High Ripple-Rejection High Output Current CMOS Voltage Regulator

■ General Description

The LN1170 Series is a positive voltage regulator with a low dropout voltage, high output voltage accuracy, and low current consumption developed based on CMOS technology. A built-in low on-resistance transistor provides a low dropout voltage and large output current, a built-in overcurrent protector prevents the load current from exceeding the current capacitance of the output transistor, and a built-in thermal shutdown circuit prevents damage caused by the heat. An ON/OFF circuit ensures a long battery life. Small SOT-89-5 packages realize high-density mounting.

■ Features

- Output voltage: 1.5V to 5.5V, selectable in 0.1V steps.
- High-accuracy output voltage: ±1.0%
- Low dropout voltage: 120mV typ. (3.0V output product, I_{OUT} = 300 mA)
- Low current consumption:
  During operation: 80μA typ, 160μA max.
  During shutdown: 0.1μA typ, 1.0μA max.
- High peak current capability: 800mA output is possible (at $V_{IN} \geqslant V_{OUT(S)}$ + 1.0 V)[*1]
- Built-in ON/OFF circuit: ensures long battery life.
- Built-in overcurrent protector: overcurrent of output transistor can be restricted.
- Built-in thermal shutdown circuit: damage caused by heat can be prevented.
- High ripple rejection: 70 dB typ. (at 1.0 kHz)
- Small package: SOT-89-5L

1. Attention should be paid to the power dissipation of the package when the output current is large.

■ Applications

- Power supply for DVD and CD-ROM drives
- Power supply for battery-powered devices
- Power supply for personal communication devices
- Power supply for note PCs

■ Package

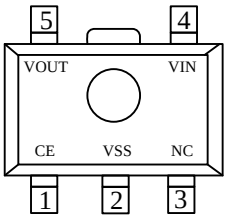
- SOT-89-5L

■ Ordering Information

LN1170 ①②③④⑤⑥

Designator	Symbol	Description
①		CE Pin Logic :
	A	Active 'High' (pull-down resistor built in)
	B	Active 'High' (no pull-down resistor built in)
	C	Active 'Low' (pull-up resistor built in)
	D	Active 'Low' (no pull-up resistor built in)
②③	12-60	Output Voltage:e.g. ②=3，③=0 ⇒3.0V
④	2	Output Voltage : 100mV increments e.g. ②=3, ③=0, ④=2 ⇒3.0V
	A	Output Voltage : 50mV increments e.g. ②=3, ③=0, ④=A ⇒3.05V
⑤	P	Package Type : SOT-89-5
⑥		Device Orientation :
	R	Embossed Tape : Standard Feed
	L	Embossed Tape : Reverse Feed

■ Pin Configuration

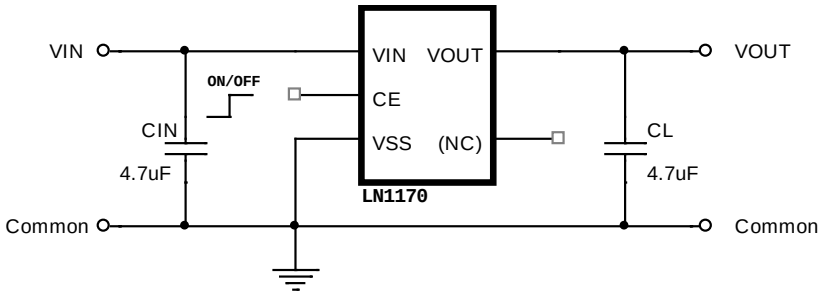


SOT-89-5L
(Top View)

■ Pin Assignment

Pin Number	Pin Name	Function
SOT-89-5		
4	VIN	Supply Power
2	VSS	Ground
1	CE	Enable Pin
3	NC	No Connect
5	VOUT	Voltage Output

■ Typical Application Circuit



Caution: The above connection diagram and constant will not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.

■ Application Conditions

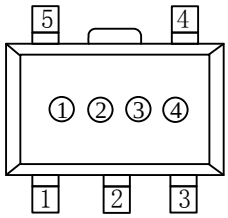
Input capacitor (CIN): 4.7μF or more

Output capacitor (CL): 4.7μF or more (tantalum capacitor)

Caution A general series regulator may oscillate, depending on the external components selected. Check that no oscillation occurs with the application using the above capacitor.

■ Marking Rule

- SOT-89-5L



SOT-89-5L

① Represents the product name

Symbol	Product Name
R	LN1170◆◆◆◆M◆

② Represents the range of output voltage

Voltage(V)	1.2～3.0	3.1～6.0	1.25～3.05	3.15～6.05		
Symbol	V	A	E	L	Product Name	LN1170A◆◆◆M◆
	X	B	F	M		LN1170B◆◆◆M◆
	Y	C	H	N		LN1170C◆◆◆M◆
	Z	D	K	P		LN1170D◆◆◆M◆

④ Represents the Output Voltage

Symbol	Output Voltage（V）			
0		3.1		3.15
1		3.2		3.25
2		3.3		3.35
3		3.4		3.45
4		3.5		3.55
5		3.6		3.65
6		3.7		3.75
7		3.8		3.85
8		3.9		3.95
9		4.0		4.05
A		4.1		4.15
B	1.2	4.2	1.25	4.25
C	1.3	4.3	1.35	4.35
D	1.4	4.4	1.45	4.45
E	1.5	4.5	1.55	4.55

Symbol	Output Voltage（V）			
F	1.6	4.6	1.65	4.65
H	1.7	4.7	1.75	4.75
K	1.8	4.8	1.85	4.85
L	1.9	4.9	1.95	4.95
M	2.0	5.0	2.05	5.05
N	2.1	5.1	2.15	5.15
P	2.2	5.2	2.25	5.25
R	2.3	5.3	2.35	5.35
S	2.4	5.4	2.45	5.45
T	2.5	5.5	2.55	5.55
U	2.6	5.6	2.65	5.65
V	2.7	5.7	2.75	5.75
X	2.8	5.8	2.85	5.85
Y	2.9	5.9	2.95	5.95
Z	3.0	6.0	3.05	6.05

⑤ Represents the assembly lot no.

0~9, A~Z repeated (G, I, J, O, Q, W excepted)

■ Function Block Diagram

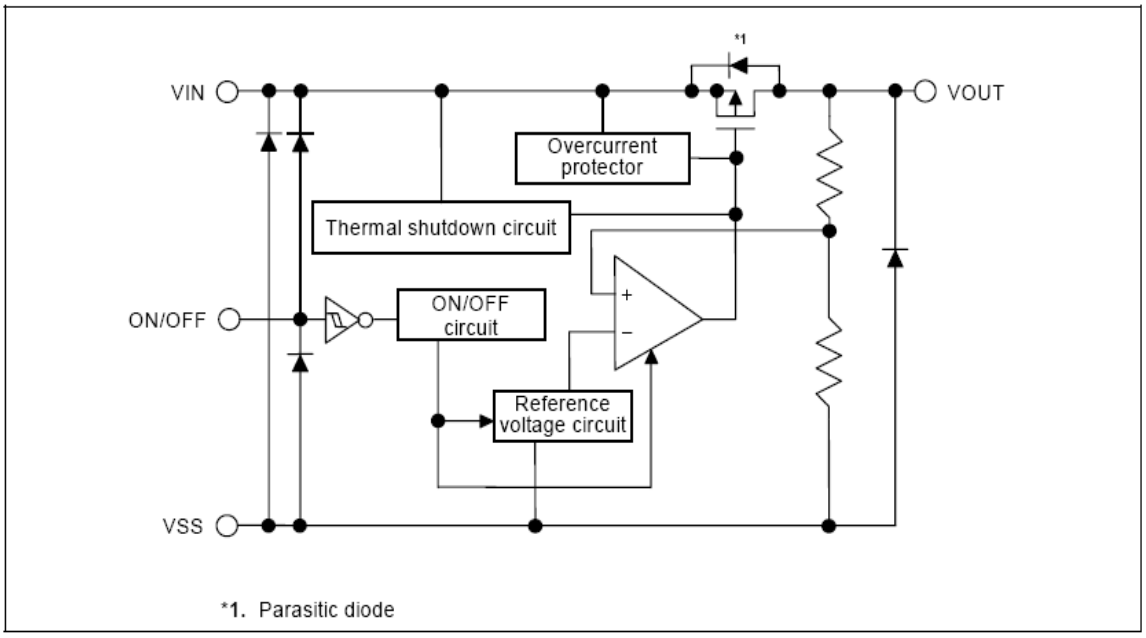


Figure 1

■ Absolute Maximum Ratings

Parameter	Symbol	Absolute Maximum Rating		Unit
Input voltage	V_{in}	V_{SS}-0.3 ~ V_{SS}+7		V
	$V_{ON/OFF}$	V_{SS}-0.3 ~ V_{IN}+0.3		
Output voltage	V_{OUT}	V_{SS}-0.3 ~ V_{IN}+0.3		
Power dissipation	P_D	SOT-89-5	500	mW
		6-Pin HSON(A)	1000	
Operating ambient temperature	T_{opr}	-40 ~ +85		℃
Storage ambient temperature	T_{stg}	-40 ~ +125		

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

■ Electrical Characteristics

Parameter	Symbol	Conditions		Min.	Typ.	Max	Unit	Test Circuit
Output voltage*1	$V_{OUT(E)1}$	V_{IN} =$V_{OUT(S)}$+1.0 V, I_{OUT}=100 mA		$V_{OUT(S)}$ ×0.99	$V_{OUT(S)}$	$V_{OUT(S)}$ ×1.01	V	1
Output current*2	I_{OUT}	V_{IN}≥$V_{OUT(S)}$+1.0 V		800 *5	—	—	mA	3
Dropout voltage*3	V_{drop}	I_{OUT}=300 mA	1.8 V ≤$V_{OUT(S)}$≤2.0 V	—	0.20	0.26	V	1
			2.1 V ≤$V_{OUT(S)}$≤2.9 V	—	0.15	0.22		
			3.0 V ≤$V_{OUT(S)}$≤5.5 V	—	0.12	0.18		
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$	$V_{OUT(S)}$+0.5 V ≤V_{IN}≤6.5 V I_{OUT}=100 mA		—	0.05	0.3	%/V	
Load regulation	ΔV_{OUT2}	V_{IN}=$V_{OUT(S)}$+1.0 V 1.0 mA ≤I_{OUT} ≤300 mA		—	30	100	mV	
Output voltage temperature coefficient*4	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	V_{IN}=$V_{OUT(S)}$+1.0 V, I_{OUT}=10 mA -40°C ≤Ta ≤85°C		—	±150	—	ppm/℃	
Current consumption during peration	I_{SS1}	V_{IN}=$V_{OUT(S)}$+1.0 V,no load		—	80	160	μA	2
Input voltage	V_{IN}	——		2.0	—	7	V	—
Ripple rejection	|RR|	V_{IN}=$V_{OUT(S)}$+1.0 V ， f=1.0 kHz Vrip=0.5 Vrms, I_{OUT}=80 mA		—	70	—	dB	5
Short-circuit current	I_{short}	V_{IN}=$V_{OUT(S)}$+1.0 V,V_{OUT}=0 V			200	—	mA	3
Current consumption during shutdown	I_{SS2}	V_{IN} = $V_{OUT(S)}$ + 1.0 V, ON/OFF pin = OFF,no load		—	0.1	1.0	uA	2
Shutdown pin input voltage “H”	V_{SH}	V_{IN} = $V_{OUT(S)}$ + 1.0 V, R_L = 1.0 k&		1.5			V	4
Shutdown pin input voltage “L”	V_{SL}	V_{IN} = $V_{OUT(S)}$ + 1.0 V, R_L = 1.0 k&				0.3		
Shutdown pin input current “H”	I_{SH}	V_{IN} = 6.5 V, $V_{ON/OFF}$ = 6.5 V		-0.1		0.1	uA	
Shutdown pin input current “L”	I_{SL}	V_{IN} = 6.5 V, $V_{ON/OFF}$ = 0 V		-0.1		0.1		

***1.** $V_{OUT(S)}$: Specified output voltage. $V_{OUT(E)}$: Actual output voltage at the fixed load The output voltage when fixing IOUT(= 100 mA) and inputting VOUT(S) + 1.0 V

***2.** The output current at which the output voltage becomes 95% of $V_{OUT(E)}$ after gradually increasing the output current.

***3.** Vdrop = V_{IN1} − (V_{OUT3} × 0.98)　V_{OUT3} is the output voltage when V_{IN} = $V_{OUT(S)}$ + 1.0 V and I_{OUT} = 300 mA.
V_{IN1} is the input voltage at which the output voltage becomes 98% of V_{OUT3} after gradually decreasing the input voltage.

***4.** The change in temperature [mV/°C] is calculated using the following equation:

$$\frac{\Delta V_{OUT}}{\Delta T_a}\ [\text{mV/°C}]^{*1}=V_{OUT(S)}(\text{V})^{*2}\times\frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT}}\ [\text{ppm/°C}]^{*3}\div 1000$$

***1.** The change in temperature of the output voltage ***2.** Specified output voltage ***3.** Output voltage temperature coefficient

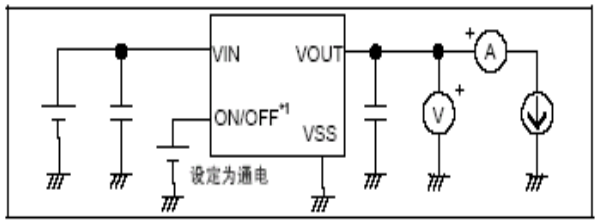
***5.** The output current can be at least this value.

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.This specification is guaranteed by design.

■ Test Circuits

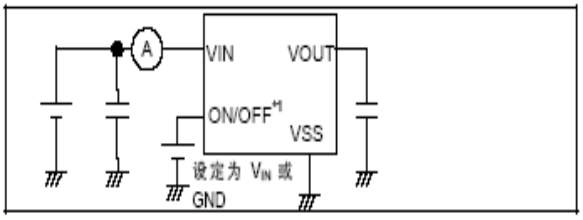
Circuit 1

1.



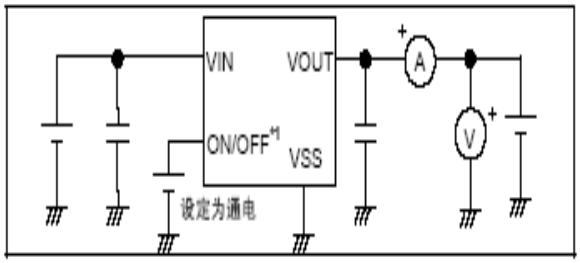
Circuit 2

2.



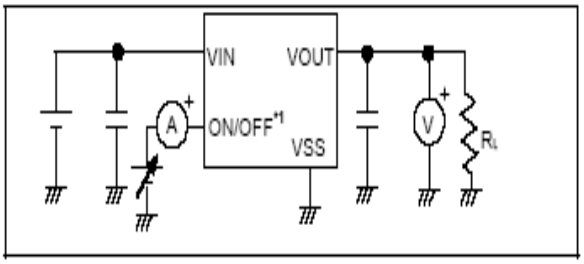
Circuit 3

3.



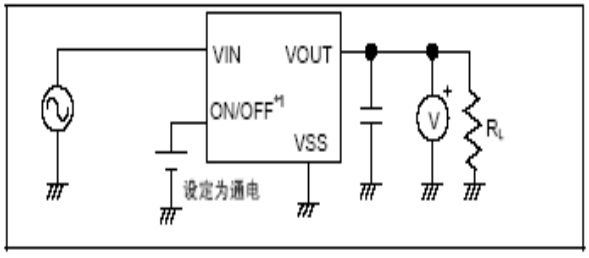
Circuit 4

4.



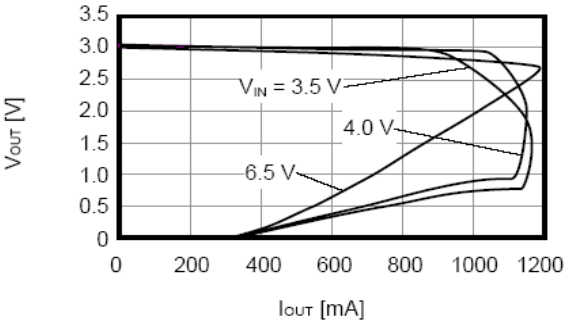
Circuit 5

5.

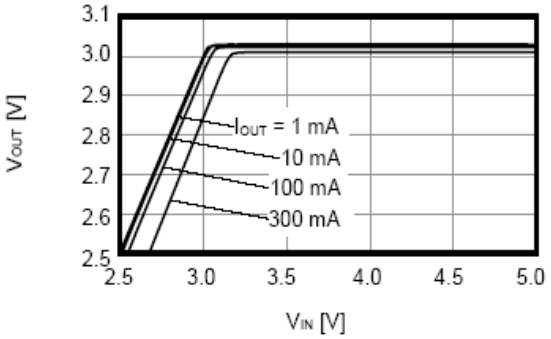


■ Typical Performance Characteristics

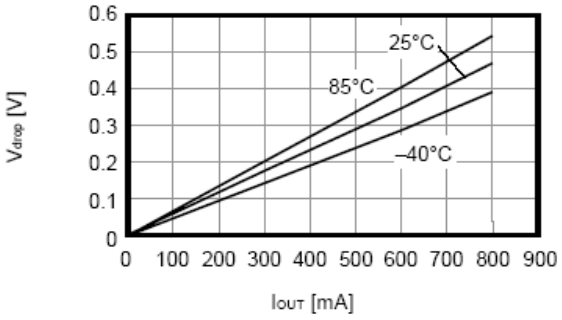
1、Output Voltage vs. Output Current



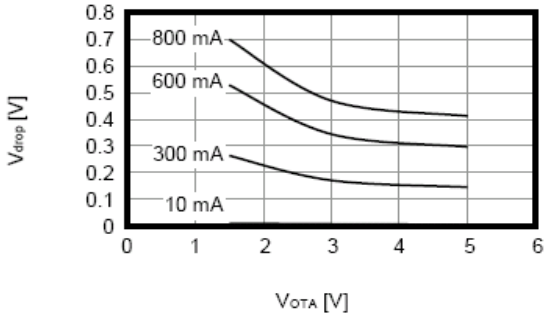
2、Output Voltage vs. Input Voltage (Contd.)



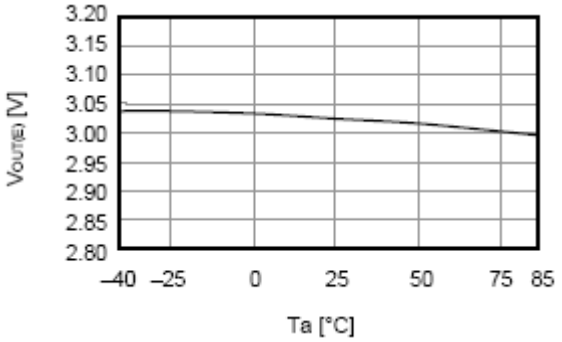
3、Dropout Voltage vs. Output Current



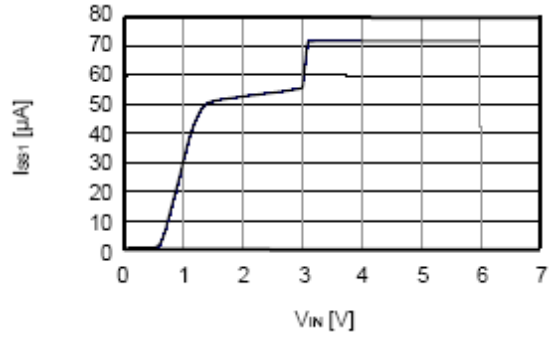
4. Dropout Voltage Vs Output Voltage



5、Output Voltage VS. Ambient Temperature

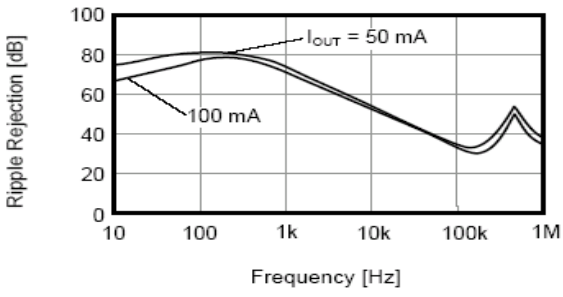


6、Consumption Of Current VS. Input Voltage

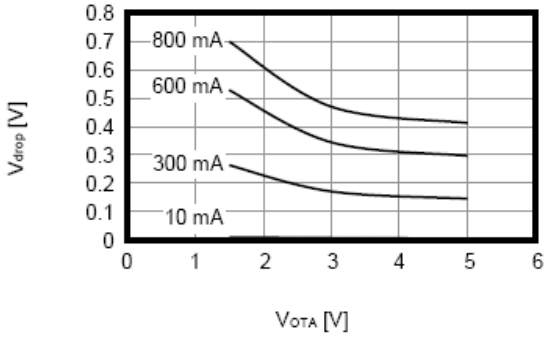


7、Ripple Rejection

VIN = 4.0 V, COUT = 4.7 µF

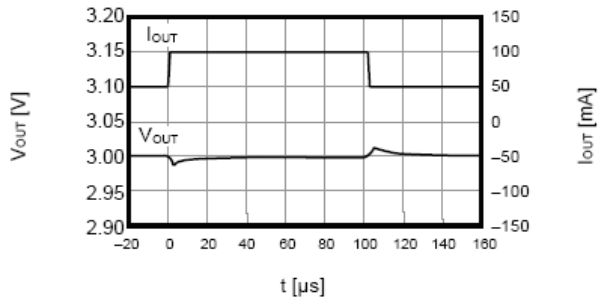


8、Input Transient Response

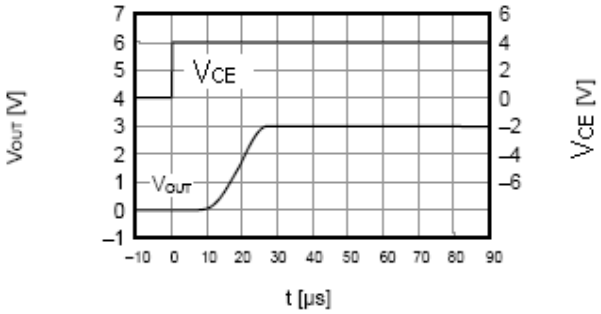


9、Load Transient Response

V_{IN} = 4.0 V, C_{OUT} = 4.7 μF, C_{IN} = 4.7 μF, I_{OUT} = 50↔100 mA

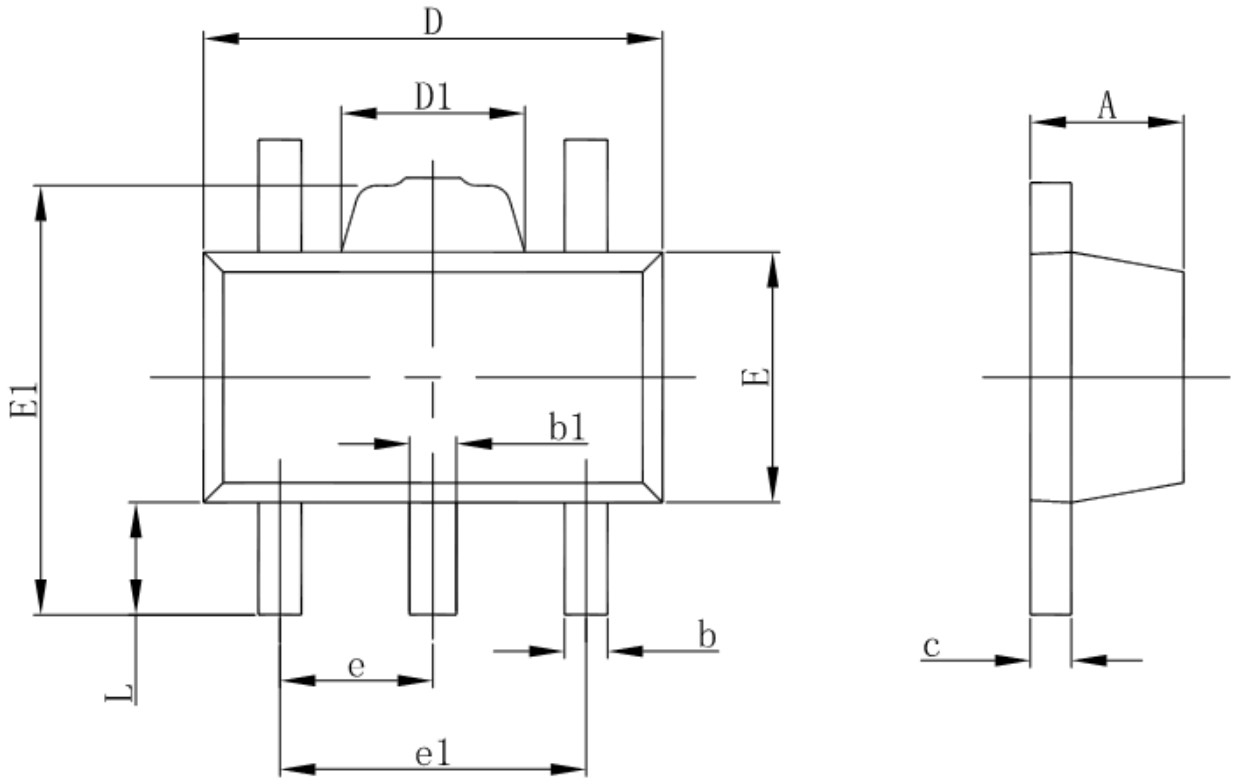


10、CE Pin Transient Response Characteristics



■ Package Information

- **SOT-89-5L**



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	0.360	0.560	0.014	0.022
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.400	1.800	0.055	0.071
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500TYP.		0.060TYP.	
e1	2.900	3.100	0.114	0.122
L	0.900	1.100	0.035	0.043