

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 0.25Ω . 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

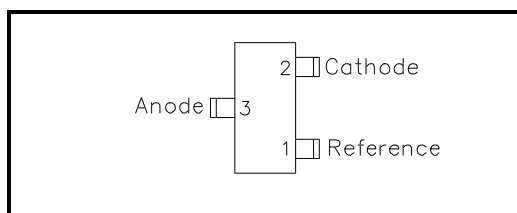
- Low voltage operation (1.24V)
- Adjustable output voltage $V_O = V_{REF}$ to 20V
- Wide operating current range $60\mu A$ to 100mA
- Low dynamic output impedance 0.25Ω typ.
- Trimmed bandgap design $\pm 0.5\%$
- Upgrade for TLV431A

APPLICATIONS

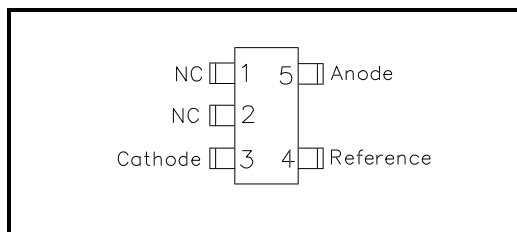
- Linear Regulators
- Adjustable Supplies
- Switching Power Supplies
- Battery Operated Computers
- Instrumentation
- Computer Disk Drives

PIN CONFIGURATIONS

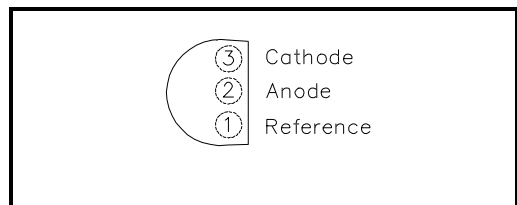
SOT-23-3 Lead (Top View)



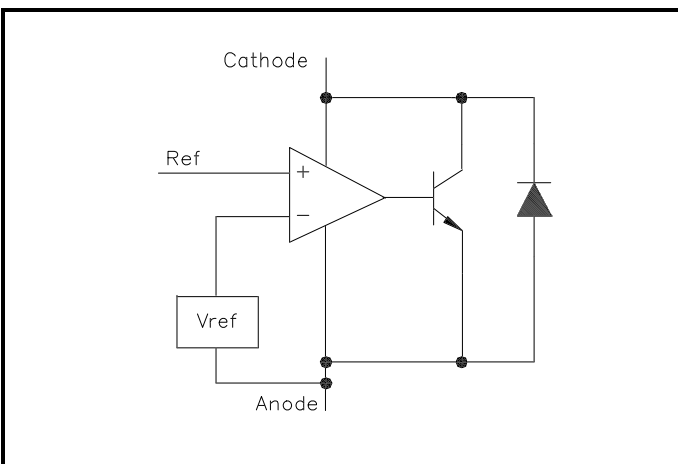
SOT-23-5 Lead (Top View)



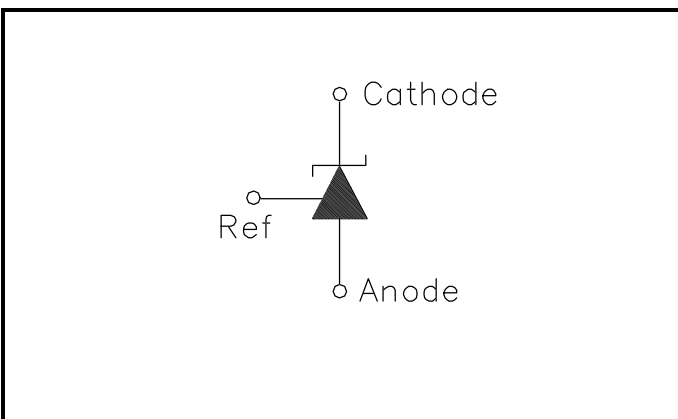
TO-92 (Top View)



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	θ_{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 ⁽¹⁾	SC431LCSK - .5	SC431LCSK - 1	SC431LCSK - 2	3K
SOT-23-5L ⁽²⁾	SC431LC5SK - .5	SC431LC5SK - 1	SC431LC5SK - 2	3K
TO-92 ⁽¹⁾⁽³⁾	SC431LCZ - .5	SC431LCZ - 1	SC431LCZ - 2	TR=3K, TA=2K

Notes:

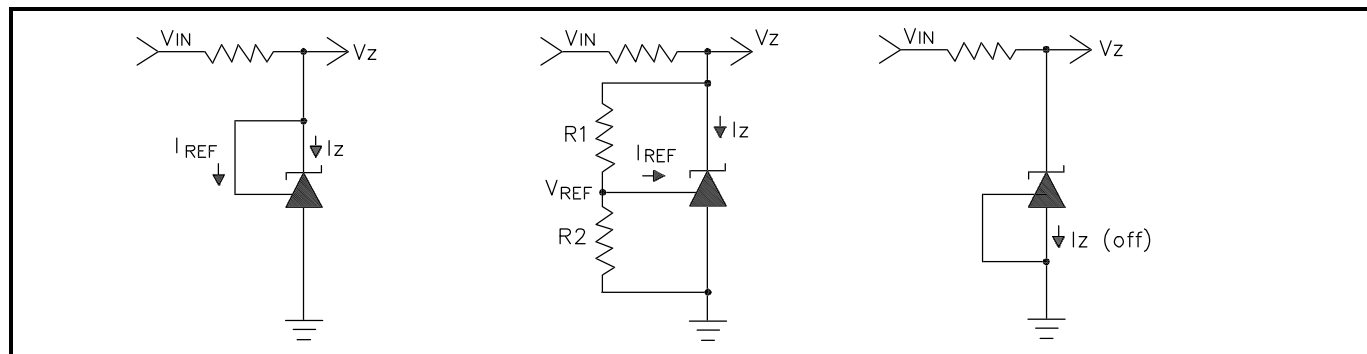
- (1) Add suffix 'TR' for Tape & Reel.
- (2) Add suffix 'TC' for Tape & Reel.
- (3) Add suffix 'TA' for Tape Ammo.

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ELECTRICAL CHARACTERISTICS

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

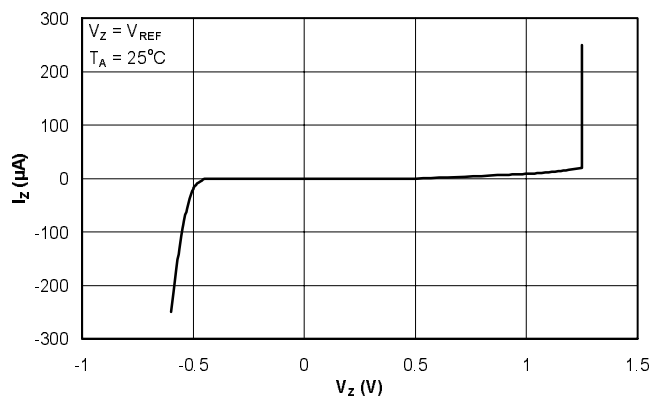
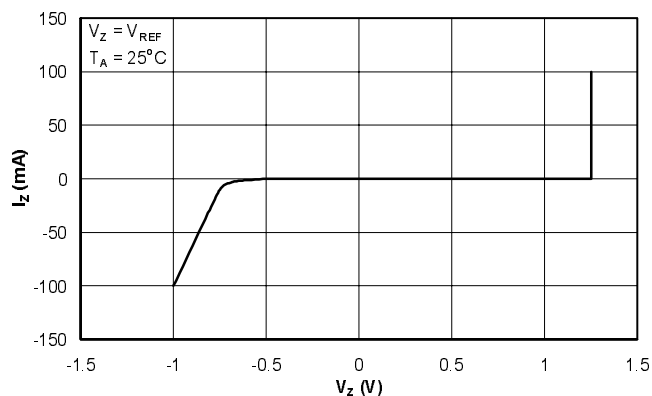
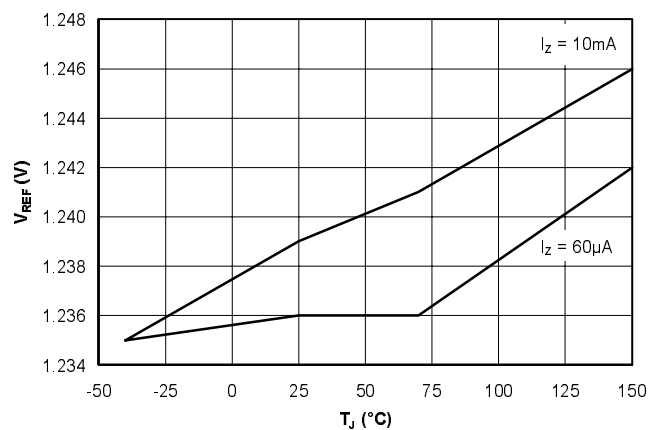
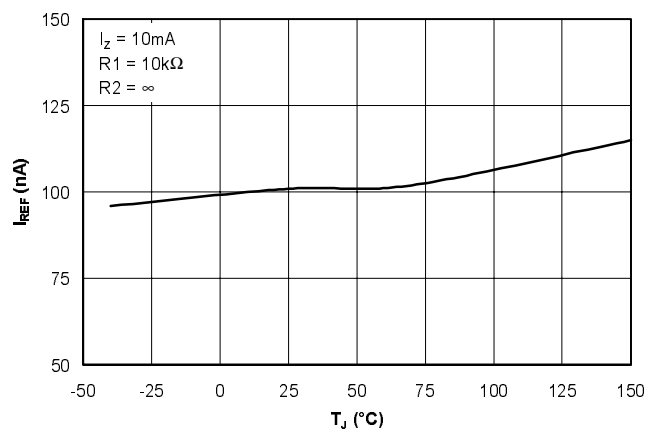
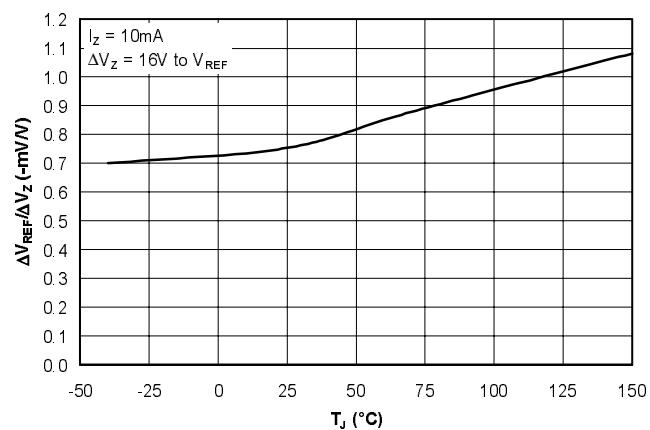
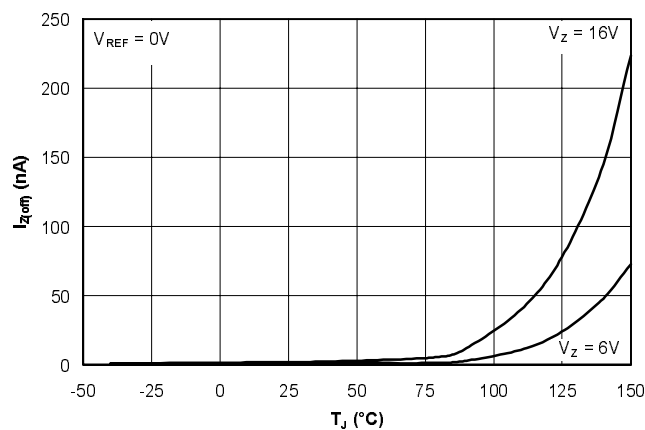
Parameter	Symbol	Condition		SC431L 0.5%			SC431L 1%			SC431L 2%			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Reference Voltage	V_{REF}	$V_Z = V_{REF}$, $I_Z = 10\text{mA}$ (test circuit 1)	$T_A = 25^\circ\text{C}$ $T_A = -40 \text{ to } +85^\circ\text{C}$	1.234 1.222	1.240	1.246 1.258	1.228 1.215	1.240	1.252 1.265	1.215 1.200	1.240	1.265 1.280	V
V_{REF} Temp Deviation	V_{DEV}	$T_A = -40 \text{ to } +85^\circ\text{C}$, $V_Z = V_{REF}$ (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}	$R1 = 10\text{k}\Omega$, $R2 = \infty$, $I_Z = 10\text{mA}$ (test circuit 2)			0.15	0.5		0.15	0.5		0.15	0.5	μA
I_{REF} Temp Deviation	$I_{REF(DEV)}$	$T_A = -40 \text{ to } +85^\circ\text{C}$ $R1 = 10\text{k}\Omega$, $R2 = \infty$, $I_Z = 10\text{mA}$ (test circuit 2)			0.1	0.4		0.1	0.4		0.1	0.4	μA
Off State Cathode Current	$I_{Z(off)}$	$V_{REF} = 0\text{V}$, $V_Z = 6\text{V}$ (test circuit 3)			0.04	0.1		0.04	0.1		0.04	0.1	μA
		$V_Z = 16\text{V}$			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 100mA (test circuit 1)			0.25	0.4		0.25	0.4		0.25	0.4	Ω
Minimum Operating Current	$I_{Z(min)}$	$V_Z = V_{REF}$ (test circuit 1)			60	80		60	80		60	80	μA

TEST CIRCUITS

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

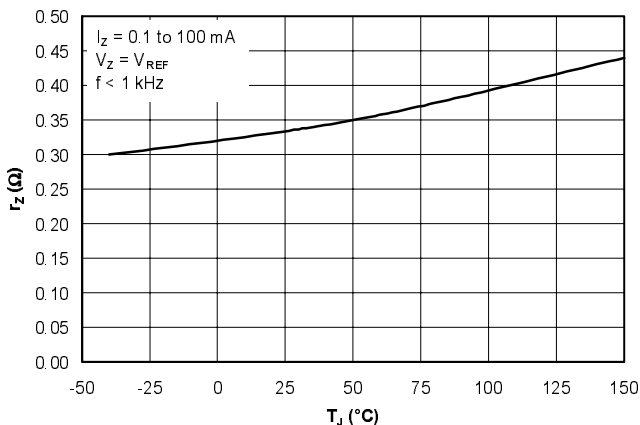
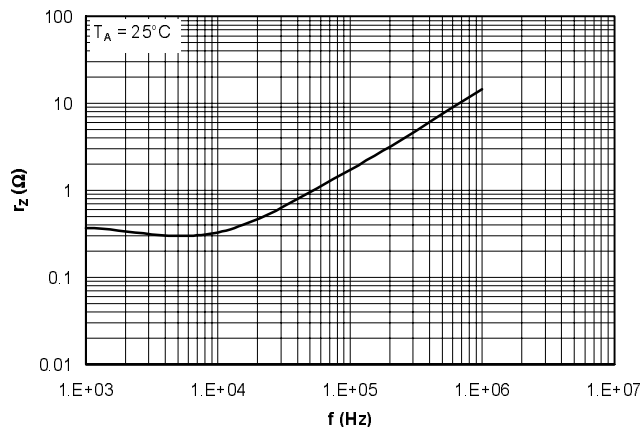
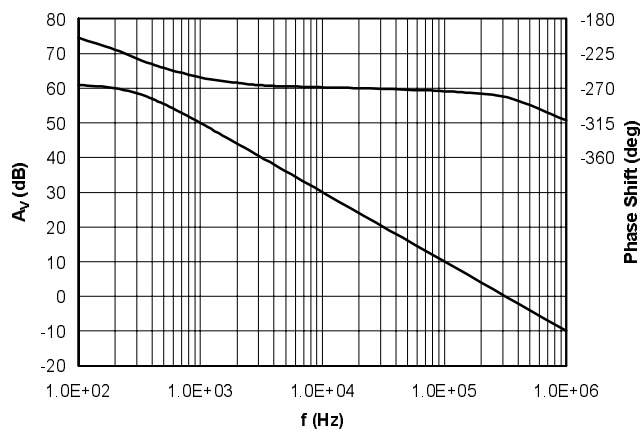
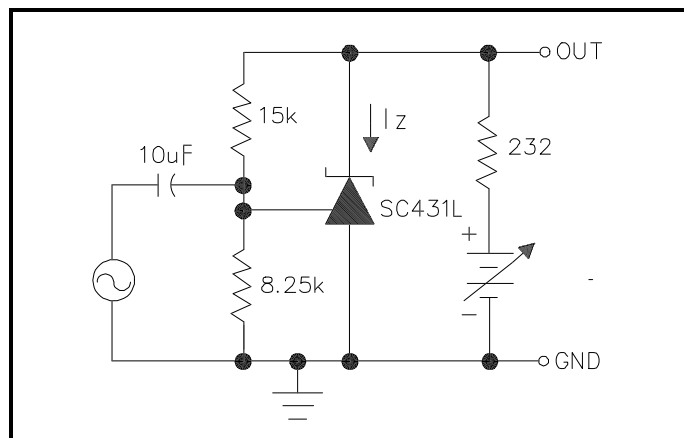
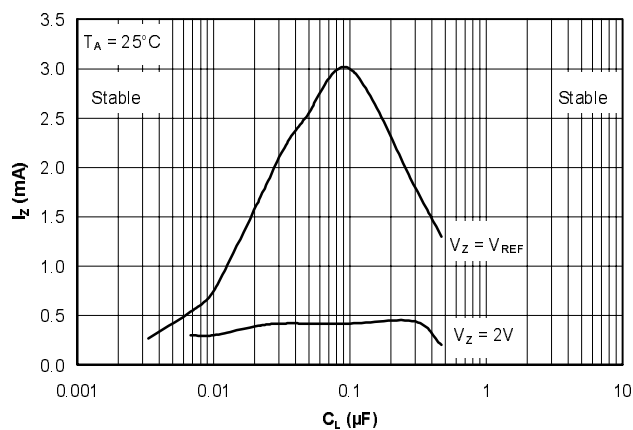
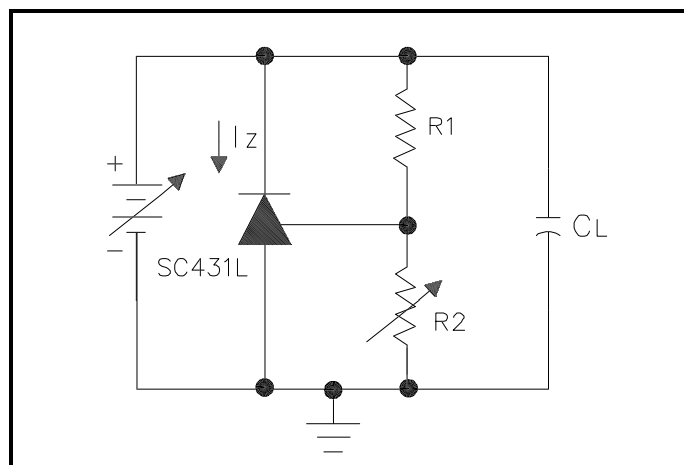
RECOMMENDED OPERATING CONDITIONS

	Min	Max	Symbol
Cathode Voltage, V_Z	V_{REF}	16	V
Cathode Current, I_Z	80 μA	100	mA

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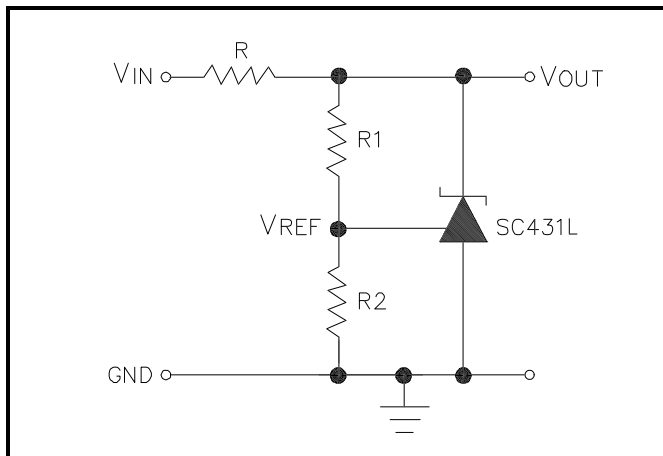
CHARACTERISTIC CURVES
Cathode Current vs. Cathode Voltage

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:

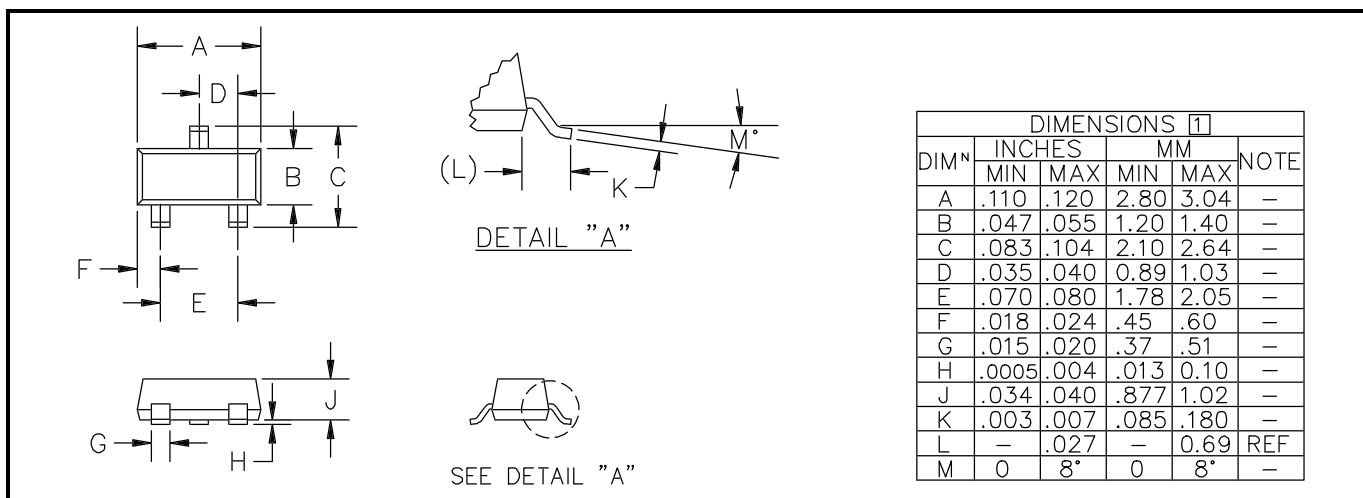
- The maximum limit for R should be such that the cathode current, I_Z , is greater than the minimum operating current ($80\mu A$) at $V_{IN(min)}$.
- The minimum limit for R should be such that I_Z does not exceed 100mA under all load conditions, and the instantaneous turn-on value for I_Z does not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

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

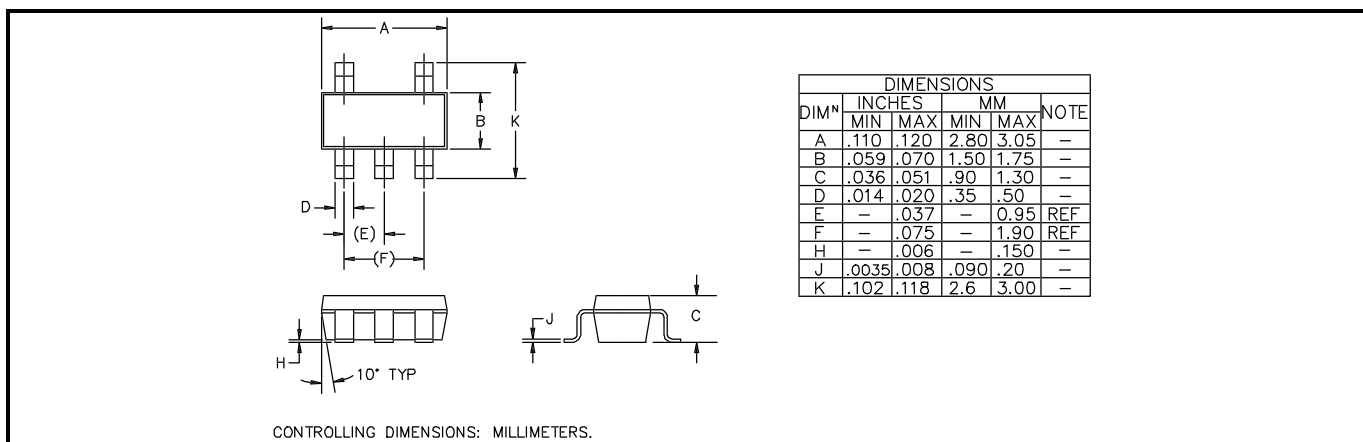
$$R_{min} \geq \frac{V_{IN(max)} - V_{OUT}}{I_{OUT(min)} + 100 \text{ mA}} \quad (\text{to limit } I_Z \text{ under normal operating conditions})$$

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OUTLINE DRAWING SOT-23-3L



OUTLINE DRAWING SOT-23-5L



OUTLINE DRAWING TO-92

