

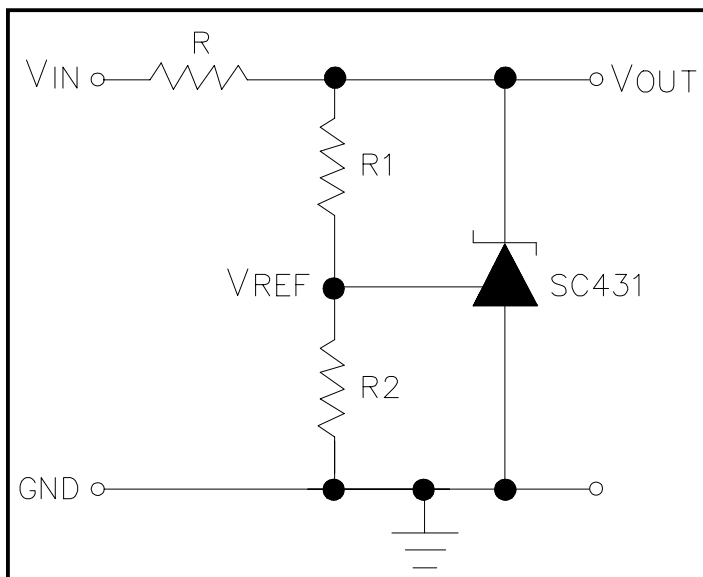
POWER MANAGEMENT

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 30V with two external resistors. The SC431 has a typical dynamic output impedance of 0.25Ω . 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 with four voltage tolerances (0.5%, 1.0% and 2.0% over $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ and 0.5% over $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$) and three package options (SOT-23-3, SO-8 and TO-92). This allows the designer the opportunity to select the optimum combination of cost and performance for their application.

Typical Application Circuit⁽¹⁾⁽²⁾



Features

- ◆ Wide operating current range 130 μA to 150mA
- ◆ Low dynamic output impedance 0.25Ω typ.
- ◆ Trimmed bandgap design $\pm 0.5\%$
- ◆ Alternate for TL1431, TL431, LM431 & AS431
- ◆ Industrial temperature range
- ◆ Available in SOT-23-3, SO-8 and TO-92 packages

Applications

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

Notes:

- 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 (130 μA) 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:

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

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

POWER MANAGEMENT

Absolute Maximum Ratings

Exceeding the specifications below may result in permanent damage to the device, or device malfunction. Operation outside of the parameters specified in the Electrical Characteristics section is not implied.

Parameter	Symbol	Maximum	Units
Cathode Voltage	V_Z	31	V
Continuous Cathode Current	I_Z	150	mA
Reference Input Current	I_{REF}	10	mA
Power Dissipation at $T_A = 25^\circ\text{C}$ SOT-23-3 SO-8 TO-92	P_D	0.37 0.78 0.95	W
Thermal Resistance SOT-23-3 SO-8 TO-92	θ_{JA}	336 163 132	$^\circ\text{C/W}$
Operating Ambient Temperature Range SC431Cx-5, SC431Cx-1, SC431Cx-2 SC431CxQ	T_A	-40 to +85 -40 to +125	$^\circ\text{C}$
Operating Junction Temperature Range	T_J	-40 to +150	$^\circ\text{C}$
Storage Temperature Range	T_{STG}	-65 to +150	$^\circ\text{C}$
Lead Temperature (Soldering) 10 seconds	T_{LEAD}	300	$^\circ\text{C}$
ESD Rating (Human Body Model)	V_{ESD}	2	kV

Electrical Characteristics

Unless specified: $T_A = 25^\circ\text{C}$. Values in **bold** apply over full operating ambient temperature range.

			SC431Cx-5, SC431CxQ			SC431Cx-1			Units
Parameter	Symbol	Condition	Min	Typ	Max	Min	Typ	Max	
Reference Voltage	V_{REF}	$V_Z = V_{REF}, I_Z = 10\text{mA}^{(1)}$	2.482	2.495	2.507	2.470	2.495	2.520	V
V_{REF} Temp Deviation	V_{DEV}	$V_Z = V_{REF}, I_Z = 10\text{mA}^{(1)}$		8	17		8	25	mV
Ratio of Change in V_{REF} to Change in V_Z	$\frac{\Delta V_{REF}}{\Delta V_Z}$	$I_Z = 10\text{mA}, \Delta V_Z = 10\text{V to } V_{REF}$		-0.5	-2.7		-0.5	-2.7	mV/V
		$I_Z = 10\text{mA}, \Delta V_Z = 30\text{V to } 10\text{V}$		-1.0	-2.0		-1.0	-2.0	
Reference Input Current	I_{REF}	$R1 = 10\text{k}\Omega, R2 = \infty,$ $I_Z = 10\text{mA}^{(2)}$		0.5	4		0.5	4	μA
I_{REF} Temperature Deviation	$I_{REF(DEV)}$	$R1 = 10\text{k}\Omega, R2 = \infty,$ $I_Z = 10\text{mA}^{(2)}$		0.4	1.2		0.4	1.2	μA
Off-State Cathode Current	$I_{Z(OFF)}$	$V_{REF} = 0\text{V}, V_Z = 30\text{V}^{(3)}$		0.04	0.50		0.04	0.50	μA
Dynamic Output Impedance	r_Z	$f < 1\text{kHz}, V_Z = V_{REF}$ $I_Z = 130\mu\text{A to } 100\text{mA}^{(1)}$		0.25	0.50		0.25	0.50	Ω
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$			130			130	μA

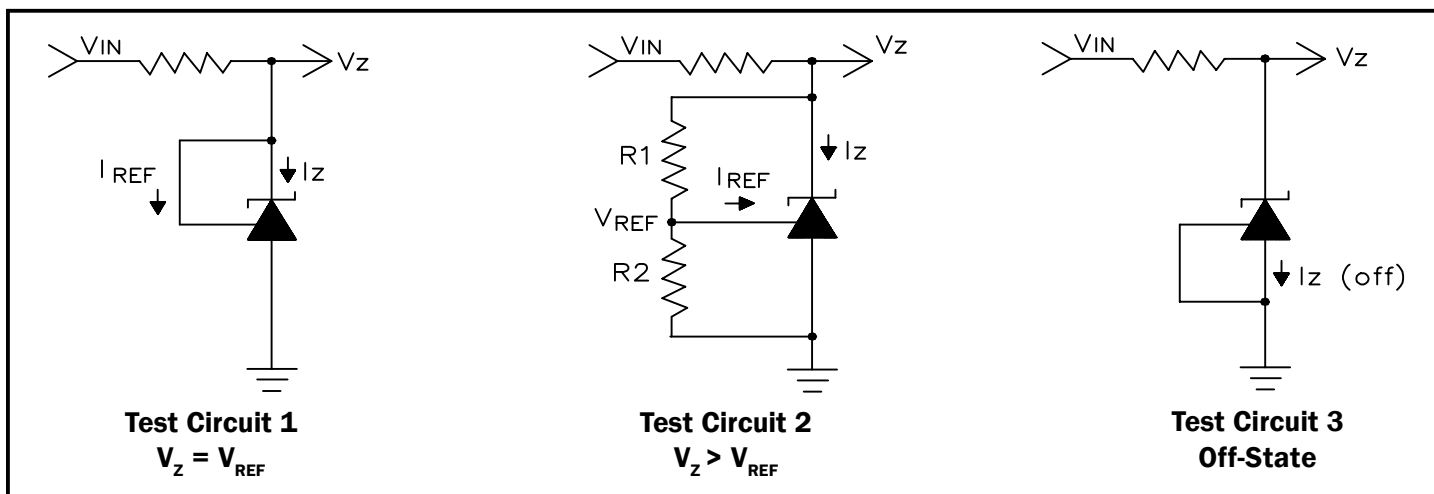
POWER MANAGEMENT
Electrical Characteristics (Cont.)

Unless specified: $T_A = 25^\circ\text{C}$. Values in **bold** apply over full operating ambient temperature range.

			SC431Cx-2			
Parameter	Symbol	Condition	Min	Typ	Max	Units
Reference Voltage	V_{REF}	$V_Z = V_{REF}, I_Z = 10\text{mA}^{(1)}$	2.445	2.495	2.545	V
V_{REF} Temp Deviation	V_{DEV}	$V_Z = V_{REF}, I_Z = 10\text{mA}^{(1)}$		15	30	mV
Ratio of Change in V_{REF} to Change in V_Z	$\frac{\Delta V_{REF}}{\Delta V_Z}$	$I_Z = 10\text{mA}, \Delta V_Z = 10\text{V to } V_{REF}$		-0.5	-2.7	mV/V
		$I_Z = 10\text{mA}, \Delta V_Z = 30\text{V to } 10\text{V}$		-1.0	-2.0	
Reference Input Current	I_{REF}	$R1 = 10\text{k}\Omega, R2 = \infty, I_Z = 10\text{mA}^{(2)}$		0.5	4	μA
I_{REF} Temperature Deviation	$I_{REF(DEV)}$	$R1 = 10\text{k}\Omega, R2 = \infty, I_Z = 10\text{mA}^{(2)}$		0.4	1.2	μA
Off-State Cathode Current	$I_{Z(OFF)}$	$V_{REF} = 0\text{V}, V_Z = 30\text{V}^{(3)}$		0.04	0.50	μA
Dynamic Output Impedance	r_z	$f < 1\text{kHz}, V_Z = V_{REF}, I_Z = 130\mu\text{A to } 100\text{mA}^{(1)}$		0.25	0.50	Ω
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$			130	μA

Notes:

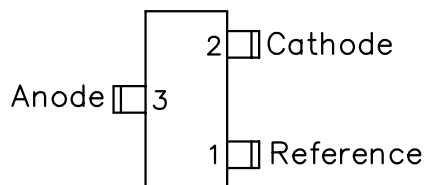
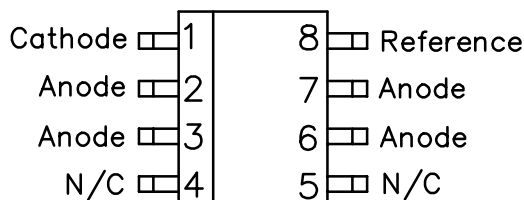
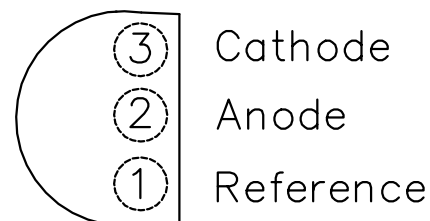
- (1) See Test Circuit 1 below.
- (2) See Test Circuit 2 below.
- (3) See Test Circuit 3 below.

Test Circuits

Recommended Operating Conditions

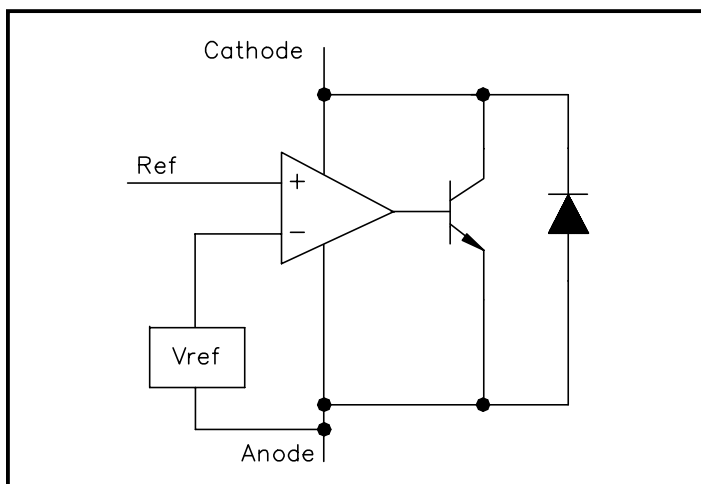
	Min	Max	Symbol
Cathode Voltage, V_Z	V_{REF}	30	V
Cathode Current, I_Z	0.1	150	mA

POWER MANAGEMENT

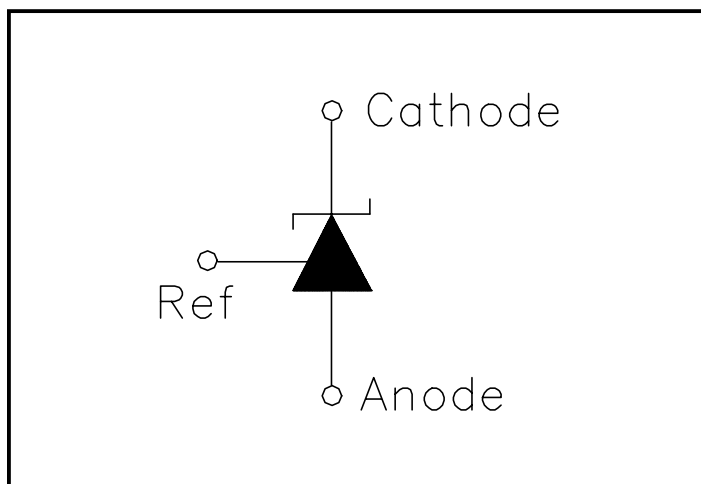
Pin Configurations

SOT-23-3 (Top View)

SO-8 (Top View)

TO-92 (Top View)


Block Diagram



Symbol

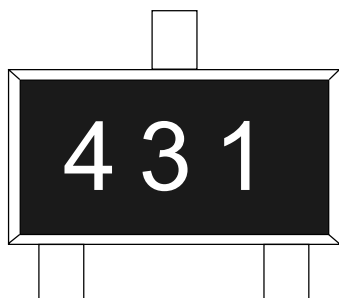
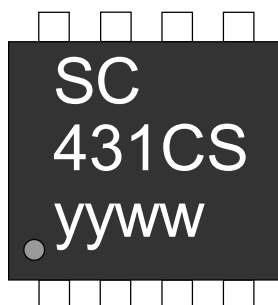
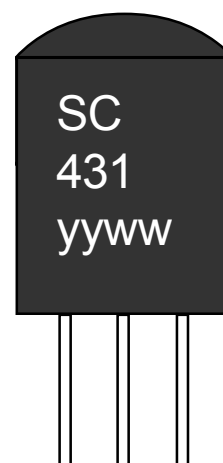
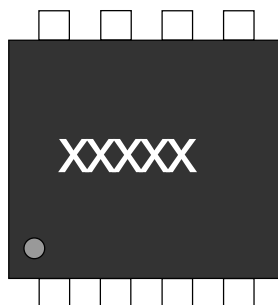


Ordering Information

Tolerance	0.5%	0.5%	1.0%	2.0%
Ambient Temperature Range	-40°C to +85°C	-40°C to +125°C	-40°C to +85°C	-40°C to +85°C
SOT-23-3 ⁽¹⁾	SC431CSK-.5 TR	SC431CSKQTR	SC431CSK-1.TR	SC431CSK-2.TR
SOT-23-3 ^{(1), (4)}	SC431CSK-.5 TRT	SC431CSKQTRT	SC431CSK-1.TRT	SC431CSK-2.TRT
SO-8 ⁽²⁾	SC431CS-.5 TR	SC431CSQTR	SC431CS-1.TR	SC431CS-2.TR
TO-92 ⁽³⁾	SC431CZ-.5 TA	SC431CZQTA	SC431CZ-1.TA	SC431CZ-2.TA

Notes:

- (1) Only available in tape and reel packaging. A reel contains 3000 devices.
- (2) Only available in tape and reel packaging. A reel contains 2500 devices.
- (3) Only available in an ammo pack. An ammo pack contains 2000 devices.
- (4) "T" at end of part number indicates "lead free".

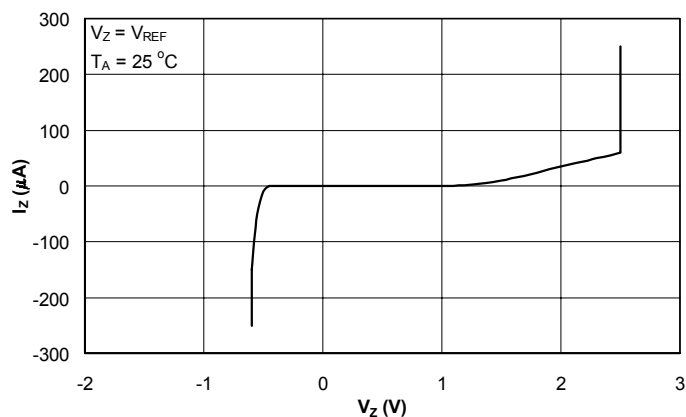
POWER MANAGEMENT
Marking Information
SOT-23-3 (Top View)

S0-8 (Top View)

TO-92 (Top View)

S0-8 (Bottom View)


yyww = Datecode
(Example: 9815)

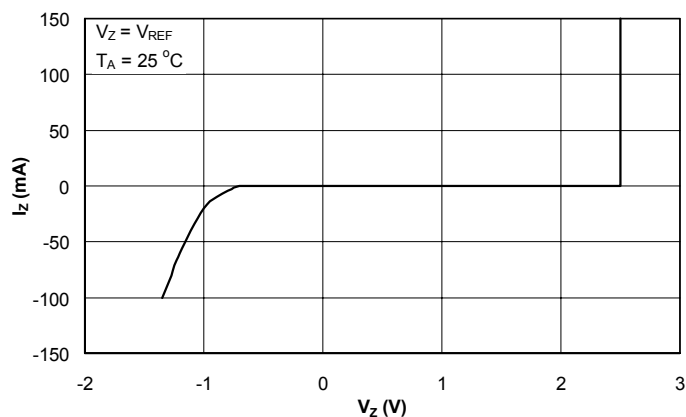
yyww = Datecode (Example: 0008)
xxxxx = Semtech Lot # (Example: 00101)

POWER MANAGEMENT
Typical Characteristics

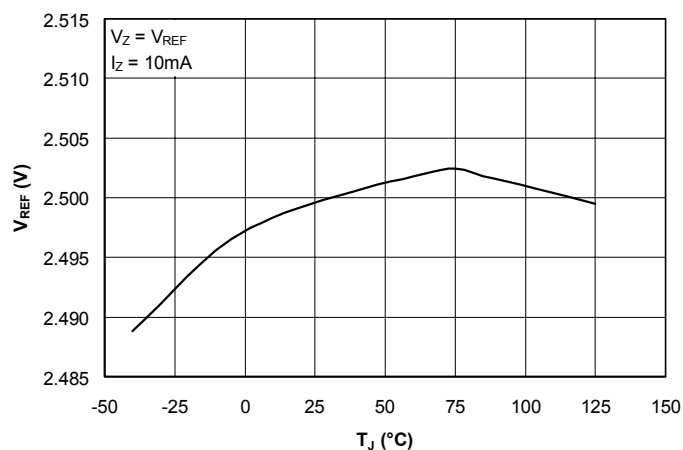
**Cathode Current vs.
Cathode Voltage**



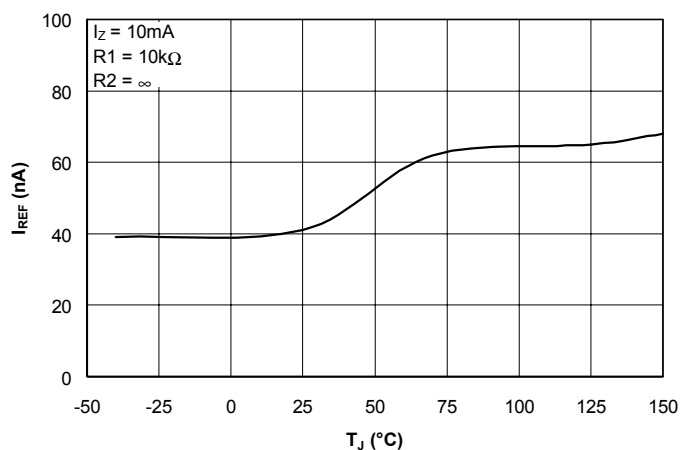
**Cathode Current vs.
Cathode Voltage**



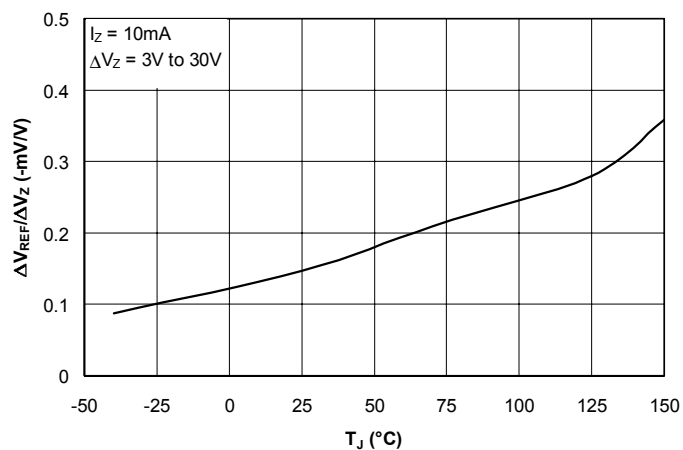
**Reference Voltage vs.
Junction Temperature**



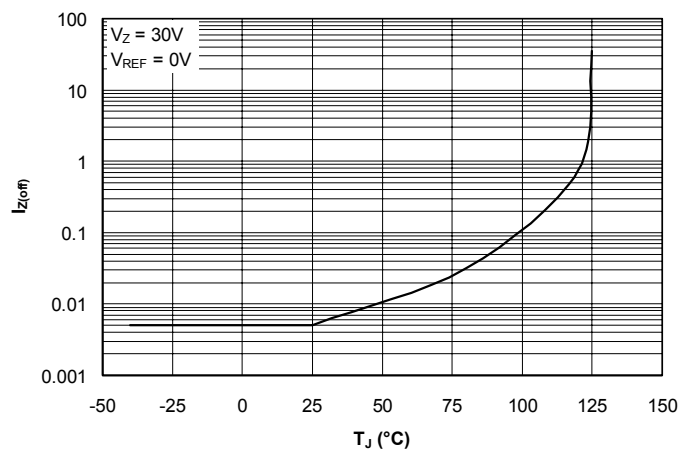
**Reference Input Current vs.
Junction Temperature**

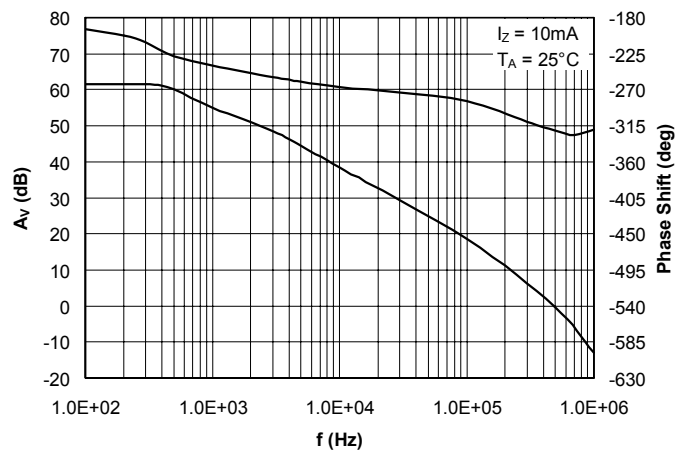
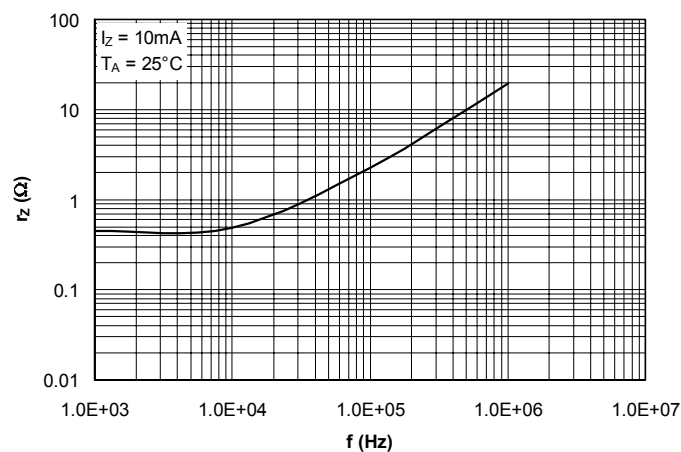
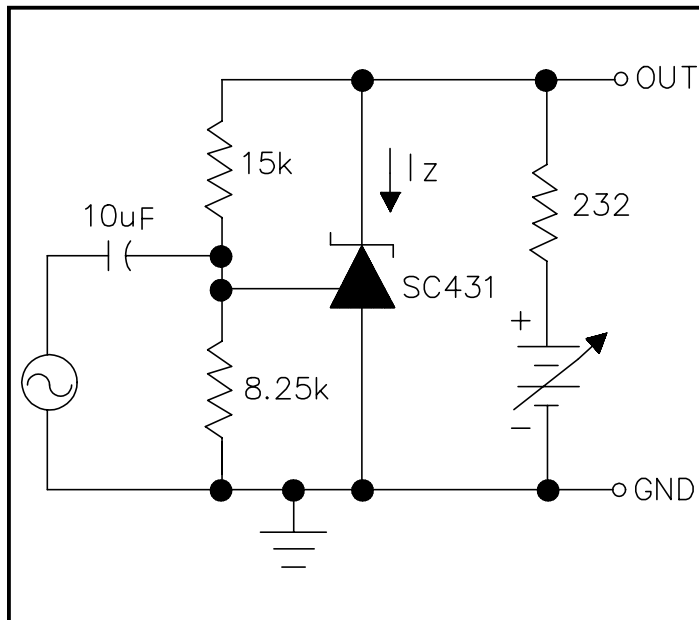


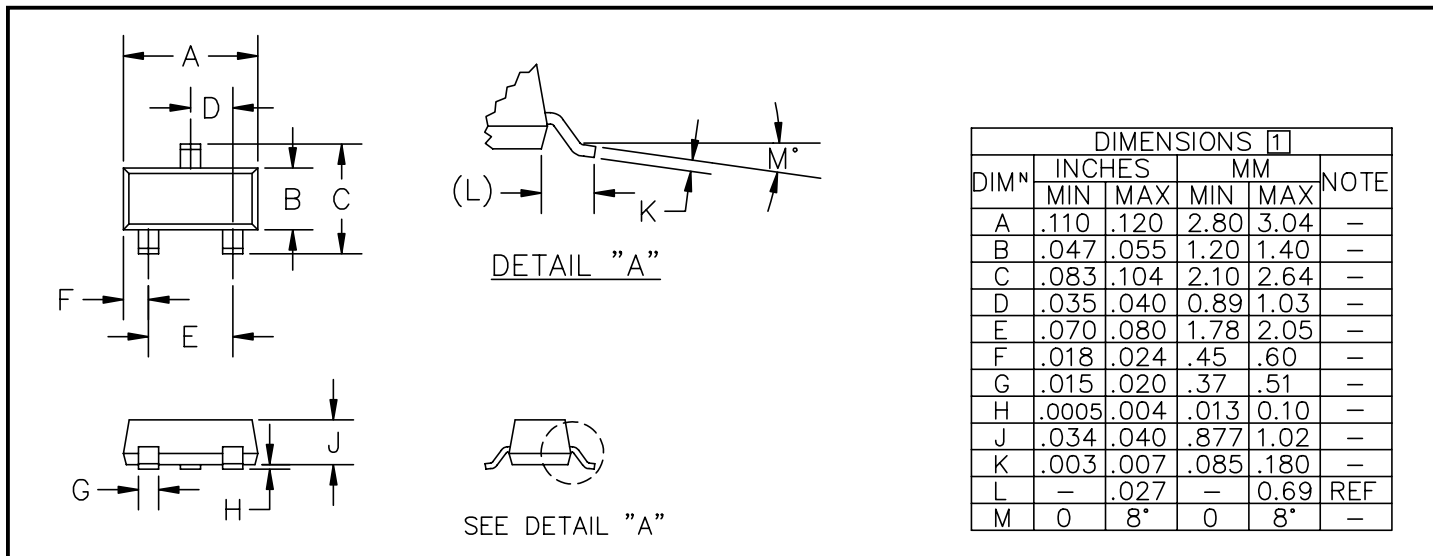
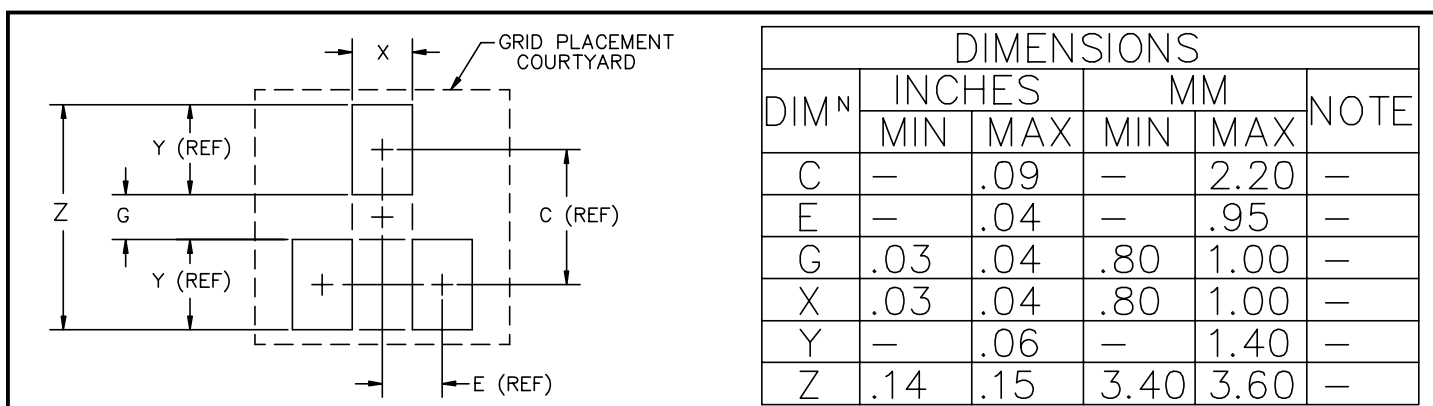
**Ratio of Delta Reference Voltage to Delta Cathode
Voltage vs. Junction Temperature**



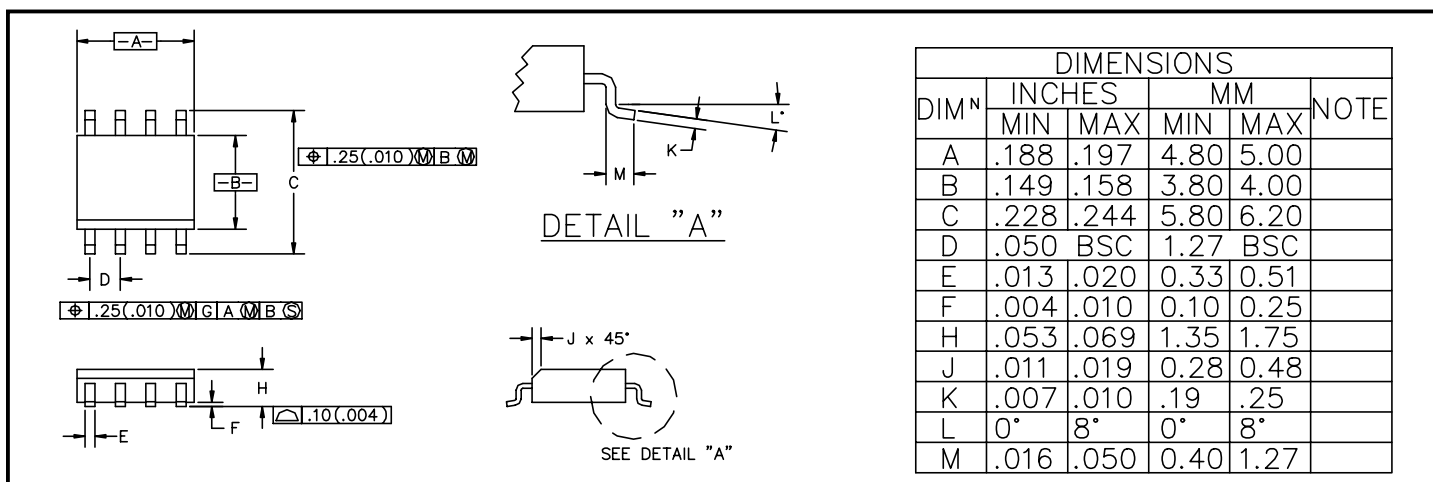
**Off-State Cathode Current
vs. Junction Temperature**

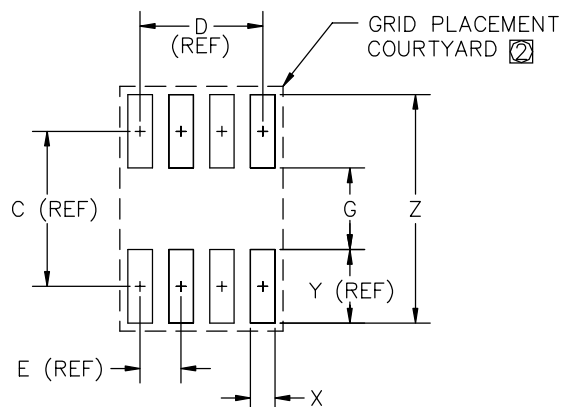


POWER MANAGEMENT
Typical Characteristics (Cont.)
Small-Signal Gain and Phase Shift
vs. Frequency

Reference Impedance
vs. Frequency

Test Circuit - Small-Signal Gain and Phase


POWER MANAGEMENT
Outline Drawing - SOT-23-3

Land Pattern - SOT-23-3

Note:

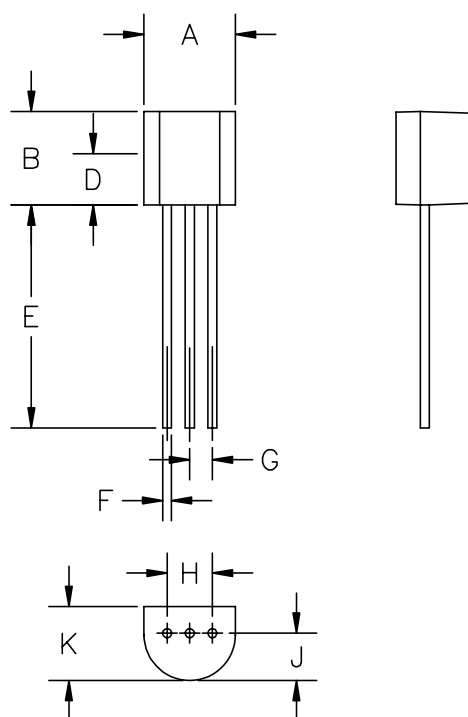
(1) Grid placement courtyard is 8 x 8 elements (4mm x 4mm) in accordance with the international grid detailed in IEC Publication 97.

Outline Drawing - SO-8


POWER MANAGEMENT
Land Pattern - SO-8


DIM ^N	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
C	—	.19	—	5.00	—
D	—	.15	—	3.81	—
E	—	.05	—	1.27	—
G	.10	.11	2.60	2.80	—
X	.02	.03	.60	.80	—
Y	—	.09	—	2.40	—
Z	—	.29	7.20	7.40	—

Ⓜ GRID PLACEMENT COURTYARD IS 12x16 ELEMENTS
(6 mm X 8mm) IN ACCORDANCE WITH THE
INTERNATIONAL GRID DETAILED IN IEC PUBLICATION 97.

Outline Drawing - TO-92


DIM ^N	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.175	.205	4.445	5.207	—
B	.170	.210	4.318	5.334	—
E	.500	.610	12.7	15.5	—
F	.016	.021	.407	.533	—
G	.045	.055	1.143	1.397	—
H	.095	.105	2.413	2.667	—
J	.080	.105	2.032	2.667	—
K	.125	.165	3.175	4.191	—

Contact Information

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