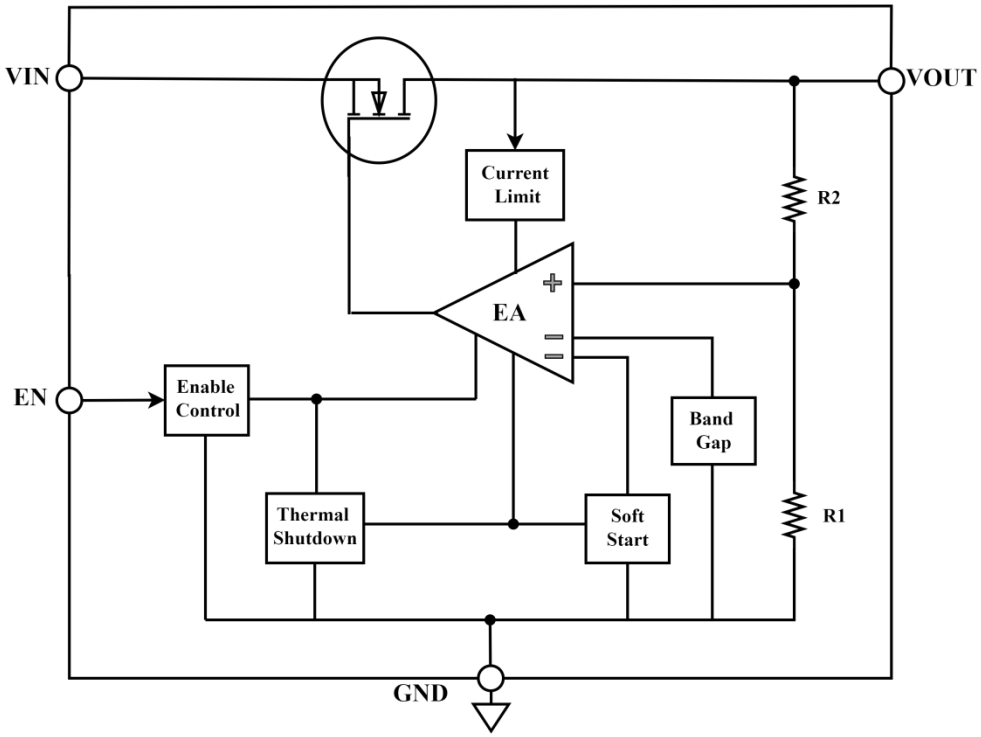


Figure 3. Functional Block Diagram

Absolute Maximum Ratings (Note 1)

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{IN}	Supply Voltage	-0.3	36	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 Mode) (Note 2)		2000	V

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions. Extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Recommended Operating Conditions (Note 3)

SYMBOL	PARAMETER	LIMITS	UNIT
V_{IN}	Supply Voltage	3.0 to 24	V
EN	Enable Voltage	0 to 24	V
V_{OUT}	Output Voltage	1.5 to 5	V
T_J	Junction Temperature	-40 ~ 125	°C

Electrical Characteristics

(V_{IN}=5.0V, C_{IN}=10uF, C_{OUT}=10μF, T_A=25°C, unless otherwise specified)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage						
V_{IN}	Input Voltage	V_{IN} Input Range ,V_{OUT}=V_{FB}	3.0		24	V
V_{IN_H}	V_{IN} POR Rising Threshold	I_{OUT}=1.0mA		1.6		V
V_{IN_L}	V_{IN} POR Hysteresis	I_{OUT}=1.0mA		60		mV
I_{GND}	Quiescent Current	V_{IN}=12V,I_{OUT}=0A		2.5		uA
I_{SD}	Shutdown Current	V_{IN}=12V,EN=0V		0.2	1.0	uA
Output Voltage						
V_{OUT}	Output Voltage Accuracy	V_{IN}=12V,I_{OUT}=10mA	-2.0		+2.0	%
$\triangle V_{LOAD}$	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}≤24V, I_{OUT}=1mA		0.01		%/V
V_{DROP}	Dropout Voltage (Note 4)	V_{OUT}=5V,I_{OUT}=50mA		62.5		mV
		V_{OUT}=5V,I_{OUT}=100mA		125		mV
Enable						
I_{EN}	EN Input Bias Current	V_{IN}=V_{EN}=12V			1.0	uA
V_{ENH}	EN Input Voltage High	V_{IN}=12V,I_{OUT}=10mA	1.4			V
V_{ENL}	EN Input Voltage Low	V_{IN}=12V,I_{OUT}=10mA			0.4	V
PSRR						
PSRR	Ripple Rejection	V_{IN}=12V,V_{OUT}=3.3V,I_{OUT}=10mA, F=1KHz		90		dB
Output Current Protection						
I_{OUT_MAX}	Output Current	V_{IN}=12V	500			mA
I_{OCP}	Limit Current	V_{IN}=12V		830		mA
I_{SHORT}	Short Current	V_{IN}=12V, V_{OUT}<0.2V		430		mA
T_{SS}	Soft Start Time	V_{IN}=12V,V_{OUT}=5V,I_{OUT}=0A		280		uS
Enable						
R_{DIS}	ShutdownAuto-Discharge Resistance	EN=0V,V_{IN}=5V		2.44		KΩ
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 for stress ratings. 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 remain possibility to affect device reliability.

Note 2. θJA is measured in the natural convection at T_A=25°C on a high effective thermal conductivity test board (40mm x 40mm x 1.6mm double sided board with 2oz, copper ratio: approx. 50%) of JEDEC 51-7 thermal measurement standard.

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

Note 4. The dropout voltage is defined as VIN - VOUT, which is measured when VOUT is 98%*VOUT.

Application Information

Input Capacitor

Good bypassing capacitor is recommended from input to ground to help IC ac performance, bypass VIN to ground with a 1uF 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 ITE9913 is specifically designed to employ ceramic output capacitors as low as 1uF.

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. capacitor ESR should be less than 50mohm.

Current Limit

The ITE9913 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, it allows 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

ITE9913 contains an internal soft-start function controls rise rate of the output voltage to limit the current surge at start-up. The typical application VIN=12V, VOUT=3.3V, soft-start interval is about 190us.

OTP Protection

A Thermal shutdown protection circuit disables the ITE9913 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 the protection IC against overheating power dissipation due to some application failure and it is not intended to be used as a normal working function.

Enable

The ITE9913 uses the dedicated EN pin to enable its operation. If the EN pin voltage is < 0.4 V the regulator will be turned off. If the EN pin voltage is > 1.2 V the regulator will be turned on and undergoes a new soft-start cycle. The EN pin can take 24V input voltage, connected the EN pin with VIN to keep the regulator in operating mode. Do not left the

EN pin in floating state when this pin is not used.

Power Dissipation

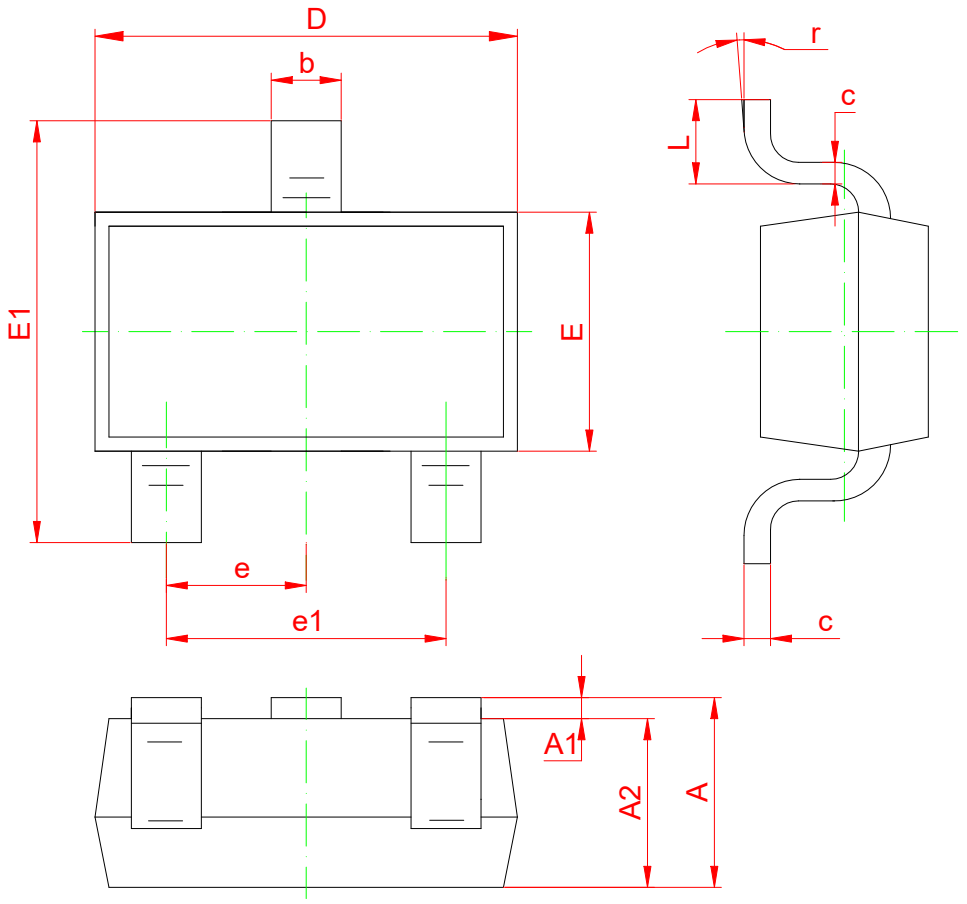
Power dissipation caused by voltage drop across the LDO and by the output current flowing through the device needs to be dissipated out from the chip. The maximum power dissipation is dependent on the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature.

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

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

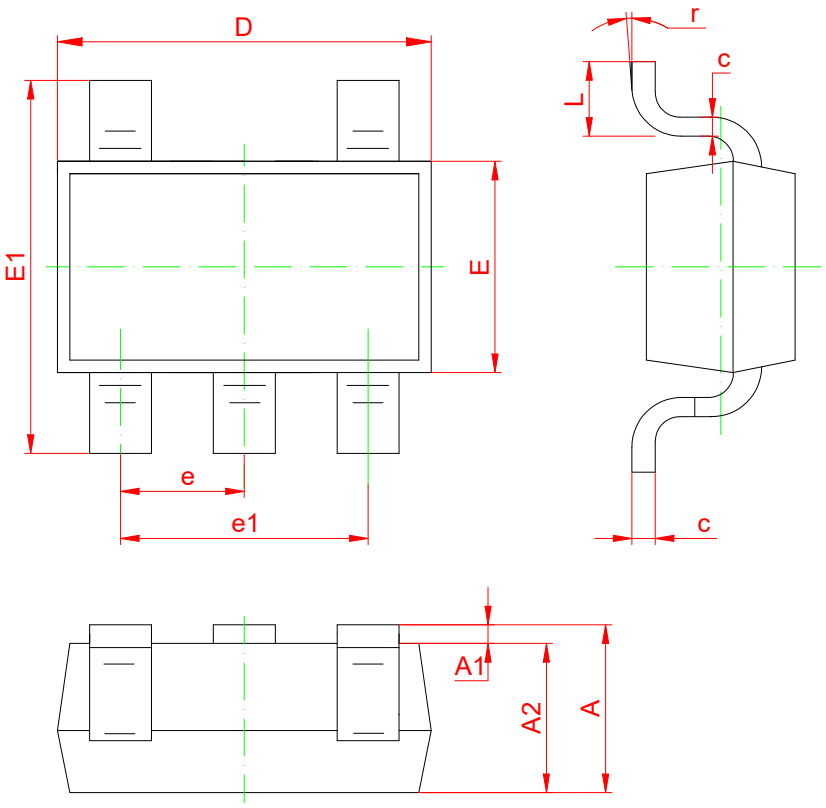
Power dissipation can be minimized, and thus greater efficiency achieved, by proper selection of the system voltage rails. To avoid thermally overloading the ITE9913, refrain from exceeding the absolute maximum junction temperature rating of 150°C under continuous operating condition. Over-stressing the regulator with high loading currents and elevated input-to-output differential voltages can increase the IC die temperature significantly.

Package Information: SOT23-3L



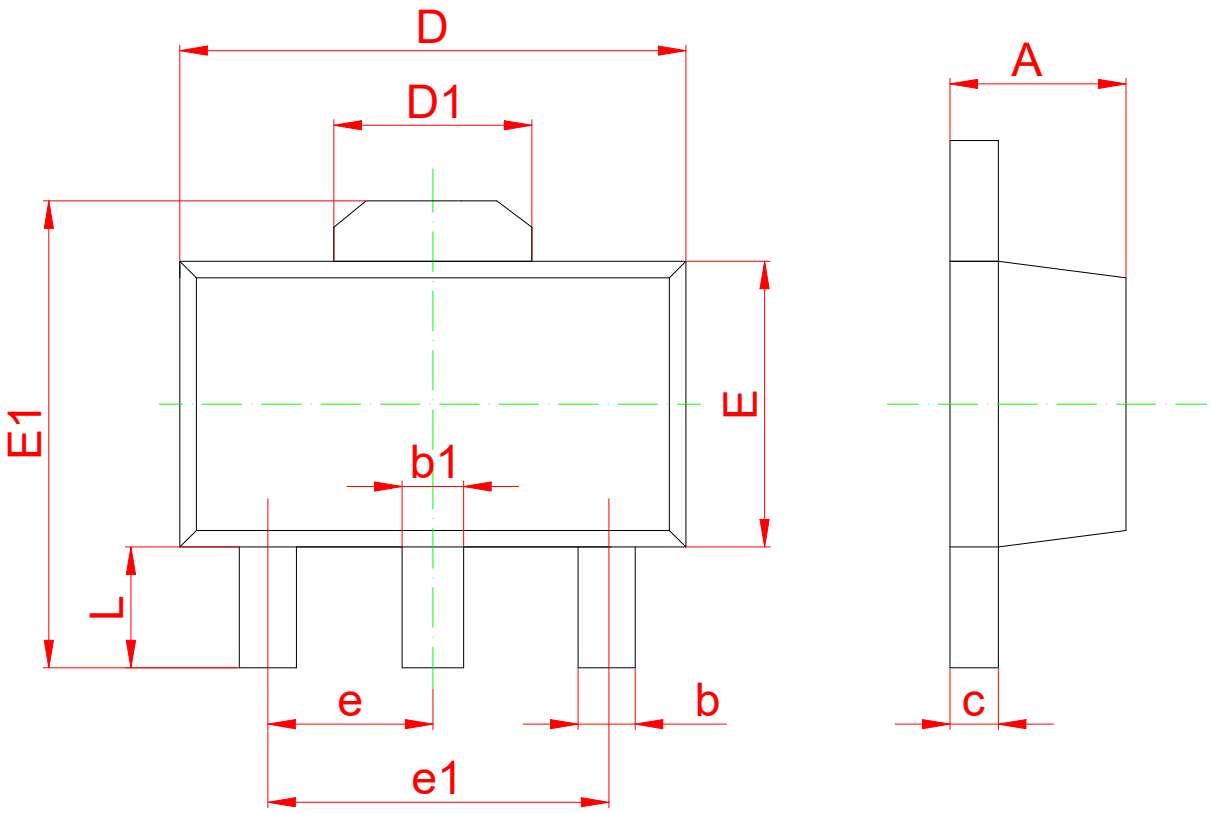
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 (BSC)		0.037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