

April 14, 1998

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

## DESCRIPTION

The SC431L is a low voltage three terminal adjustable shunt regulator with thermal stability guaranteed over temperature. The output voltage can be adjusted to any value from 1.24V ( $V_{REF}$ ) to 20V with two external resistors. The SC431L has a typical dynamic output impedance of  $0.25\Omega$ . Active output circuitry provides a very sharp turn on characteristic, making the SC431L an excellent replacement for zener diodes.

The SC431L shunt regulator is available in three voltage tolerances (0.5%, 1.0% and 2.0%) and three package options (SOT-23-3, SOT-23-5 and TO-92). The three voltage tolerances allow the designer the opportunity to select the proper cost/tolerance for their application.

## FEATURES

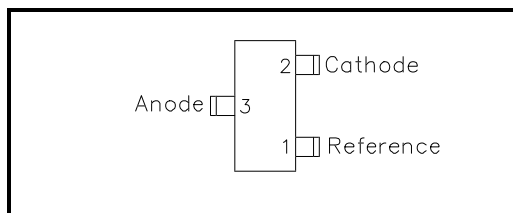
- Low voltage operation (1.24V)
- Adjustable output voltage  $V_O = V_{REF}$  to 20V
- Wide operating current range  $60\mu A$  to 100mA
- Low dynamic output impedance  $0.25\Omega$  typ.
- Trimmed bandgap design  $\pm 0.5\%$
- Upgrade for TLV431A

## APPLICATIONS

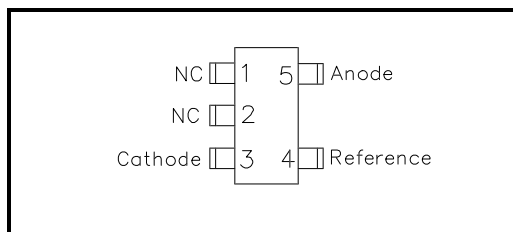
- Linear Regulators
- Adjustable Supplies
- Switching Power Supplies
- Battery Operated Computers
- Instrumentation
- Computer Disk Drives

## PIN CONFIGURATIONS

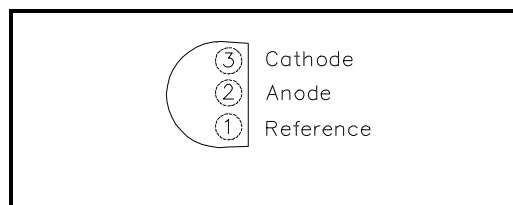
### SOT-23-3 Lead (Top View)



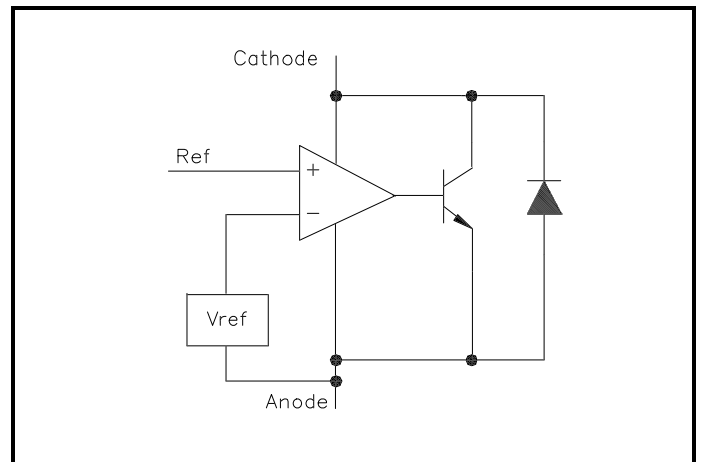
### SOT-23-5 Lead (Top View)



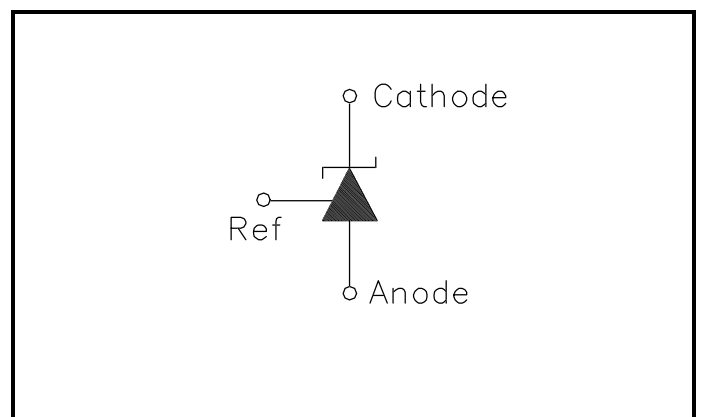
### TO-92 (Top View)



## BLOCK DIAGRAM



## SYMBOL DIAGRAM



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**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Maximum	Units
Cathode Voltage	$V_Z$	20	V
Continuous Cathode Current	$I_Z$	100	mA
Reference Current	$I_{REF}$	3	mA
Operating Junction Temperature Range	$T_J$	-40 to +150	°C
Storage Temperature Range	$T_{STG}$	-65 to +150	°C
Thermal Resistance TO-92 SOT-23-3L, SOT-23-5L	$\theta_{JA}$	160 410	°C/W
Power Dissipation at $T_A = 25^\circ\text{C}$ TO-92 SOT-23-3L, SOT-23-5L	$P_D$	0.78 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
SOT-23-3L <sup>(1)</sup>	SC431LCSK - .5	SC431LCSK - 1	SC431LCSK - 2	3K
SOT-23-5L <sup>(2)</sup>	SC431LC5SK - .5	SC431LC5SK - 1	SC431LC5SK - 2	3K
TO-92 <sup>(1)(3)</sup>	SC431LCZ - .5	SC431LCZ - 1	SC431LCZ - 2	TR=3K, TA=2K

Notes:

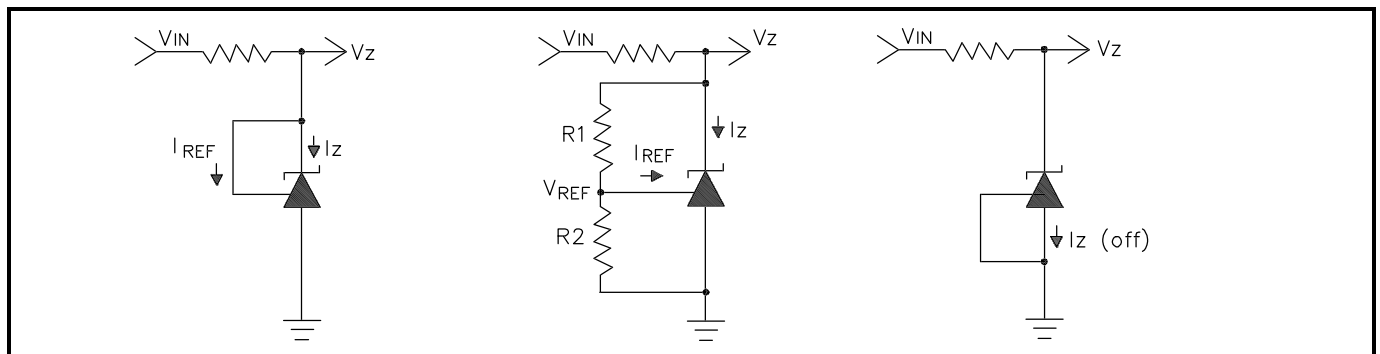
- (1) Add suffix 'TR' for Tape & Reel.
- (2) Add suffix 'TC' for Tape & Reel.
- (3) Add suffix 'TA' for Tape Ammo.

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**ELECTRICAL CHARACTERISTICS**

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

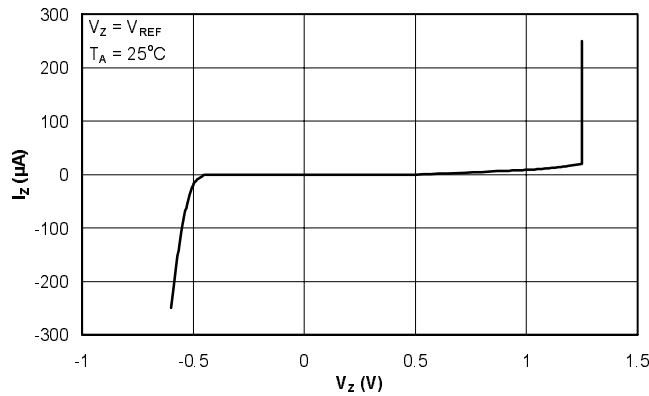
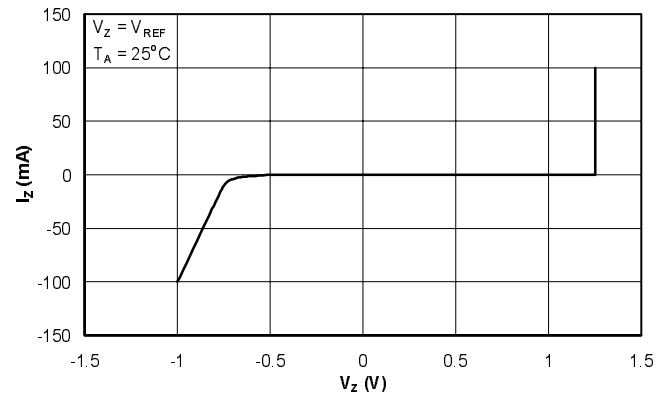
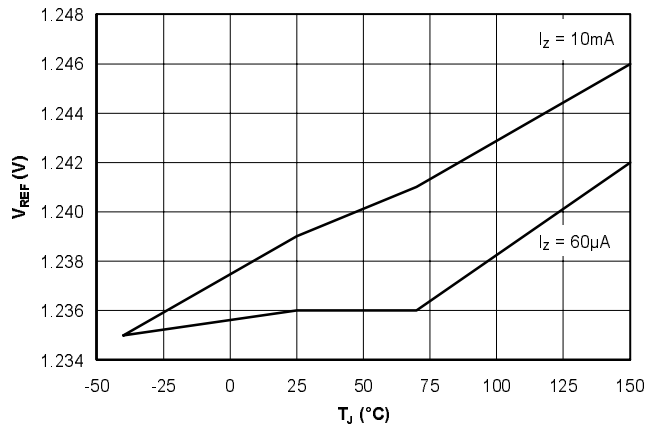
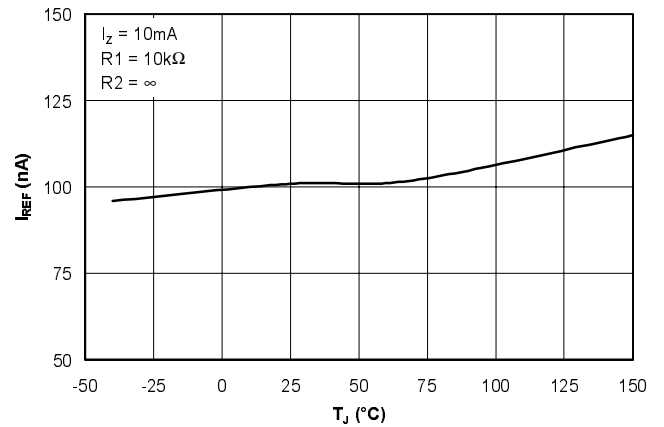
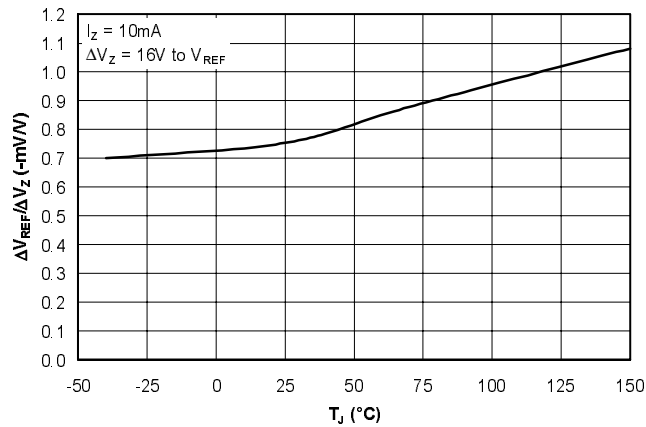
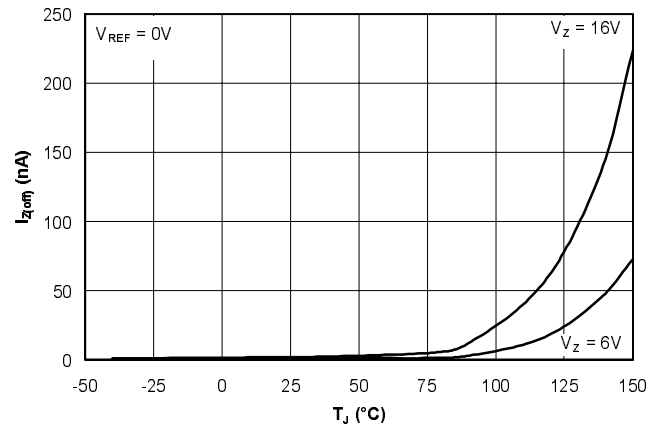
Parameter	Symbol	Condition	SC431L 0.5%			SC431L 1%			SC431L 2%			UNITS	
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
Reference Voltage	$V_{REF}$	$V_Z = V_{REF}$ , $I_Z = 10\text{mA}$ (test circuit 1)	$T_A = 25^\circ\text{C}$	1.234	1.240	1.246	1.228	1.240	1.252	1.215	1.240	1.265	V
			$T_A = -40$ to $+85^\circ\text{C}$	1.222		1.258	1.215		1.265	1.200		1.280	
$V_{REF}$ Temp Deviation	$V_{DEV}$	$T_A = -40$ to $+85^\circ\text{C}$ , $V_Z = V_{REF}$ (test circuit 1) $I_Z = 10\text{mA}$		10	25		10	25		10	35	mV	
Ratio of Change in $V_{REF}$ to Change in Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_Z}$	$I_Z = 10\text{mA}$ , $\Delta V_Z = 16\text{V}$ to $V_{REF}$ (test circuit 2)		-1.0	-2.7		-1.0	-2.7		-1.0	-2.7	mV/V	
Reference Input Current	$I_{REF}$	$R_1 = 10\text{k}\Omega$ , $R_2 = \infty$ , $I_Z = 10\text{mA}$ (test circuit 2)		0.15	0.5		0.15	0.5		0.15	0.5	$\mu\text{A}$	
$I_{REF}$ Temp Deviation	$I_{REF(DEV)}$	$T_A = -40$ to $+85^\circ\text{C}$ $R_1 = 10\text{k}\Omega$ , $R_2 = \infty$ , $I_Z = 10\text{mA}$ (test circuit 2)		0.1	0.4		0.1	0.4		0.1	0.4	$\mu\text{A}$	
Off State Cathode Current	$I_Z(\text{off})$	$V_{REF} = 0\text{V}$ (test circuit 3)	$V_Z = 6\text{V}$		0.04	0.1		0.04	0.1		0.04	0.1	$\mu\text{A}$
			$V_Z = 16\text{V}$		0.04	0.5		0.04	0.5		0.04	0.5	
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	0.4		0.25	0.4		0.25	0.4	$\Omega$	
Minimum Operating Current	$I_Z(\text{min})$	$V_Z = V_{REF}$ (test circuit 1)		60	80		60	80		60	80	$\mu\text{A}$	

**TEST CIRCUITS**

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

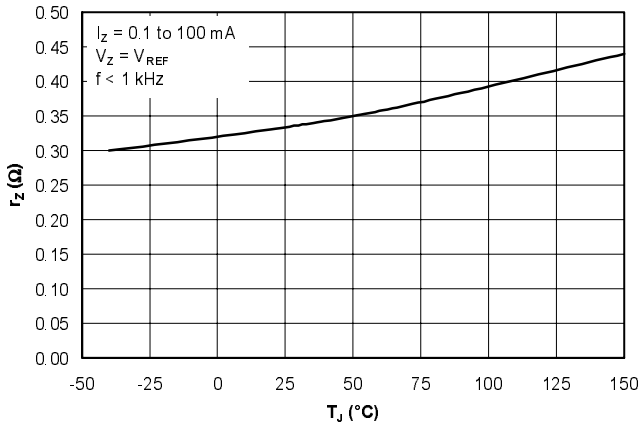
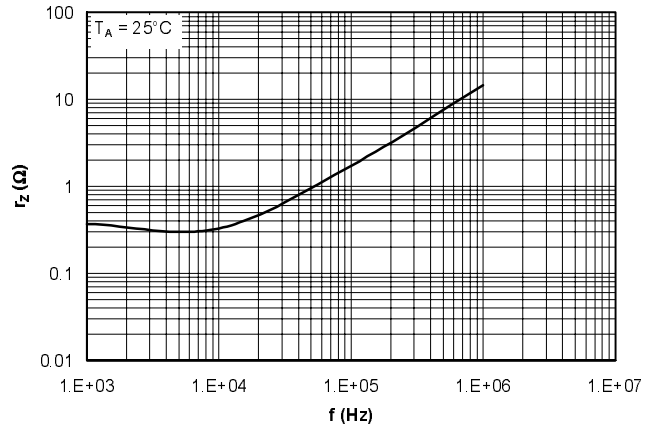
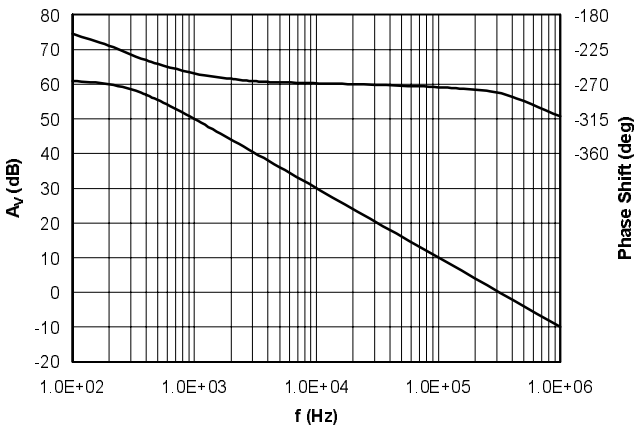
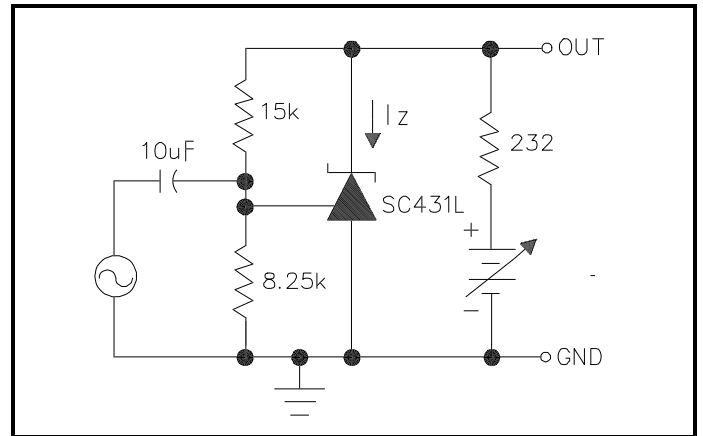
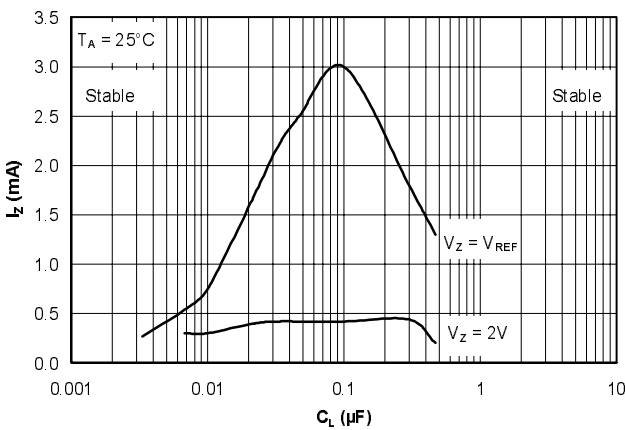
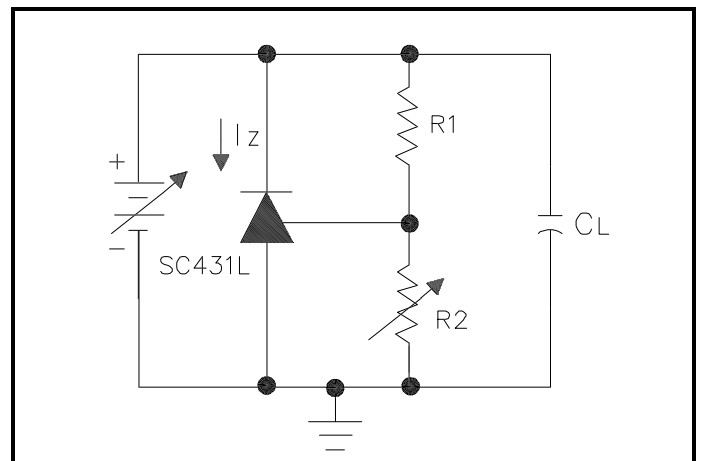
**RECOMMENDED OPERATING CONDITIONS**

	Min	Max	Symbol
Cathode Voltage, $V_Z$	$V_{REF}$	16	V
Cathode Current, $I_Z$	$80\mu\text{A}$	100	mA

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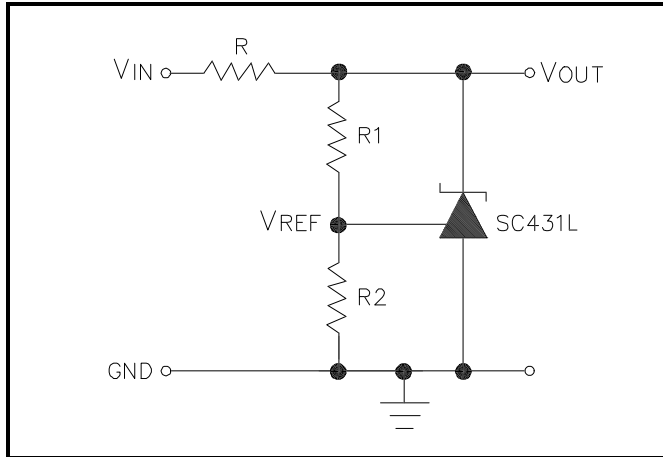
**CHARACTERISTIC CURVES**
**Cathode Current vs. Cathode Voltage**

**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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**Reference Impedance  
vs. Junction Temperature**

**Reference Impedance  
vs. Frequency**

**Small Signal Gain and Phase Shift  
vs. Frequency**

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

**Stability Boundary Condition**

**Stability Circuit**


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### APPLICATION CIRCUIT



#### Notes for Application Circuit:

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

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

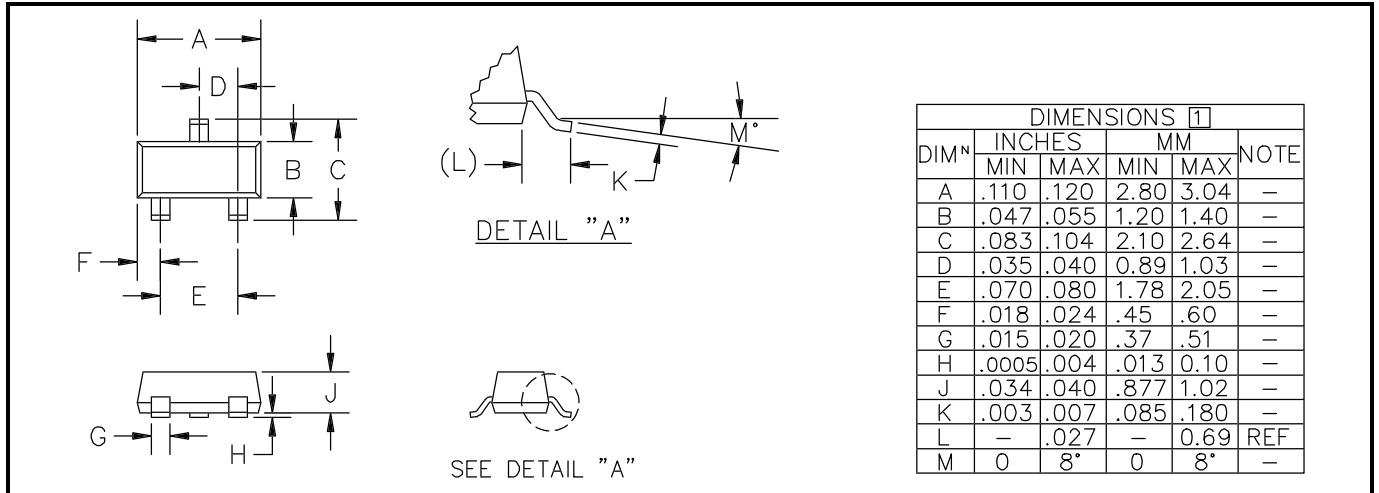
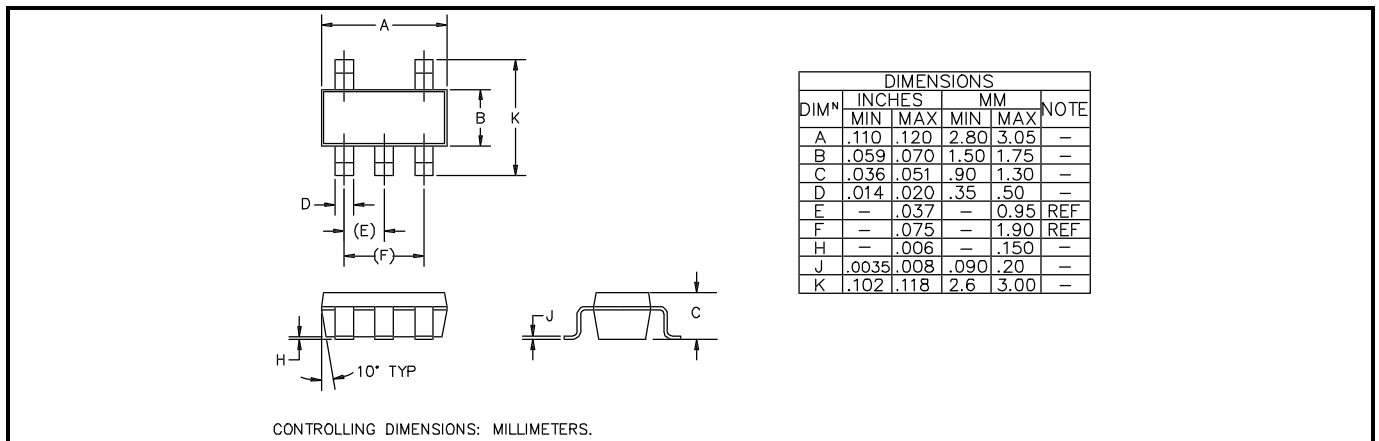
2) Choose the value for R as follows:

- The maximum limit for R should be such that the cathode current,  $I_Z$ , is greater than the minimum operating current ( $80\mu A$ ) at  $V_{IN(min)}$ .
- The minimum limit for R should be such that  $I_Z$  does not exceed 100mA under all load conditions, and the instantaneous turn-on value for  $I_Z$  does not exceed 150mA. Both of the following conditions must be met:

$$R_{min} \geq \frac{V_{IN(max)}}{150 \text{ mA}} \quad (\text{to limit instantaneous turn-on } I_Z)$$

$$R_{min} \geq \frac{V_{IN(max)} - V_{OUT}}{I_{OUT(min)} + 100 \text{ mA}} \quad (\text{to limit } I_Z \text{ under normal operating conditions})$$

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**OUTLINE DRAWING SOT-23-3L**

**OUTLINE DRAWING SOT-23-5L**

**OUTLINE DRAWING TO-92**
