

April 13, 1998

TEL:805-498-2111 FAX:805-498-3804 WEB:http://www.semtech.com

## DESCRIPTION

The SC431 is a three terminal adjustable shunt regulator with thermal stability guaranteed over temperature. The output voltage can be adjusted to any value from 2.5V ( $V_{REF}$ ) to 36V with two external resistors. The SC431 has a typical dynamic output impedance of  $0.25\Omega$ . Active output circuitry provides a very sharp turn on characteristic, making the SC431 an excellent replacement for zener diodes.

The SC431 shunt regulator is available in three voltage tolerances (0.5%, 1.0% and 2.0%) and three package options (SOT-23-3, SO-8 and TO-92). The three voltage tolerances allow the designer the opportunity to select the proper cost/tolerance for their application.

## FEATURES

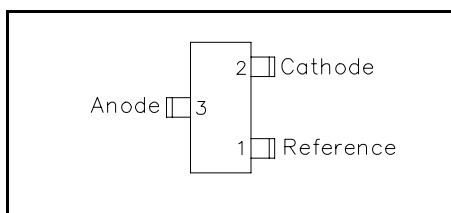
- Wide operating current range 100 $\mu$ A to 150mA
- Low dynamic output impedance  $0.25\Omega$  typ.
- Trimmed bandgap design  $\pm 0.5\%$
- Alternate for TL431, LM431 & AS431

## APPLICATIONS

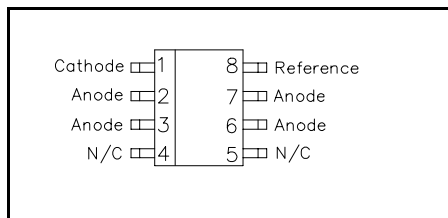
- Linear Regulators
- Adjustable Supplies
- Switching Power Supplies
- Battery Operated Computers
- Instrumentation
- Computer Disk Drives

## PIN CONFIGURATIONS

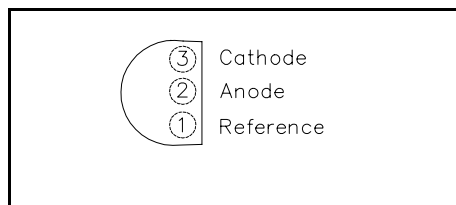
### SOT-23 -3 Lead (Top View)



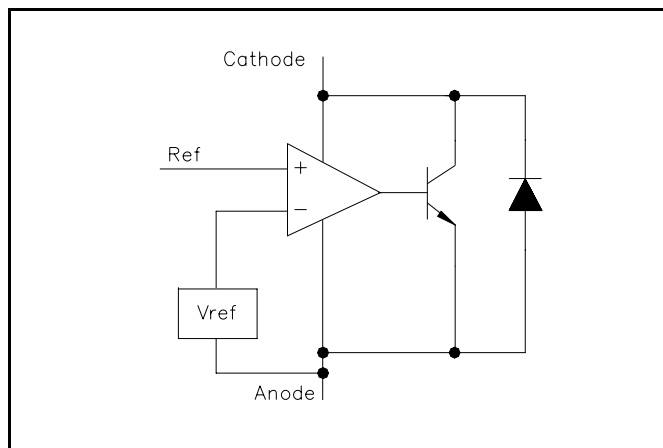
### SOIC 8 Lead (Top View)



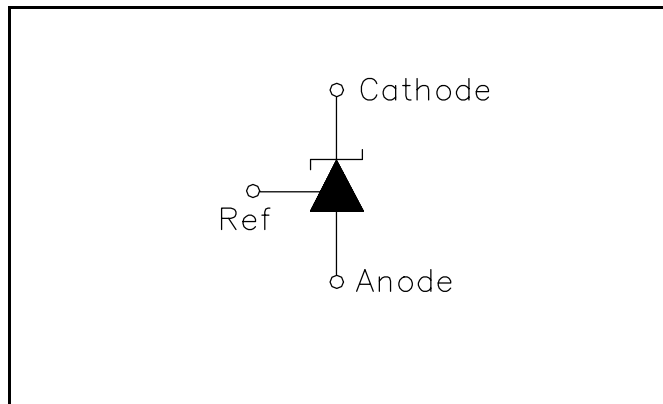
### TO-92 (Top View)



## BLOCK DIAGRAM



## SYMBOL DIAGRAM



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**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Maximum	Units
Cathode Voltage	$V_Z$	37	V
Continuous Cathode Current	$I_Z$	150	mA
Reference Input Current	$I_{REF}$	10	mA
Operating Junction Temperature Range	$T_J$	-40 to +150	°C
Storage Temperature Range	$T_{STG}$	-65 to +150	°C
Thermal Resistance TO-92 SO-8 SOT-23	$\theta_{JA}$	160 175 410	°C/W
Power Dissipation at $T_A = 25^\circ\text{C}$ TO-92 SO-8 SOT-23	$P_D$	0.78 0.71 0.30	W
Lead Temperature (Soldering) 10 seconds	$T_{LEAD}$	260	°C

**ORDERING INFORMATION**

PACKAGE	TOLERANCE			
	0.5%	1.0%	2.0%	T/R Quantity
SO-8 <sup>(1)</sup>	SC431CS - .5	SC431CS - 1	SC431CS - 2	2.5K
SOT-23 <sup>(1)</sup>	SC431CSK - .5	SC431CSK - 1	SC431CSK - 2	3K
TO-92 <sup>(1)(2)</sup>	SC431CZ - .5	SC431CZ - 1	SC431CZ - 2	TR=3K, TA=2K

Notes:

(1) Add suffix 'TR' for Tape &amp; Reel.

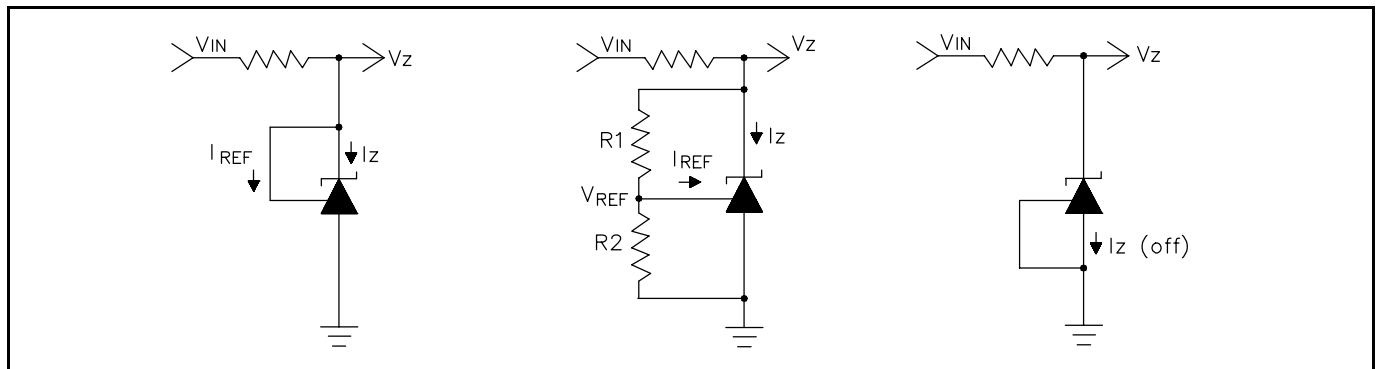
(2) Add suffix 'TA' for Tape Ammo.

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**ELECTRICAL CHARACTERISTICS**

 Unless specified,  $T_A = 25^\circ\text{C}$ 

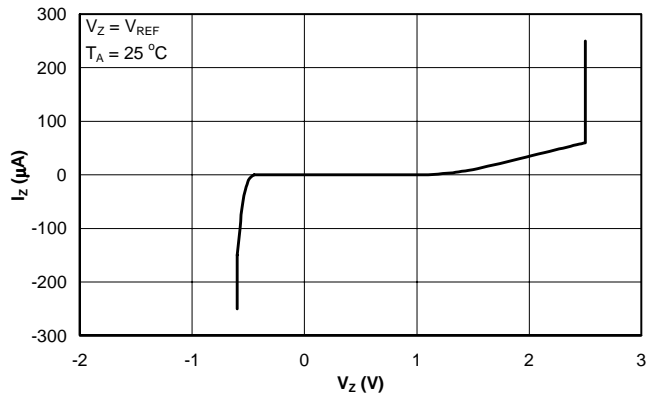
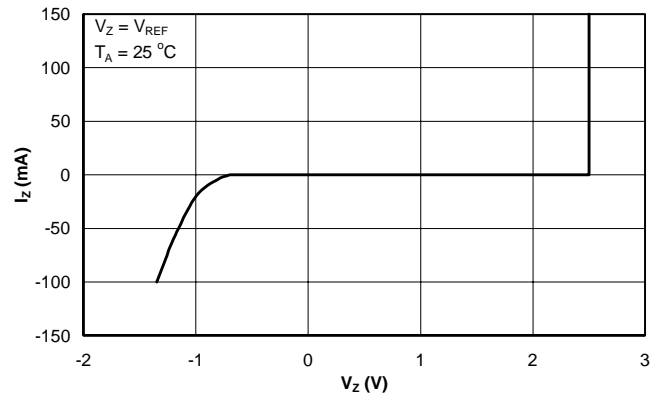
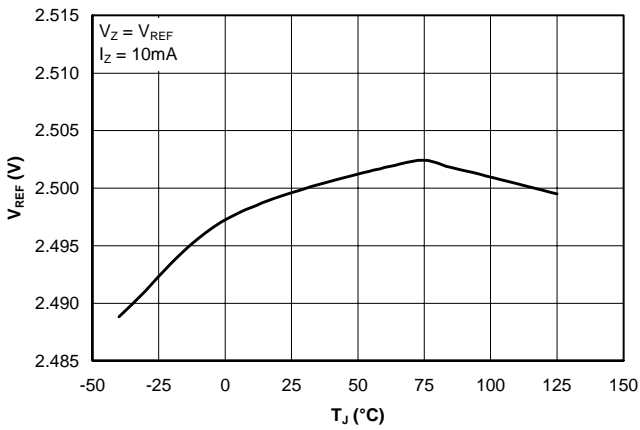
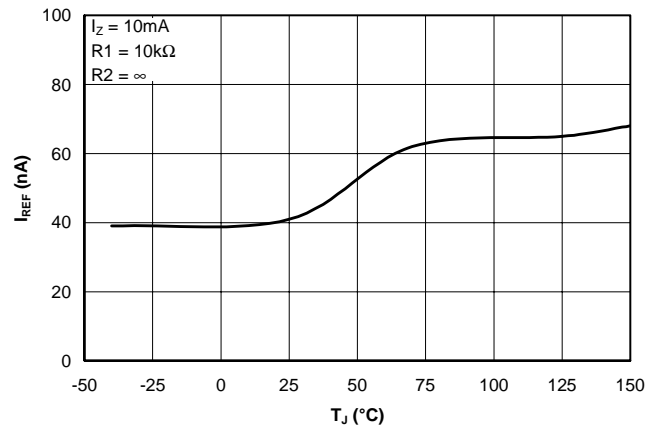
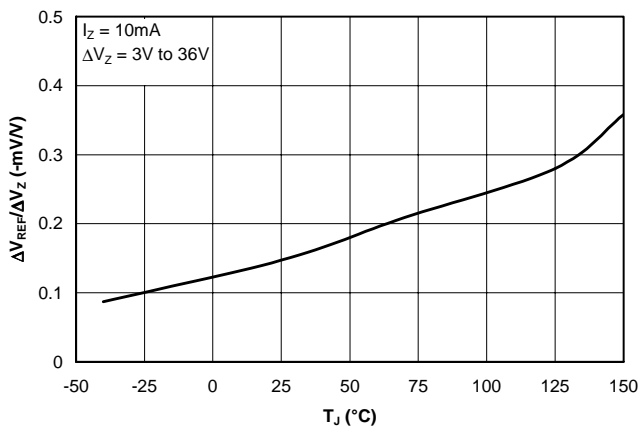
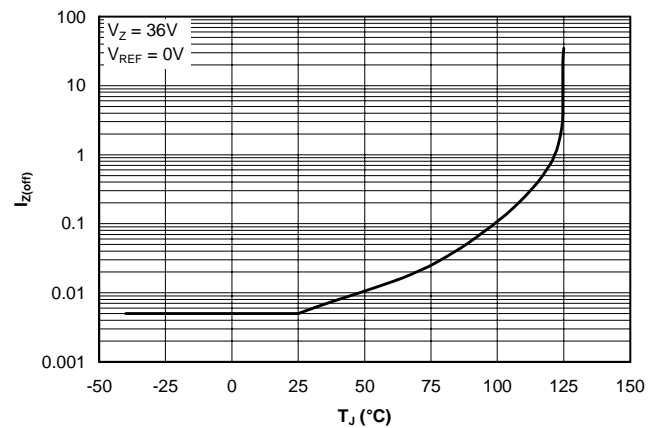
Parameter	Symbol	Condition	SC431 0.5%			SC431 1%			SC431 2%			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Reference Voltage	$V_{REF}$	$V_Z = V_{REF}$ $I_Z = 10\text{mA}$ (test circuit 1)	2.482	2.495	2.507	2.470	2.495	2.520	2.445	2.495	2.545	V
$V_{REF}$ Temp Deviation	$V_{DEV}$	$T_A = -40$ to $+85^\circ\text{C}$ , $V_Z = V_{REF}$ (test circuit 1)		8	17		8	25		15	30	mV
Ratio of Change in $V_{REF}$ to Change in Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_Z}$	$I_Z = 10\text{mA}$ , $\Delta V_Z = 10\text{V}$ to $V_{REF}$		-0.5	-2.7		-0.5	-2.7		-0.5	-2.7	mV/V
		$I_Z = 10\text{mA}$ , $\Delta V_Z = 36\text{V}$ to $10\text{V}$		-1.0	-2.0		-1.0	-2.0		-1.0	-2.0	
Reference Input Current	$I_{REF}$	$R1 = 10\text{k}\Omega$ , $R2 = \infty$ , $I_Z = 10\text{mA}$ (test circuit 2)		0.5	4		0.5	4		0.5	4	$\mu\text{A}$
$I_{REF}$ Temp Deviation	$I_{REF(DEV)}$	$T_A = -40$ to $+85^\circ\text{C}$ , $R1 = 10\text{k}\Omega$ , $R2 = \infty$ , $I_Z = 10\text{mA}$ (test circuit 2)		0.4	1.2		0.4	1.2		0.4	1.2	$\mu\text{A}$
Off State Cathode Current	$I_Z(\text{off})$	$V_{REF} = 0\text{V}$ , $V_Z = 36\text{V}$ (test circuit 3)		0.04	0.5		0.04	0.5		0.04	0.5	$\mu\text{A}$
Dynamic Output Impedance	$r_Z$	$f < 1\text{kHz}$ , $V_Z = V_{REF}$ $I_Z = 100\mu\text{A}$ to $100\text{mA}$ (test circuit 1)		0.25	0.5		0.25	0.5		0.25	0.5	$\Omega$
Minimum Operating Current	$I_Z(\text{min})$	$V_Z = V_{REF}$ (test circuit 1)			100			100			100	$\mu\text{A}$

**TEST CIRCUITS**

**Test Circuit 1:**  
 $V_Z = V_{REF}$ 
**Test Circuit 2:**  
 $V_Z > V_{REF}$ 
**Test Circuit 3:**  
 Off State Current

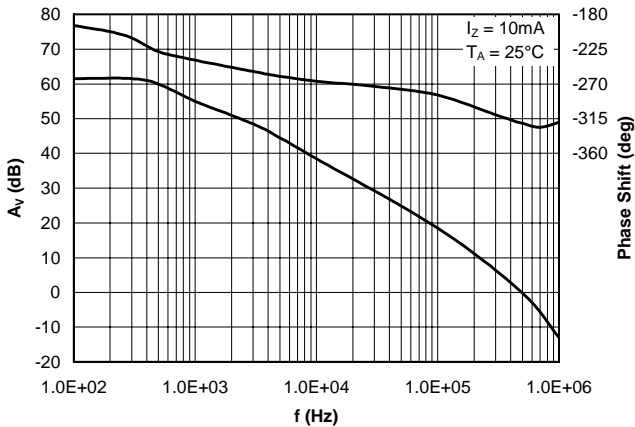
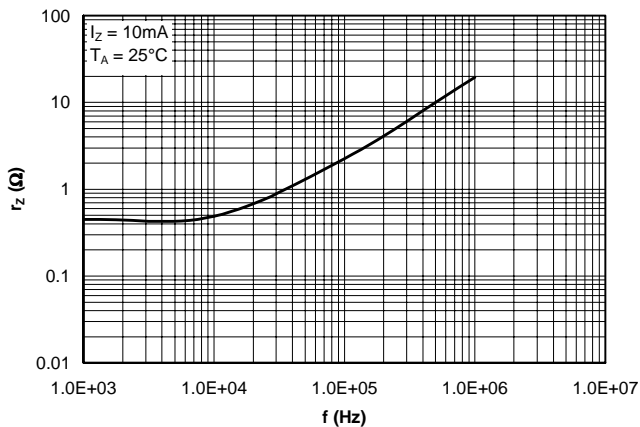
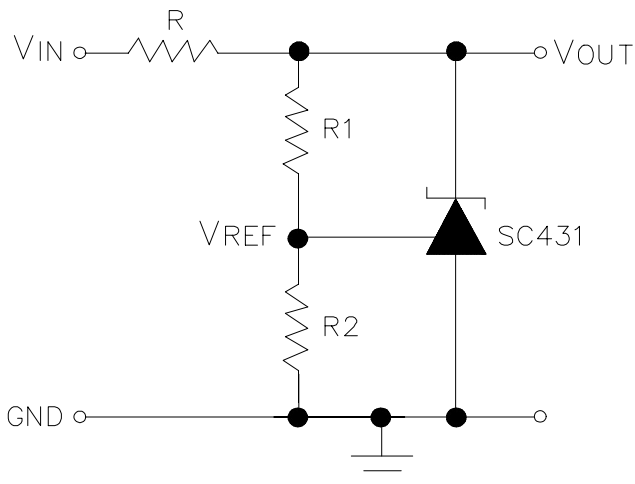
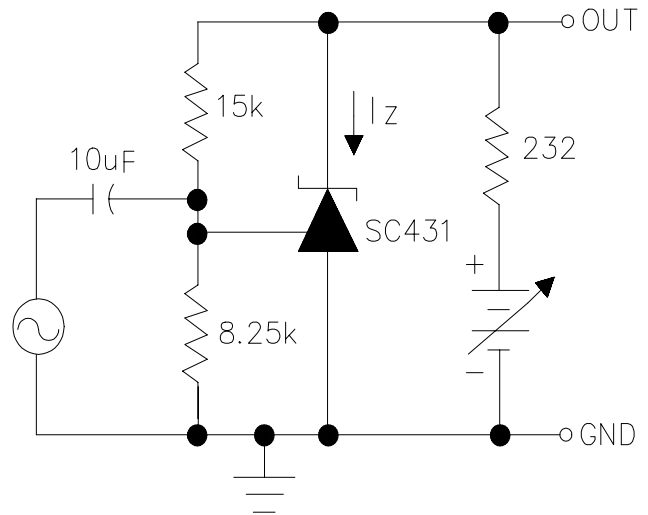
**RECOMMENDED OPERATING CONDITIONS**

	Min	Max	Symbol
Cathode Voltage, $V_Z$	$V_{REF}$	36	V
Cathode Current, $I_Z$	0.1	150	mA

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**TYPICAL CHARACTERISTICS**
**Cathode Current vs. Cathode Voltage**

**Cathode Current vs. Cathode Voltage**

**Reference Voltage vs. Junction Temperature**

**Reference Input Current vs. Junction Temperature**

**Ratio of Delta Reference Voltage to Delta Cathode Voltage vs. Junction Temperature**

**Off-State Cathode Current vs. Junction Temperature**


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**TYPICAL CHARACTERISTICS (Cont.)**
**Small-Signal Gain and Phase Shift vs. Frequency**

**Reference Impedance vs. Frequency**

**APPLICATION CIRCUIT**

**Test Circuit For Small-Signal Gain and Phase Shift**

**Notes for Application Circuit:**

 1) Set  $V_{OUT}$  according to the following equation:

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

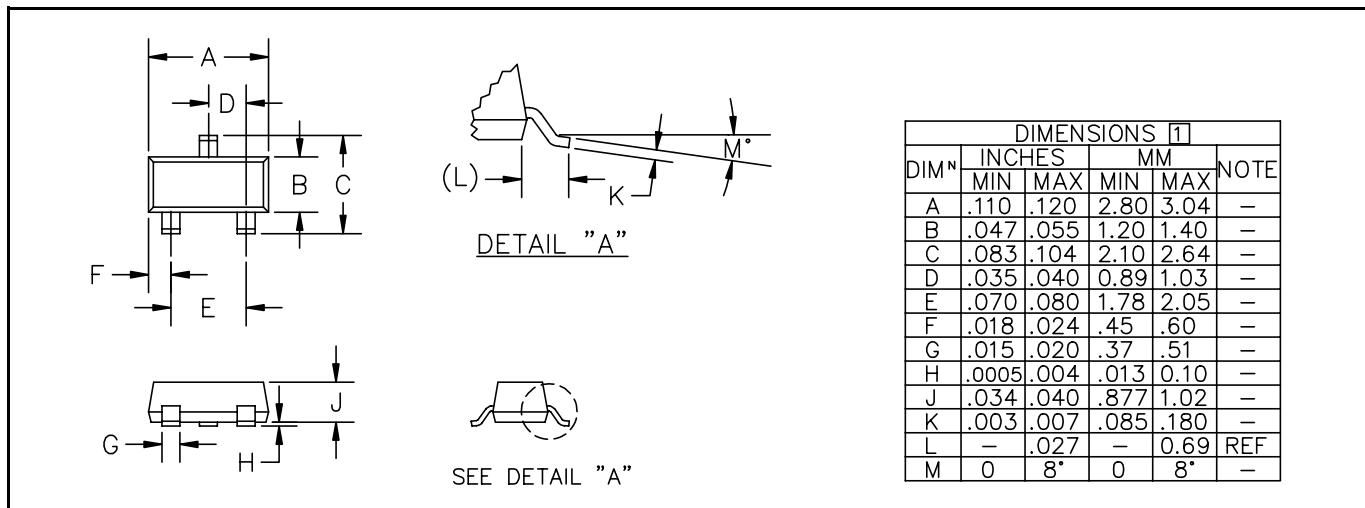
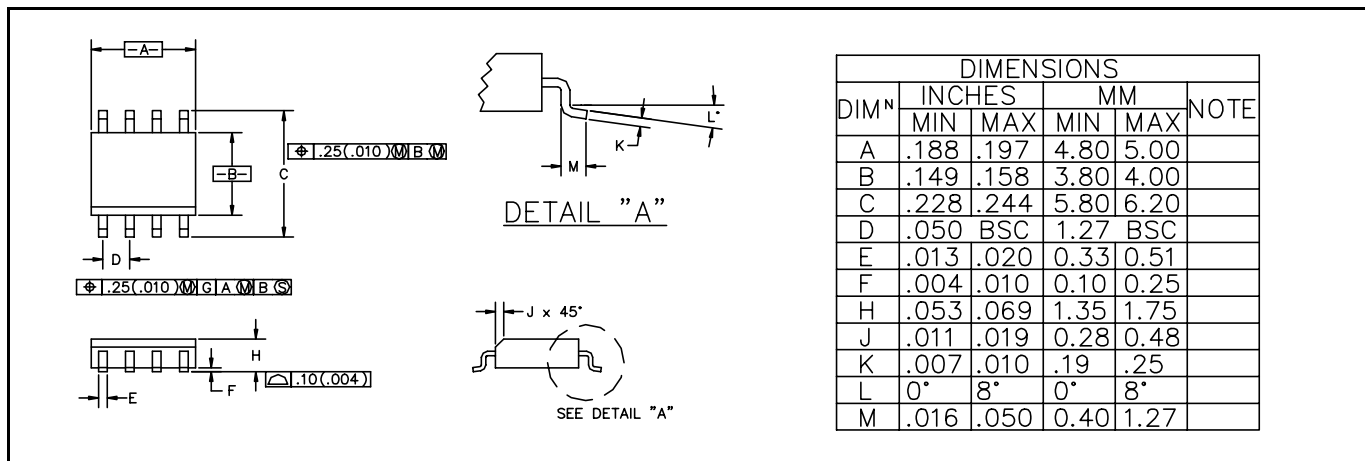
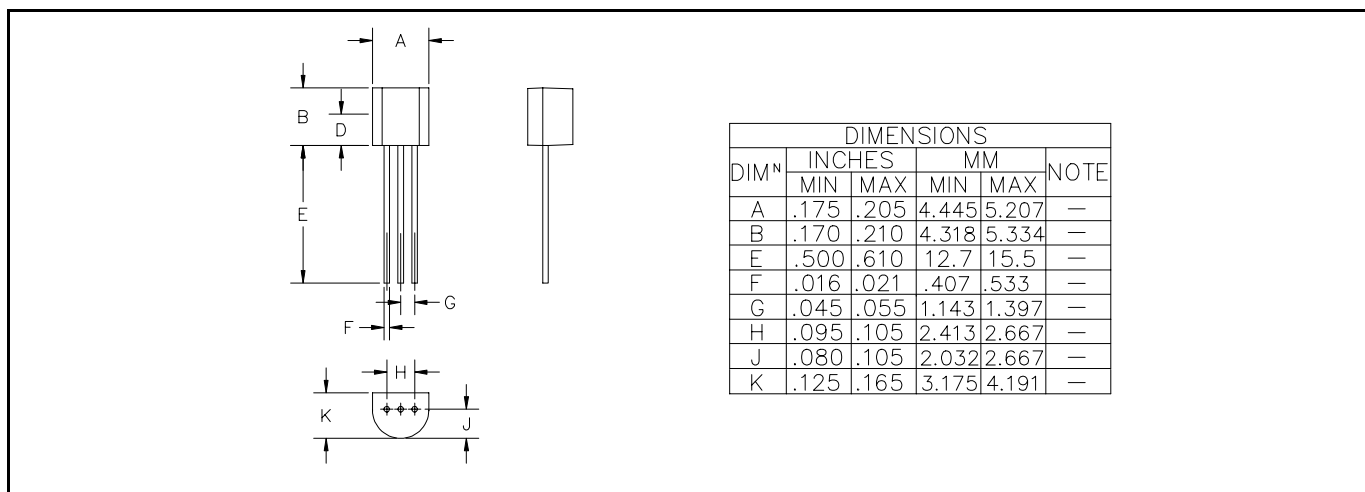
2) Choose the value for R as follows:

- The maximum limit for R should be such that the cathode current,  $I_Z$ , is greater than the minimum operating current ( $100\mu A$ ) at  $V_{IN(min)}$ .
- The minimum limit for R should be such that  $I_Z$  does not exceed 150mA under all load conditions, and the instantaneous turn-on value for  $I_Z$  does not exceed 200mA. Both of the following conditions must be met:

$$R_{min} \geq \frac{V_{IN(max)}}{200mA} \quad (\text{to limit instantaneous turn-on } I_Z)$$

$$R_{min} \geq \frac{V_{IN(max)} - V_{OUT}}{I_{OUT(min)} + 150mA} \quad (\text{to limit } I_Z \text{ under normal operating conditions})$$

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**OUTLINE DRAWING SOT-23**

**OUTLINE DRAWING SO-8**

**OUTLINE DRAWING TO-92**


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Datasheets for electronics components.