500mA Adjustable & Fixed Voltage Linear LDO

Low Dropout Regulator

DESCRIPTION

The STL6120E series is a low-dropout linear regulator that operates in the input voltage range from +2.5V to +7.0 and delivers 500mA output current..

The STL6120E is available in two types, fixed output voltage type and adjustable output voltage type. The fixed output voltage type is preset at an internally trimmed voltage 1.8V, 2.5V, or 3.3V. Other options 1.0V, 1.2V, 1.5V, 2.85V, 3.0V and 3.6V are available by special order only. The output voltage range of the adjustable type is from 1.25V to 5V.

The STL6120E (ADJ type) consists of a 1.25V bandgap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection.

The STL6120E (Fixed type) consists of a 0.95V bandgap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection. The STL6120E series devices are available in SOT-89 packages.

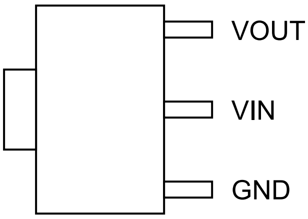
FEATURE

- Low Current Consumption: 30μA
- Typical Dropout Voltage: 650mV@500mA
- Fast Response in Power-on (Fixed only)
- Output Current Limit Protection: 800mA
- Thermal Overload Shutdown Protection
- High Ripple Rejection: 55dB
- Low ESR Capacitor Compatible

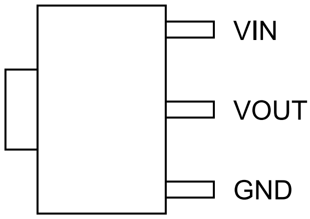
APPLICATIONS

- Battery Powered Equipment.
- Portable Information Application
- PCMCIA & New Card
- Mini PCI & PCI-Express Cards
- Digital Still Camera
- CDMA/GSM Cellular Handsets
- Laptop, Palmtops, Notebook Computers

PIN CONFIGURATION



TOP VIEW
(L Type)
SOT-89



TOP VIEW
(R Type)
SOT-89

PART MARKING INFORMATION

STL6120E-XX XX-XX X

- Lead Plating Code
- Handling Code
- Package Code
- Voltage Code

Lead Plating Code
G : Lead-free & Halogen-free product

Handling Code
TR : Tape&Reel

Package Code
LK : "L" Type SOT-89
RK : "R" Type SOT-89

Voltage Code
XX : 15 / 18 / 25 / 285 / 30 / 33 / ADJ

ORDERING INFORMATION

Part Number SOT-89	Package Code	Package	VOUT Voltage	Shipping
STL6120E-VVTK-TRG	K	SOT-89	1.5 1.8 2.5 2.85 3.0 3.3 ADJ	3000/Tape&Reel

Note:
※"VV" stands for output voltages.
※"T" Type mode (R type or L type)
※ "G" Lead-free product. This product is RoHS compliant

ABSOLUTE MAXIMUM RATINGS (T_A = 25℃ Unless otherwise noted)

Parameter	Symbol	Maximum	Unit
Power Dissipation	P_D	550	mW
Input voltage	V_{IN}	8.0	V
Output Current Limit	I_{OUT}	800	mA
Thermal resistance junction to case	θ_{JA}	180	°C /W
Operating Junction Temperature Range	T_J	-40~+85	°C
Storage Temperature Range	T_{STG}	-55~+150	°C
Lead Soldering Temperature	T_{LEAD}	+260	°C

Note: The power dissipation values are based on the condition that temperature Tj and ambient temperature TA difference is 100°C

Stresses beyond those listed under "absolute maximum rating" may cause permanent damage to the device. These are stress rating only, and function operation of the device at these or any other conditions beyond those indicated under recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

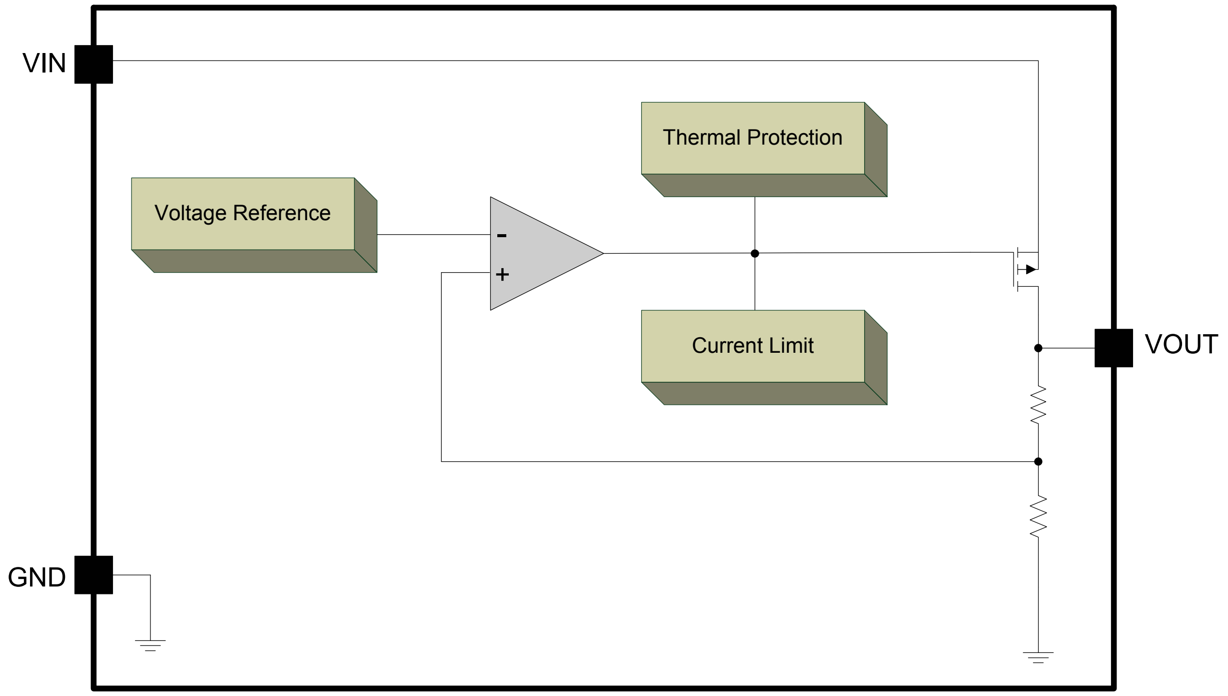
ELECTRICAL CHARACTERISTICS(T_A = 25℃ Unless otherwise noted)

Operating conditions: V_{IN}=5V, T_A=25℃,unless otherwise noted

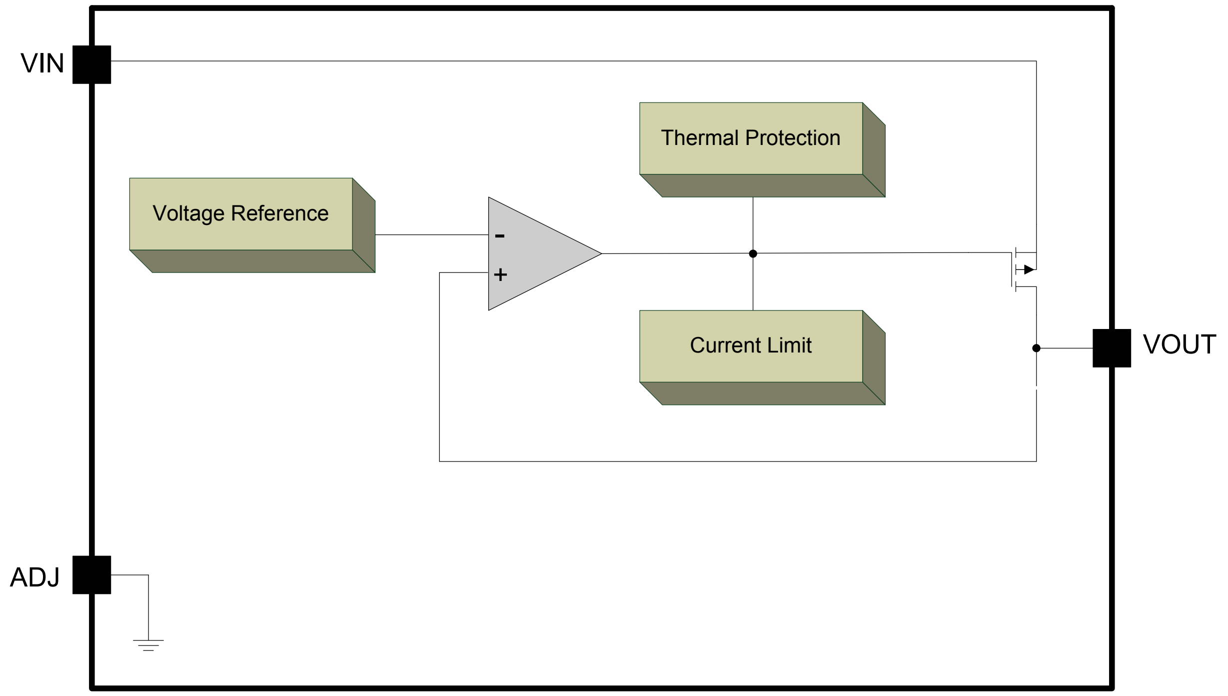
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage	V_{IN}	-	2.4	-	7.0	V
Output Voltage	V_{OUT}	V_{IN}=V_{OUT}+1V, I_{OUT} =1mA V_{OUT}≧1.8V	-2%	V_{OUT}	+2%	V
		V_{IN}=V_{OUT}+1V, I_{OUT} =1mA V_{OUT}>2.4V, V_{OUT}<1.8V	-35	V_{OUT}	+35	
Line Regulation	V_{LINE}	V_{OUT}+1V≦V_{IN}≦7.0V I_{OUT}=1mA	-	0.2	0.3	%
Load Regulation	V_{LOAD}	1mA≦I_{OUT}≦600mA V_{IN}=V_{OUT}+1V	-	0.01	0.02	%
Dropout Voltage	V_{DROP}	V_{OUT}＞3.0V, I_{OUT}=600mA	-	650	-	mV
Current Limit	I_{CL}	-	-	800	-	mA
Outpur Current (1)	I_{OUT}	V_{OUT}+1V≦V_{IN}≦7.0V V_{IN}≧2.4	500	-	-	mA
Quiescent Current	I_Q	V_{IN}=V_{OUT}+1V	-	30	50	μA
Thermal Shutdown Temperature	T_{SD}	Io=1mA	-	155	-	℃
Thermal Shutdown Hysteresis	T_{HYS}	Io=1mA	-	20	-	℃
Ripple Rejection Ratio	R_A	f=1KHz, I_{OUT}=30mA, C_{OUT}=3.3μF	-	55	-	dB
Output Noise	$θ_N$	f=1KHz, I_{OUT}=30mA, C_{OUT}=3.3μF	-	75	-	μVrms

NOTES: (1) Measured using a double sided board with 1 x 2 square inches of copper area connected to the GND pin for “heat spreading”.

FUNCTION BLOCK DIAGRAM

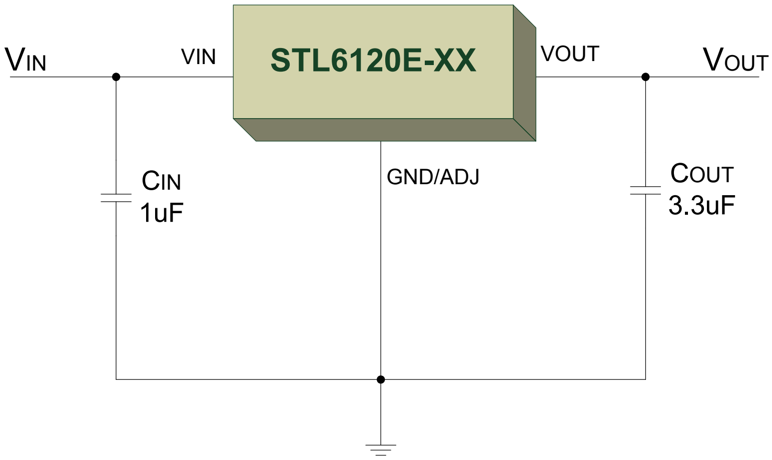


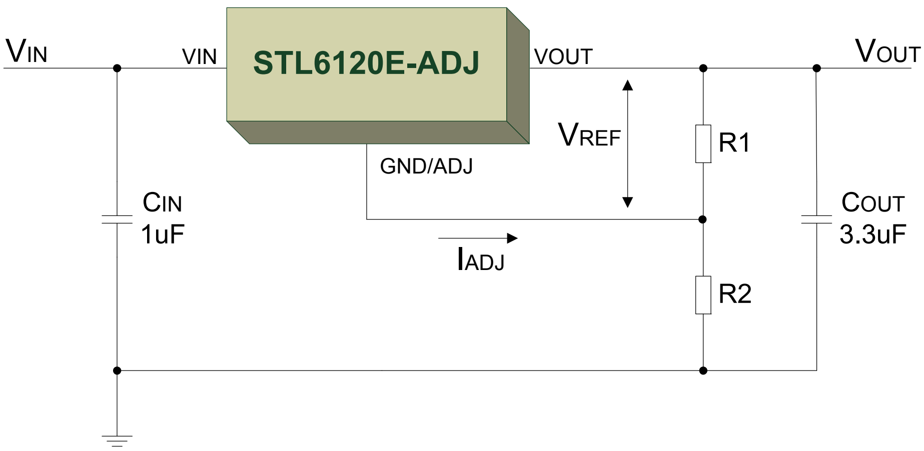
Fixed Voltage Type



Adjustable Voltage Type

TYPICAL APPLICATIONS





APPLICATION INFORMATION

◆Detail Description

The STL6120E is a low-dropout linear regulator. The device provides preset 1.8V, 2.5V and 3.3V output voltages for output current up to 600mA. Adjustable output voltage and other mask options for special output voltages are also available. As illustrated in function block diagram, it consists of a 1.25V bandgap (Fixed voltage type is 0.95V) reference, an error amplifier, a P-channel pass transistor and an internal feedback voltage divider.

The bandgap reference for adjustable voltage type is connected to the error amplifier, which compares this reference with the feedback voltage and ampliies the voltage difference. If the feedback voltage is lower than the reference voltage, the pass-transistor gate is pulled lower, which allows more current to pass to the output pin and increasees the output voltage. If the feedback voltage is too high, the pass transistor gate is pulled up to decrease the output voltage.

The output voltage is feed back through an internal resistive divider (or external resistive divider for adjustable output voltage type) connected to OUT pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

◆Internal P-channel Pass Transistor

The STL6120E features a P-channel MOSFET pass transistor. Unlike similar designs using PNP pass transistors, P-channel MOSFETs require no base drive, which reduces quiescent current. PNP-based regulators also waste considerable current in dropout when the pass transistor saturates, and use high base-drive currents under large loads.

The STL6120E does not suffer from these problems and consumes only 60µA (Typ.) of current consumption under heavy loads as well as in dropout conditions.

◆Output Voltage Selection

For fixed voltage type of STL6120E, the output voltage is preset at an internally trimmed voltage. The first two digits of part number suffix identify the output voltage (see Ordering Information). For example, the STL6120E-33 has a preset 3.3V output voltage.

For adjustable voltage type of STL6120E, the output voltage is set by comparing the feedback voltage at adjust terminal to the internal bandgap reference voltage. The reference voltage V_{REF} is 1.25V. The output voltage is given by the equation:

$$V_{OUT} = V_{REF} \times (1+R2/R1) + I_{ADJ} \times R2$$

◆Current Limit

The STL6120E also includes a fold back current limiter. It monitors and controls the pass transistor's gate voltage, estimates the output current, and limits the output current within 1.0A.

◆Thermal Overload Protection

Thermal overload protection limits total power dissipation in the STL6120E. When the junction temperature exceeds $T_J = +150^{\circ}C$, a thermal sensor turns off the pass transistor, allowing the IC to cool down. The thermal sensor turns the pass transistor on again after the junction temperature cools down by 20°C, resulting in a pulsed output during continuous thermal overload conditions. Thermal overload protection is designed to protect the STL6120E in the event of fault conditions. For continuous operation, the absolute maximum operating junction temperature rating of $T_J = +125^{\circ}C$ should not be exceeded.

◆Operating Region and Power Dissipation

Maximum power dissipation of the STL6120E depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The power dissipation across the devices is $P = I_{OUT} \times (V_{IN}-V_{OUT})$. The resulting maximum power dissipation is:

$$P_{MAX} = (T_J - T_A) / \theta_{JC} + \theta_{CA} = (T_J - T_A) / \theta_A$$

Where (T_J-T_A) is the temperature difference between the STL6120E die junction and the surrounding air, θ_{JC} is the thermal resistance of the package chosen, and θ_{CA} is the thermal resistance through the printed circuit board, copper traces and other materials to the surrounding air. For better heat-sinking, the copper area should be equally shared between the IN, OUT, and GND pins.

If the STL6120E uses a SOT-89 package and this package is mounted on a double sided printed circuit board with two square inches of copper allocated for "heat spreading", the resulting θ_{JA} is 155 °C/W.

Based on the maximum operating junction temperature 125 °C with an ambient of 25°C, the maximum power dissipation will be:

$$P_{MAX} = (T_J - T_A) / \theta_{JC}+\theta_{CA} = (125 - 25) / 155 = 0.65W$$

Thermal characteristics were measured using a double sided board with 1" x 2" square inches of copper area connected to the GND pin for "heat spreading".

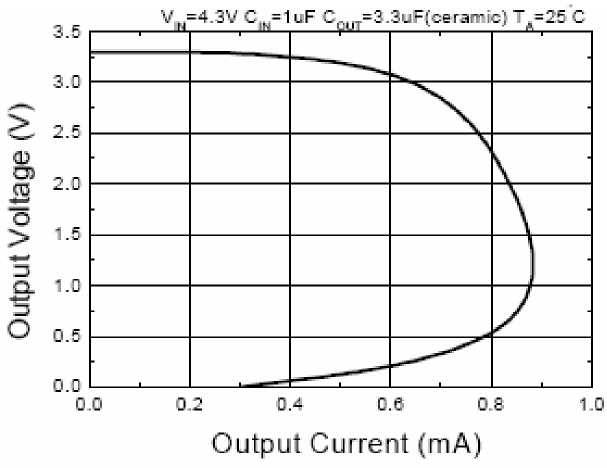
◆Dropout Voltage

A regulator's minimum input-output voltage differential, or dropout voltage, determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. The STL6120E use a P-channel MOSFET pass transistor, its dropout voltage is a function of drain-to-source on-resistance $R_{DS(ON)}$ multiplied by the load current.

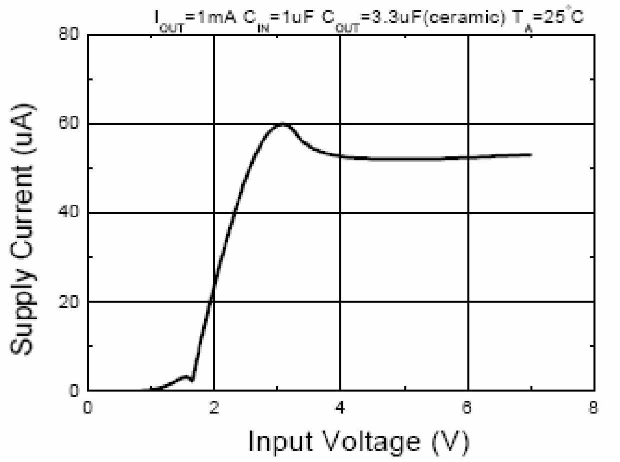
$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

■ TYPICAL CHARACTERISTICS (25℃ Unless Note)

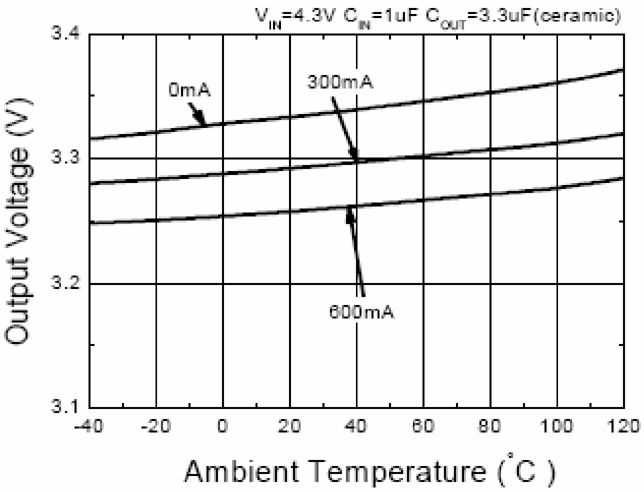
Output Voltage VS Output Current



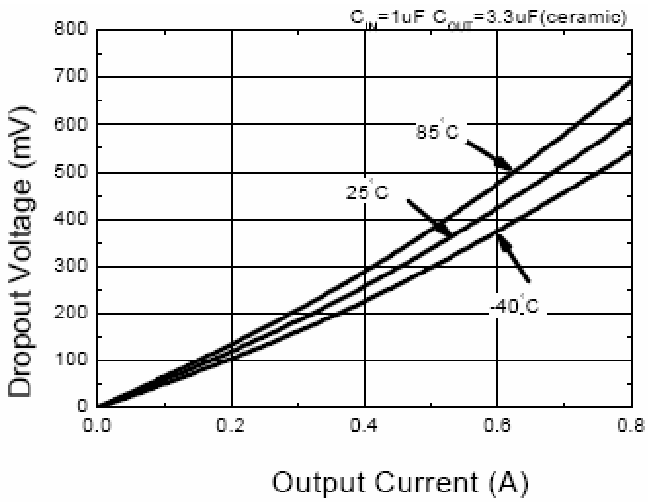
Supply Current VS Input Voltage



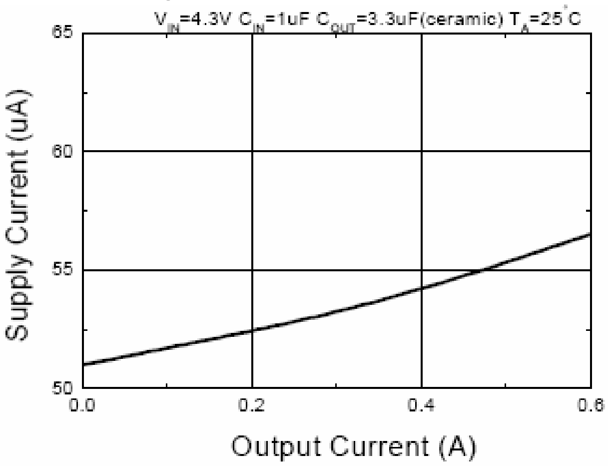
Output Voltage VS Ambient Temperature



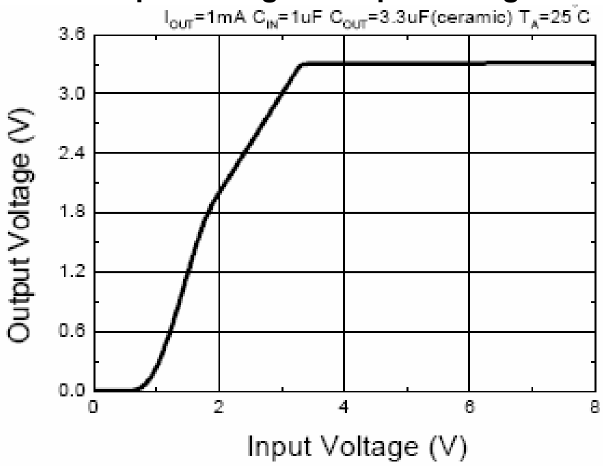
Dropout Voltage VS Output Current



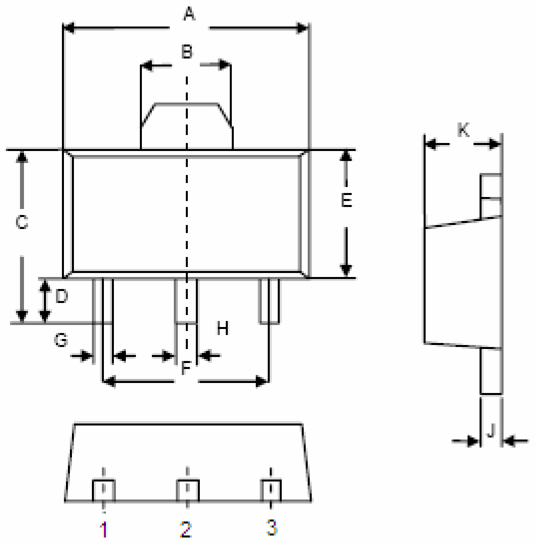
Supply Current VS Output Current



Output Voltage VS Input Voltage



SOT-89 PACKAGE DIMENSIONS



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.173	.181	4.40	4.60
B	.055	.071	1.40	1.80
C	.154	.165	3.91	4.19
D	.035	.043	0.90	1.10
E	.091	.102	2.3	2.6
F	.114	.122	2.90	3.10
G	.013	.020	0.32	0.52
H	.014	.022	0.36	0.56
J	.014	.017	0.35	0.44
K	.055	.063	1.40	1.60