



# ACE431S

## Adjustable Precision Shunt Regulator

### Description

The ACE431S is a low voltage three terminal adjustable shunt regulator with a guaranteed thermal stability over applicable temperature ranges. The output voltage can be set to any value between VREF (approximately 2.5 V) to 18V with two external resistors. This device has a typical output impedance of 0.08Ω. Active output circuitry provides a very sharp turn on characteristic, making this device excellent replacement for Zener diodes in many applications.

The ACE431S is characterized for operation from -40°C to 125°C , and five package options (SOT-23-3, SOT-23-5, SOP-8, TO-92 and SOT-89-3) allow the designer the opportunity to select the proper package for their applications.

### Features

- Low voltage operation (2.5V)
- Adjustable output voltage  $V_o = V_{REF}$  to 18V
- Wide operating current range 150μA to 80mA
- Low dynamic output impedance 0.08Ω (Typ)
- Trimmed bandgap design up to +0.5%
- ESD rating is 6KV (Per MIL-STD-883D)
- ROHS Compliant and 100% Lead (Pb)-Free

### Application

- Linear Regulators
- Adjustable Supplies
- Switching Power Supplies
- Battery Operated Computers
- Instrumentation
- Computer Disk Drives

### Absolute Maximum Ratings

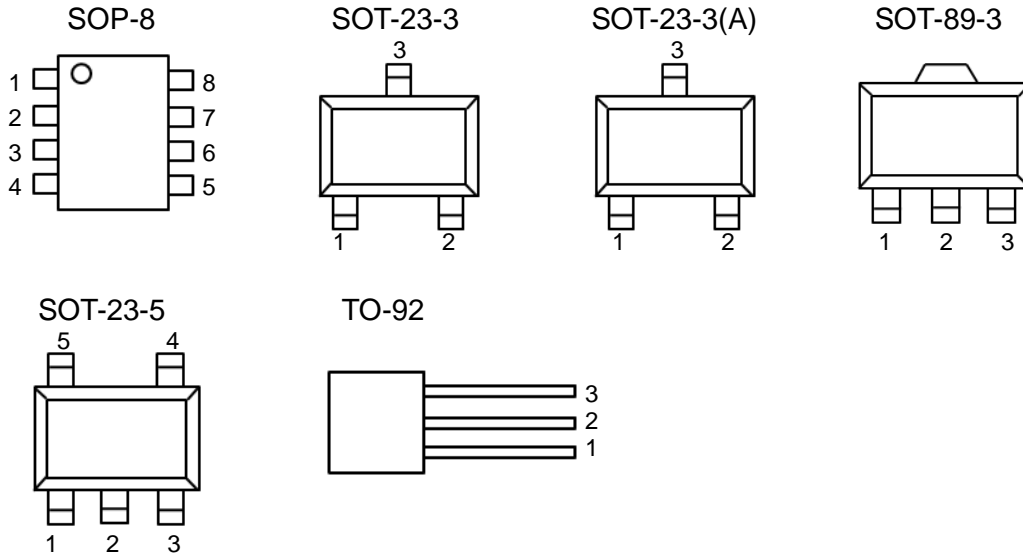
Parameter	Symbol	Max	Unit
Cathode Voltage	$V_{KA}$	18	V
Continuous Cathode Current	$I_{KA}$	90	mA
Reference Current	$I_{REF}$	1	mA
Operating Junction Temperature Range	$T_J$	150	°C
Storage Temperature Range	$T_{STG}$	-65 to 150	°C
Thermal Resistance	$\theta_{JA}$	SOT-89-3	120
		SOT-23-3	230
		SOT-23-5	230
		SOP-8	150
		TO-92	220
			°C/W



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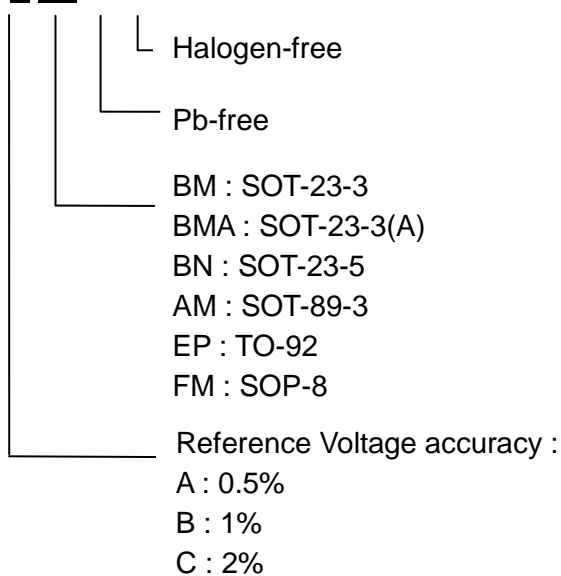
### Packaging Type



Description	SOP-8	SOT-23-3	SOT-23-3(A)	SOT-89-3	SOT-23-5	TO-92
Cathode	1	2	1	3	3	3
Anode	2.3.6.7	3	3	2	5	2
NC	4.5				1.2	
Ref	8	1	2	1	4	1

### Ordering information

ACE431S X XX + H

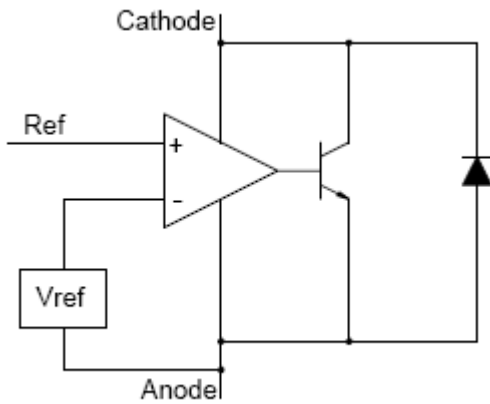




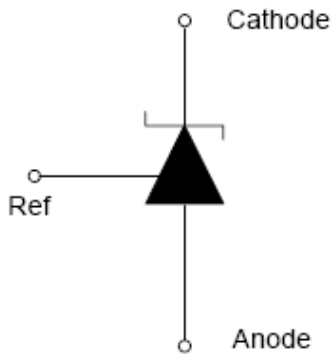
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## Adjustable Precision Shunt Regulator

### Block Diagram



### Symbol Diagram



### Electrical Characteristics

$T_A=25^{\circ}\text{C}$  unless otherwise specified.

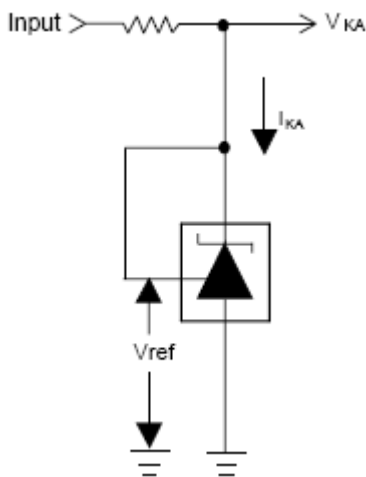
Parameter	Test Circuit	Symbol	Conditions	Min	Typ	Max	Units
Reference Voltage	1	$V_{REF}$	$V_{KA}=V_{REF},$ $I_{KA}=10\text{mA}$	2483	2495	2507	mV
				2470	2495	2520	
				2445	2495	2545	
Deviation of reference voltage over full temperature range	1	$V_{I(Dev)}$	$V_{KA}=V_{REF},$ $I_{KA}=10\text{mA}$ $T_A=-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$		-14		mV
Ration of change in reference voltage to the change in cathode voltage	2	$ \Delta V_{REF}/\Delta V_{KA} $	$I_{KA}=3\text{ mA},$ $\Delta V_{KA}=10\text{V}-V_{REF}$		0.2	2.7	mV/V
Minimum cathode current for Regulation	1	$I_{MIN}$	$V_{KA}=V_{REF}$		0.15	0.3	mA
Dynamic Impedance	1	$Z_{KA}$	$V_{KA}=V_{REF}, I_{KA}=1$ to $80\text{mA}, f \leq 1.0\text{KHz}$		0.08	0.7	$\Omega$
Reference Current	2	$I_{REF}$	$I_{KA}=10\text{mA},$		0.3	4	$\mu\text{A}$



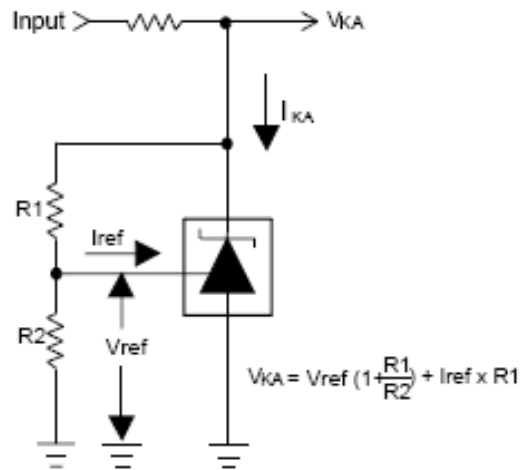
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			$R1=10K\Omega, R2=\infty$				
Deviation of Reference current over Full Temperature Range	2	$I_{I(dev)}$	$I_{KA}=10mA,$ $R1=10K\Omega, R2=\infty,$ $T_A=0 \text{ to } 125^\circ C$	-0.13			$\mu A$
Off-State cathode current	3	$I_{OFF}$	$V_{KA}=18V, V_{REF}=0$	0.4	1.0		$\mu A$

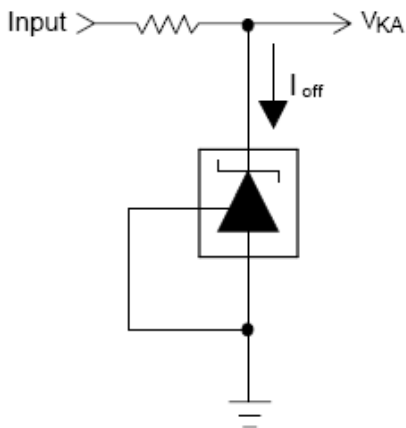
Typical Circuit



Test Circuit 1:  $V_{KA}=V_{REF}$



Test Circuit 2:  $V_{KA}>V_{REF}$

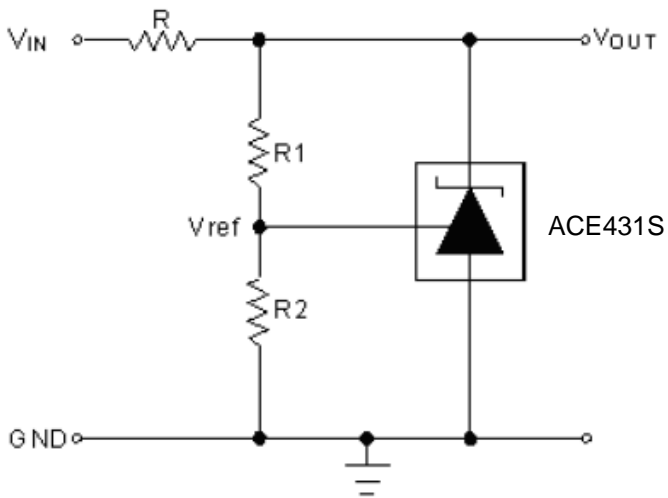


Test Circuit 3: Off State Current



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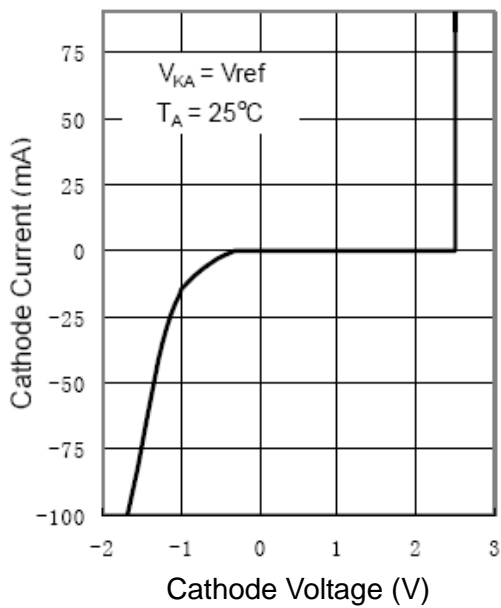
## Application Diagram



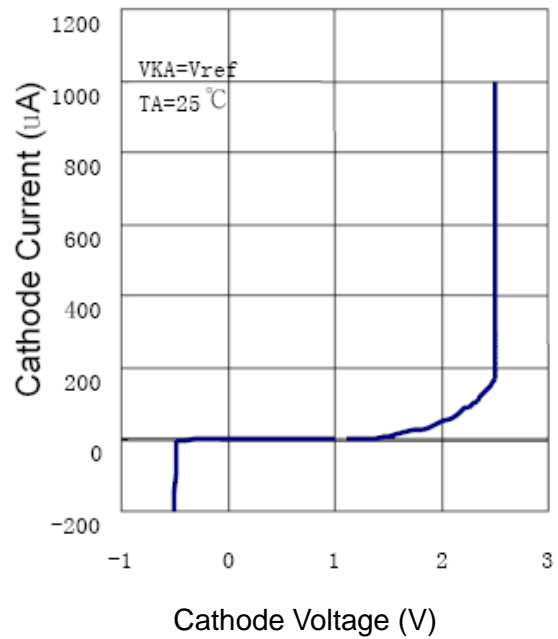
$$V_{OUT} = V_{ref} \left( 1 + \frac{R1}{R2} \right)$$

## Typical Performance Characteristics

Cathode Current vs. Cathode Voltage



Cathode Current vs. Cathode Voltage

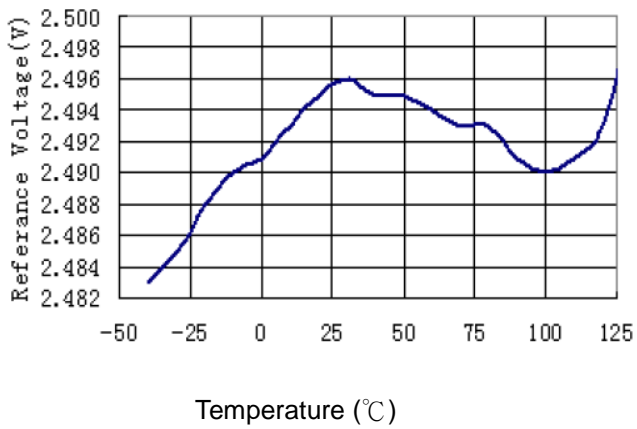




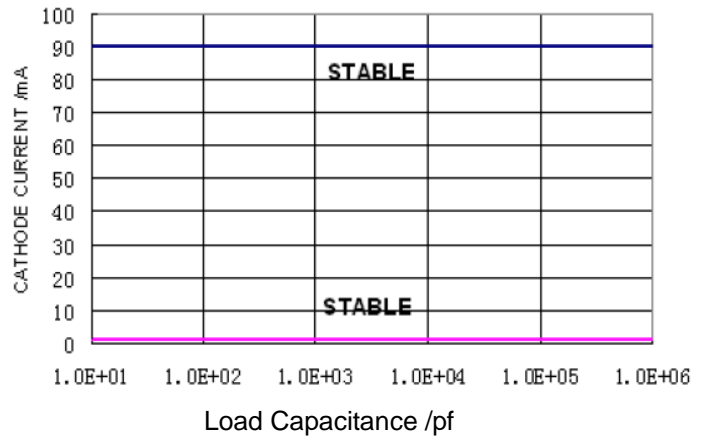
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## Adjustable Precision Shunt Regulator

Reference Voltage vs. Junction Temperature



Stability Boundry Conditions



### Thermal Consideration

Package	Power Rating (T <sub>A</sub> =25°C)	Power Rating (T <sub>A</sub> =50°C)	Power Rating (T <sub>A</sub> =70°C)
SOT-23-3 (θ <sub>JA</sub> =230°C/W)	435mW	326mW	239mW
SOT-23-5 (θ <sub>JA</sub> =230°C/W)	435mW	326mW	239mW
TO-92 (θ <sub>JA</sub> =220°C/W)	455mW	341mW	250mW

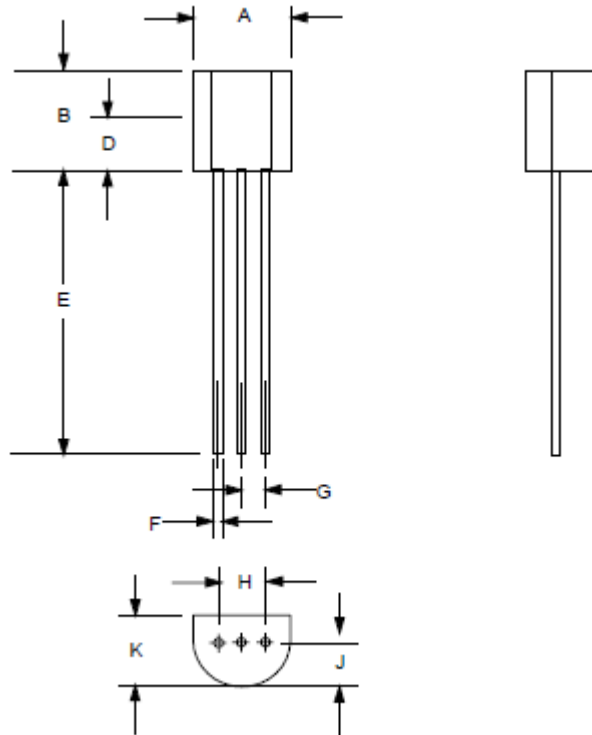
1. Maximum junction temperature is 125°C
2. θ<sub>JA</sub> is measured with packages mounted onboard under still-air condition with 1W power applied.
3. Power rating is calculated using  $P_D = (T_J - T_A) / \theta_{JA}$ , where T<sub>J</sub> denotes junction temperature and T<sub>A</sub> denotes ambient temperature.



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## Packing Information

TO-92



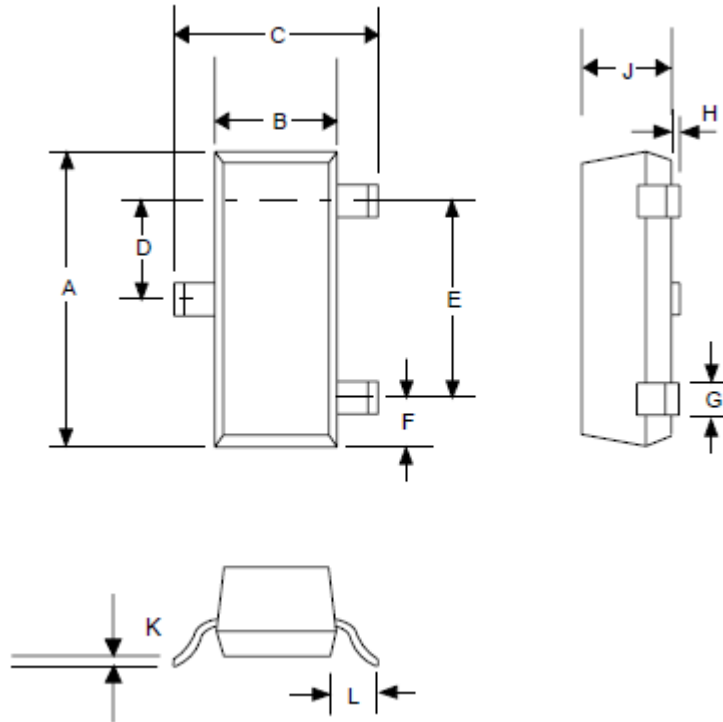
DIMENSIONS				
DIM <sup>N</sup>	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.445	5.207
B	0.170	0.210	4.318	5.334
E	0.500	0.610	12.70	15.50
F	0.016	0.021	0.407	0.533
G	0.045	0.055	1.143	1.397
H	0.095	0.105	2.413	2.667
J	0.080	0.105	2.032	2.667
K	0.125	0.165	3.175	4.191



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## Packing Information

SOT-23-3



DIMENSIONS				
DIM <sup>N</sup>	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.110	0.120	2.80	3.04
B	0.047	0.055	1.20	1.40
C	0.083	0.104	2.10	2.64
D	0.035	0.040	0.89	1.03
E	0.070	0.080	1.78	2.05
F	0.018	0.024	0.45	0.60
G	0.015	0.020	0.37	0.51
H	0.0005	0.004	0.013	0.10
J	0.034	0.040	0.887	1.02
K	0.003	0.007	0.085	0.18
L	-	0.027	-	0.69

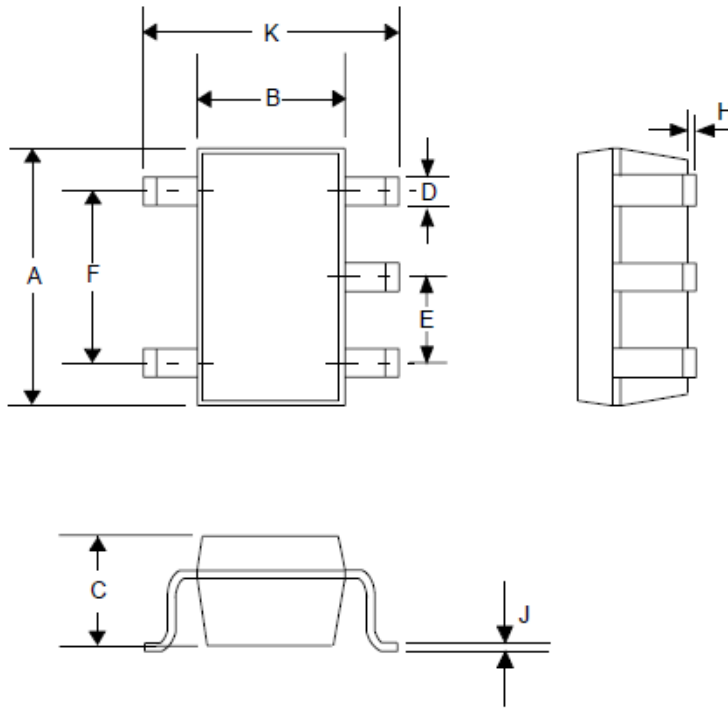




# ACE431S Adjustable Precision Shunt Regulator

## Packing Information

SOT-23-5



DIMENSIONS				
DIM <sup>N</sup>	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.110	0.120	2.80	3.05
B	0.059	0.070	1.50	1.75
C	0.036	0.051	0.90	1.30
D	0.014	0.020	0.35	0.50
E	-	0.037	-	0.95
F	-	0.075	-	1.90
H	-	0.006	-	0.15
J	0.0035	0.008	0.090	0.20
K	0.102	0.118	2.60	3.00

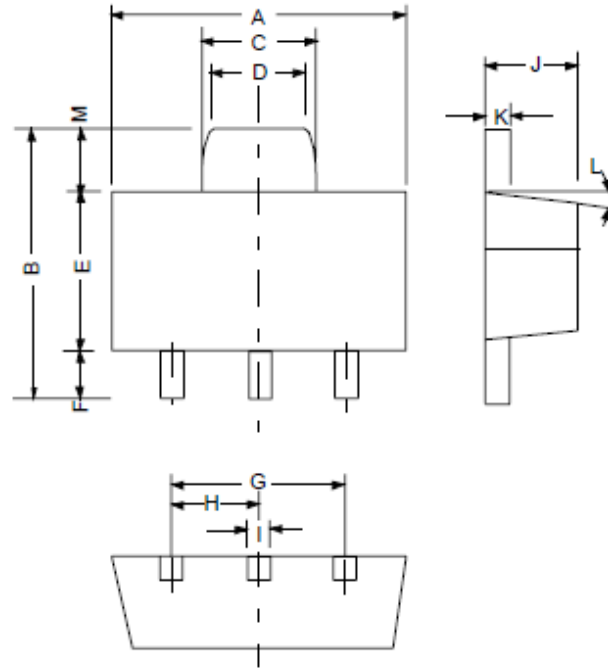


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### Packing Information

SOT-89-3



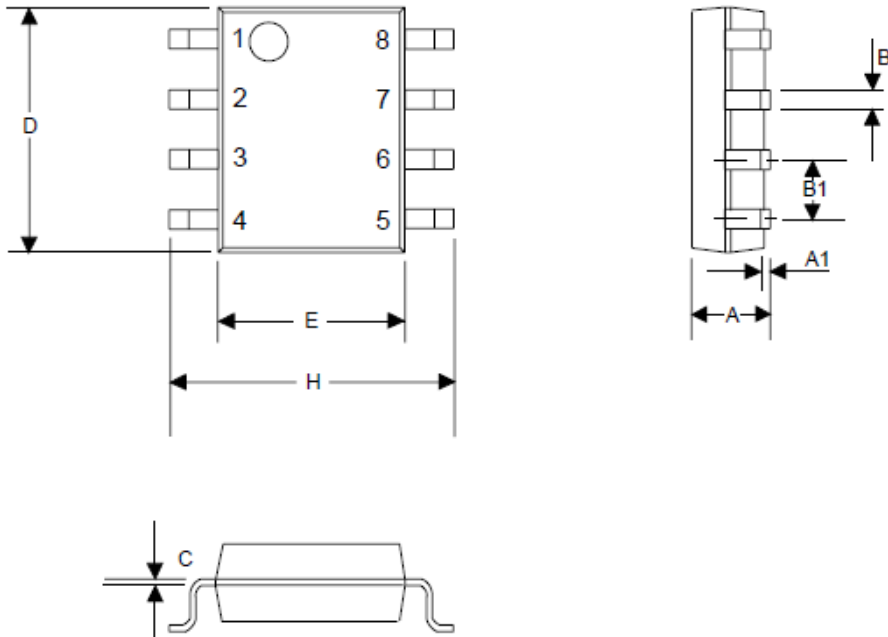
DIMENSIONS				
DIM <sup>N</sup>	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.173	0.181	4.400	4.600
B	0.159	0.167	4.050	4.250
C	0.067	0.075	1.700	1.900
D	0.051	0.059	1.300	1.500
E	0.094	0.102	2.400	2.600
F	0.035	0.047	0.890	1.200
G	0.118REF		3.00REF	
H	0.059REF		1.50REF	
I	0.016	0.020	0.400	0.520
J	0.055	0.063	1.400	1.600
K	0.014	0.016	0.350	0.410
L	10°TYP		10°TYP	
M	0.028REF		0.70REF	



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## Packing Information

### SOP-8



DIMENSIONS				
DIM <sup>N</sup>	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.0532	0.0688	1.35	1.75
A1	0.0040	0.0098	0.10	0.25
B	0.0130	0.0200	0.33	0.51
B1	0.050 BSC		1.27 BSC	
C	0.0075	0.0098	0.19	0.25
D	0.1890	0.1968	4.80	5.00
H	0.2284	0.2440	5.80	6.20
E	0.1497	0.1574	3.80	4.00



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### Notes

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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