

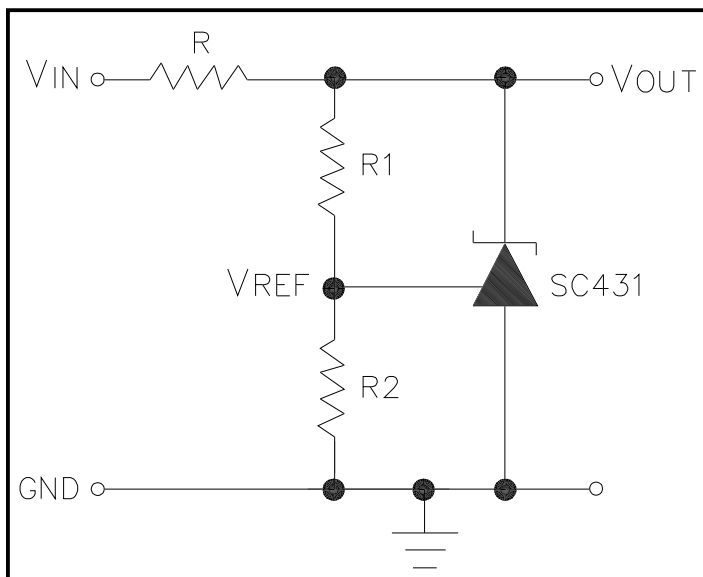
POWER MANAGEMENT

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 36V 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 100 μ A 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 (100 μ 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:

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

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

POWER MANAGEMENT
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
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			
Parameter	Symbol	Condition	Min	Typ	Max	Min	Typ	Max	Units
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
		$I_Z = 10\text{mA}, \Delta V_Z = 36\text{V to } 10\text{V}$		-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	$I_{Z(OFF)}$	$V_{REF} = 0\text{V}, V_Z = 36\text{V}^{(3)}$		0.04	0.50		0.04	0.50	μA
Dynamic Output Impedance	r_z	$f < 1\text{kHz}, V_Z = V_{REF}$ $I_Z = 100\mu\text{A to } 100\text{mA}^{(1)}$		0.25	0.50		0.25	0.50	Ω
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$			100			100	μA

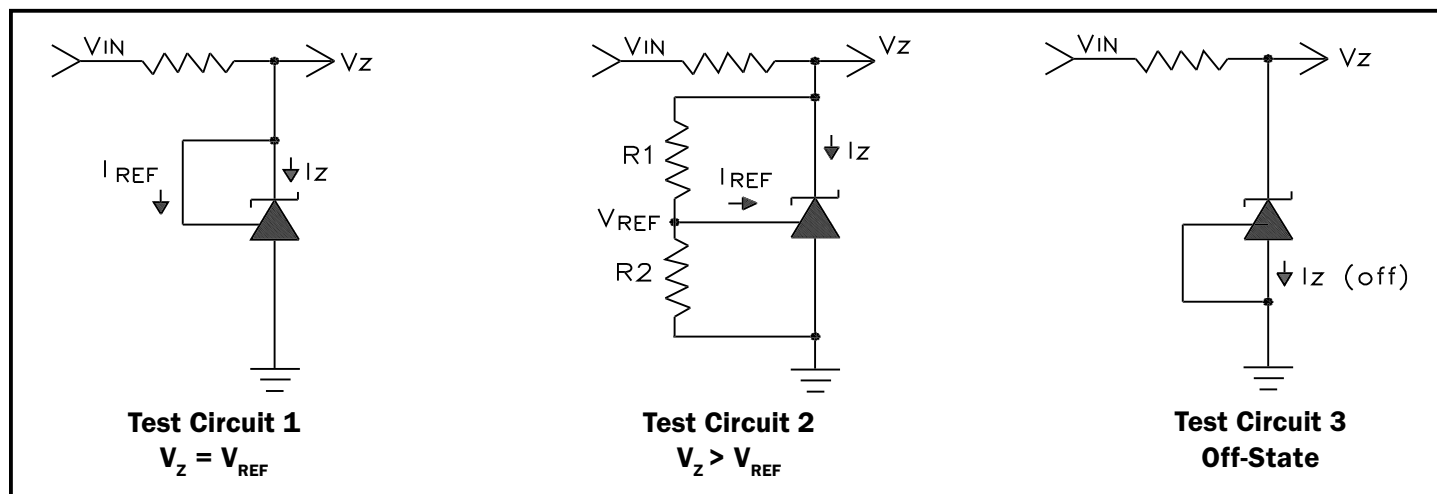
POWER MANAGEMENT
Electrical Characteristics (Cont.)

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
		$I_Z = 10\text{mA}, \Delta V_Z = 36\text{V to } 10\text{V}$		-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	$I_{Z(OFF)}$	$V_{REF} = 0\text{V}, V_Z = 36\text{V}^{(3)}$		0.04	0.50	μA
Dynamic Output Impedance	r_z	$f < 1\text{kHz}, V_Z = V_{REF}, I_Z = 100\mu\text{A to } 100\text{mA}^{(1)}$		0.25	0.50	Ω
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$			100	μA

Notes:

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

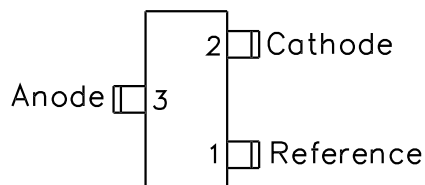
Test Circuits

Recommended Operating Conditions

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

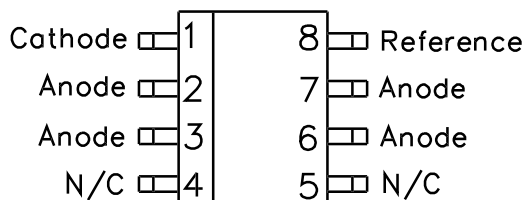
POWER MANAGEMENT

Pin Configurations

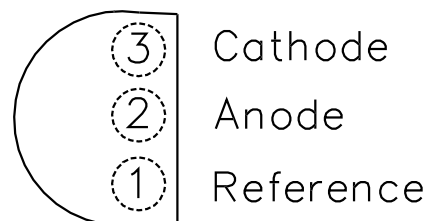
SOT-23-3 (Top View)



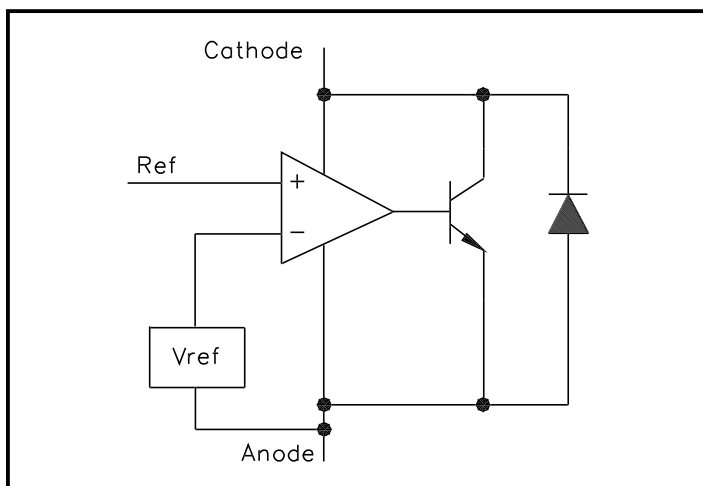
SO-8 (Top View)



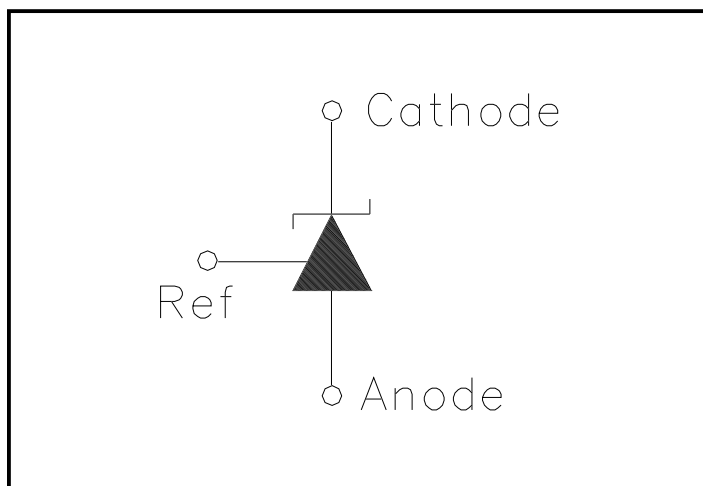
TO-92 (Top View)



Block Diagram



Symbol

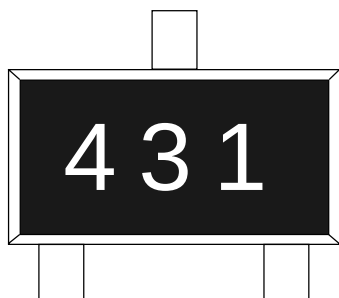
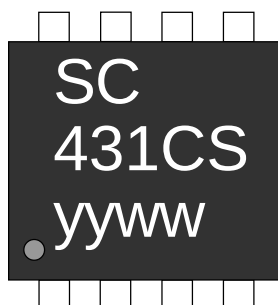
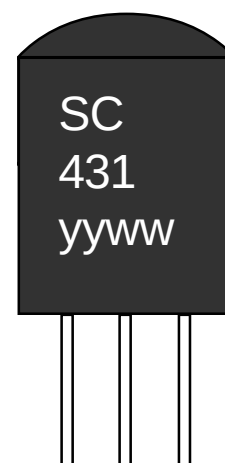
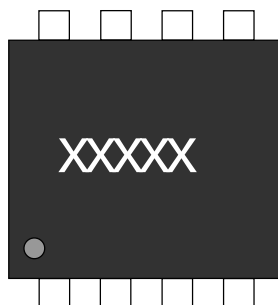


Ordering Information

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
SO-8 ⁽²⁾	SC431CS-.5 TR	SC431CSQTR	SC431CS-1.TR	SC431CSK-2.TR
TO-92 ⁽³⁾	SC431CZ-.5 TA	SC431CZQTA	SC431CZ-1.TA	SC431CZ-2.TA

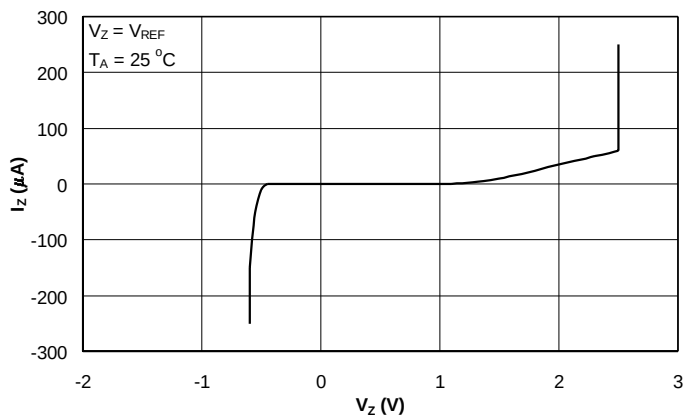
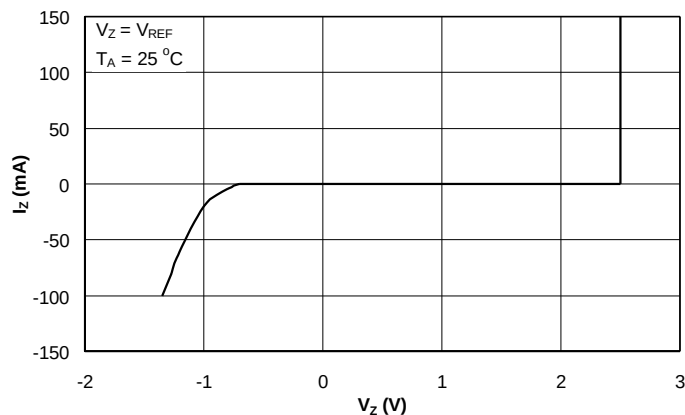
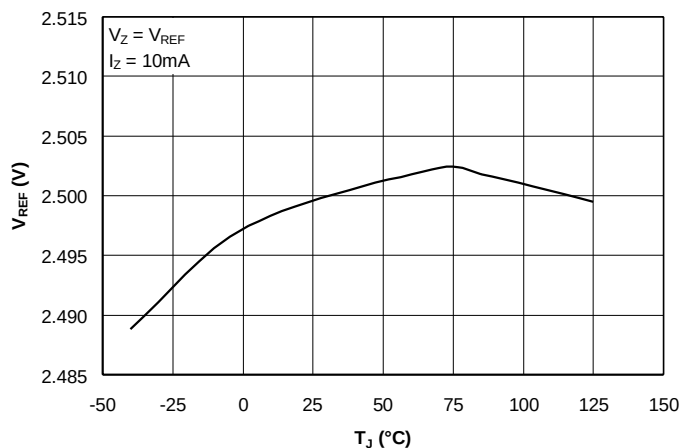
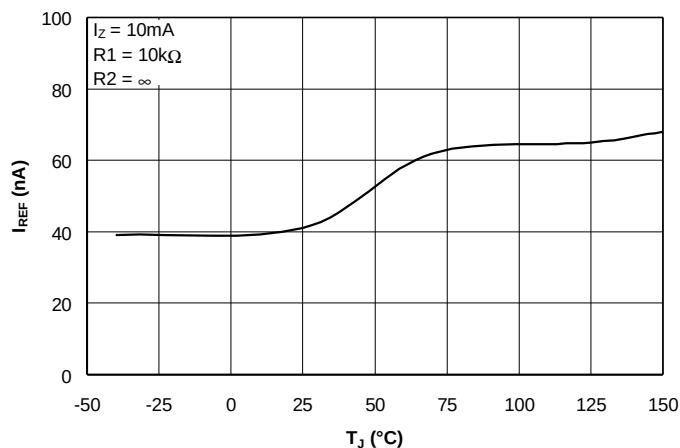
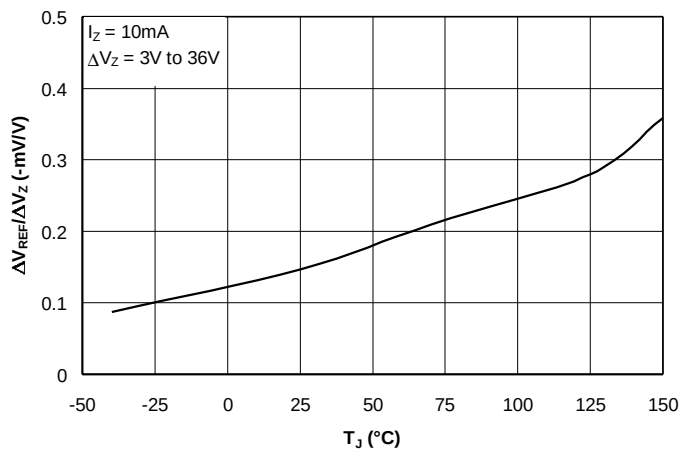
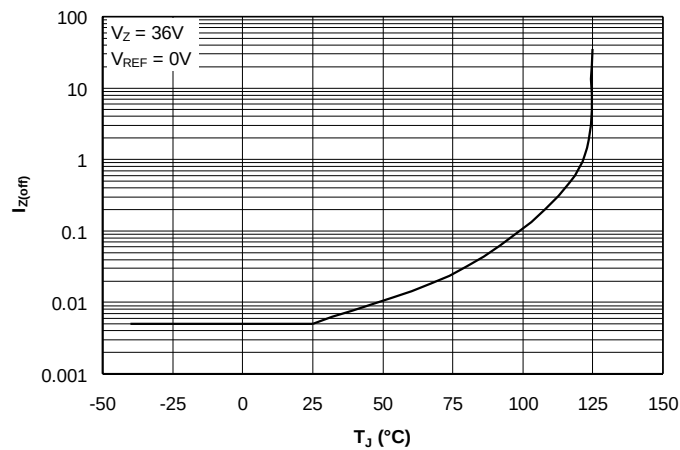
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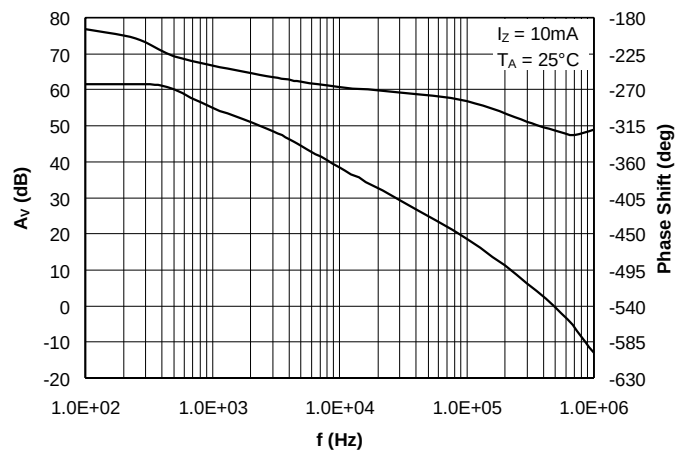
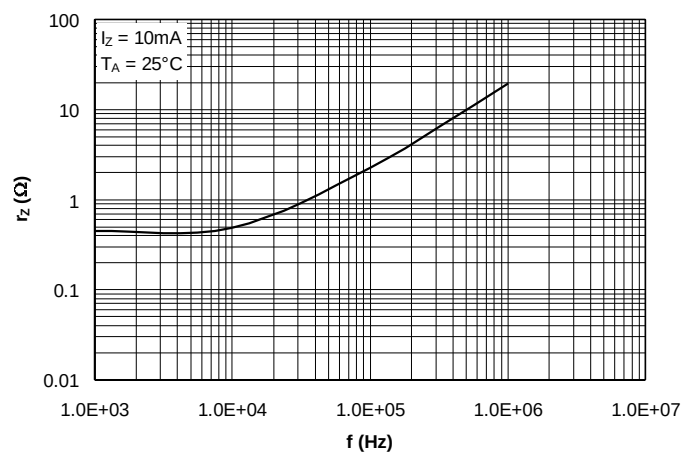
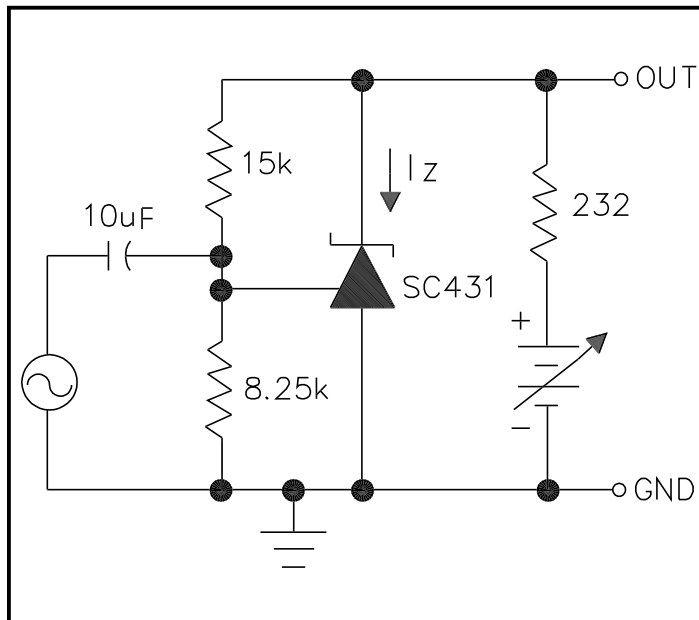
- (1) Only available in tape and reel packaging. A reel contains 3000 devices.
- (2) Only available in tape and reel packaging. A reel contains 2500 devices.
- (3) Only available in an ammo pack. An ammo pack contains 2500 devices.

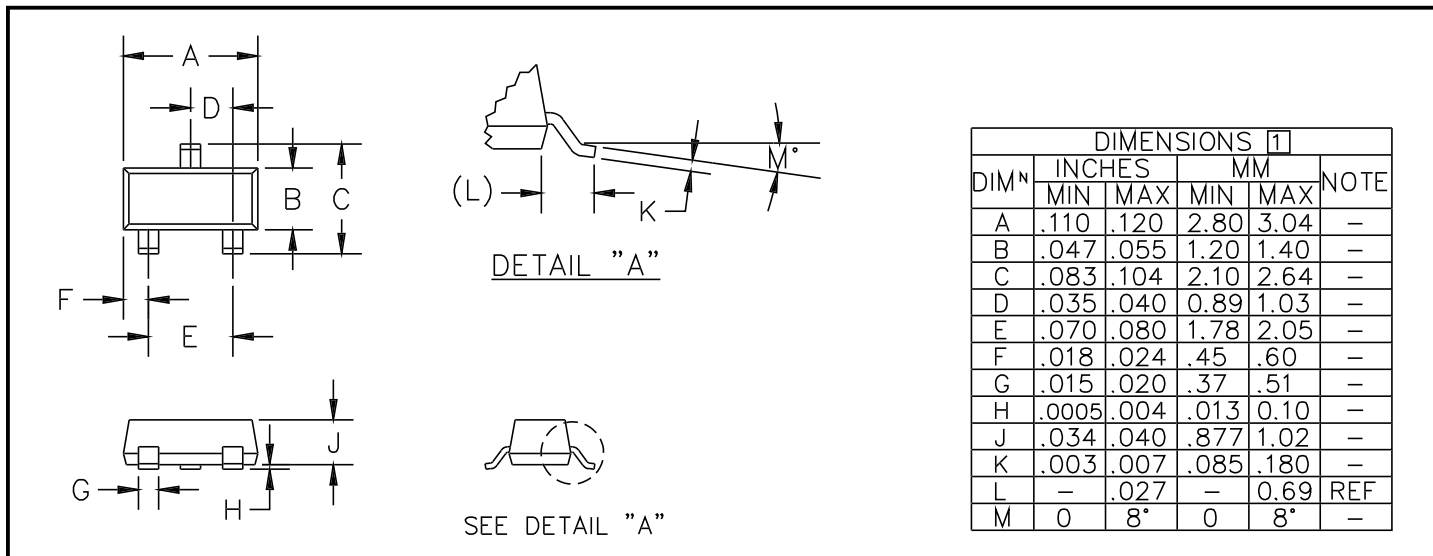
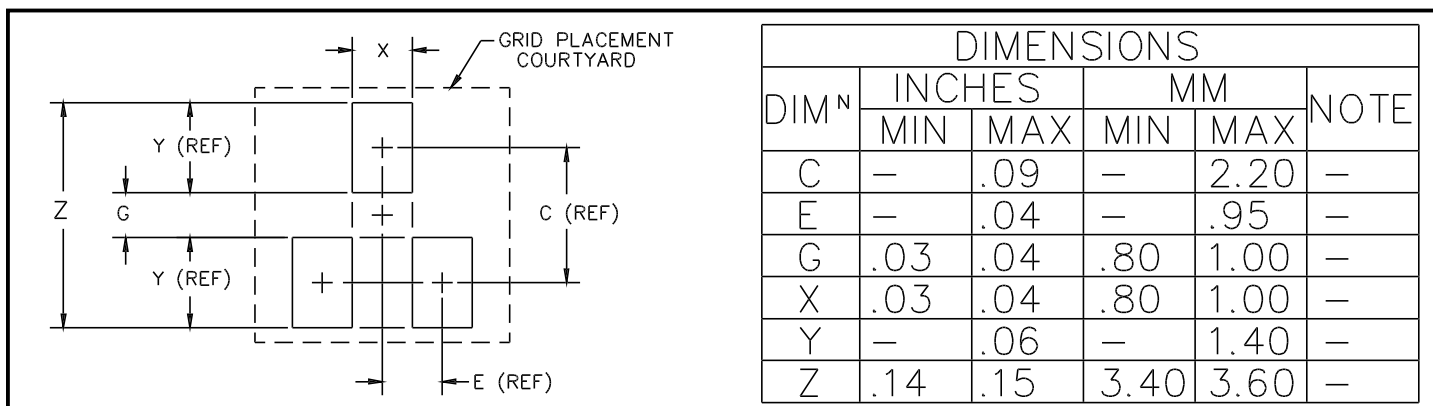
POWER MANAGEMENT
Marking Information
SOT-23-3 (Top View)

S0-8 (Top View)

TO-92 (Top View)

S0-8 (Bottom View)


yyww = Datecode
(Example: 9815)

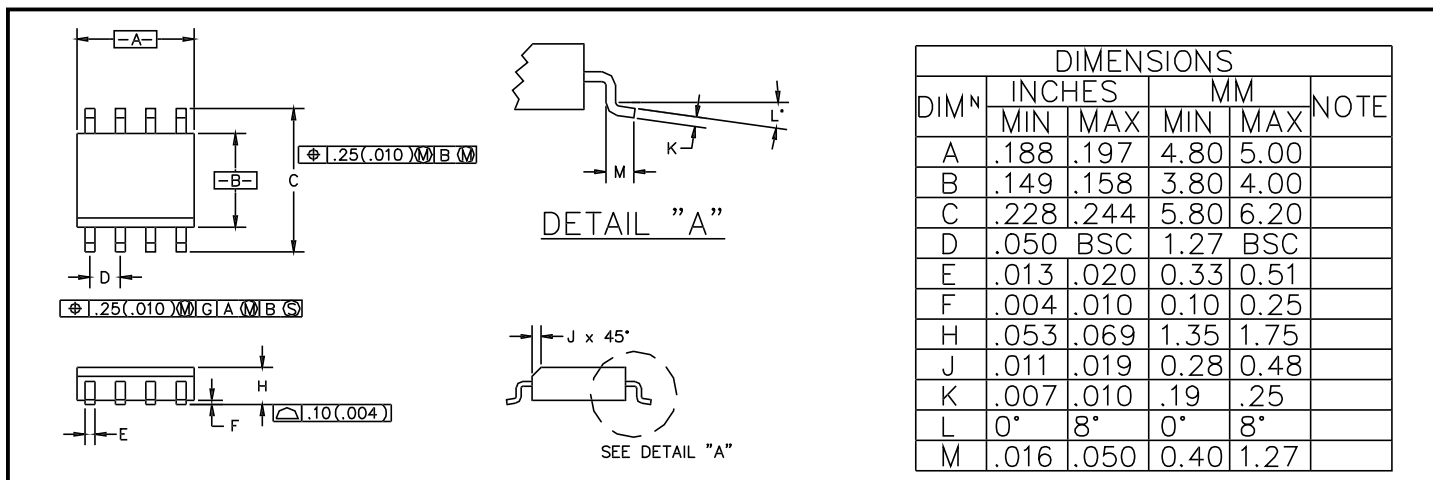
yyww = Datecode (Example: 0008)
xxxxx = Semtech Lot # (Example: 00101)

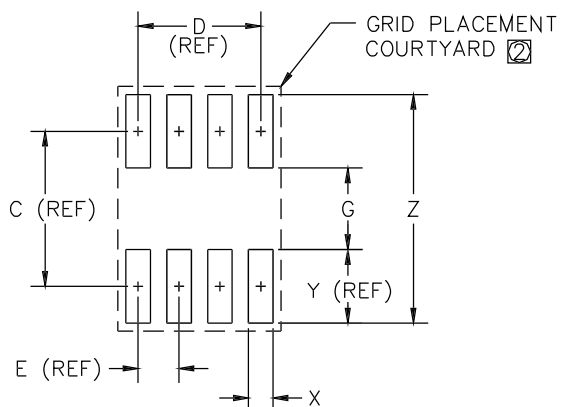
POWER MANAGEMENT
Typical Characteristics
**Cathode Current vs.
Cathode Voltage**

**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:

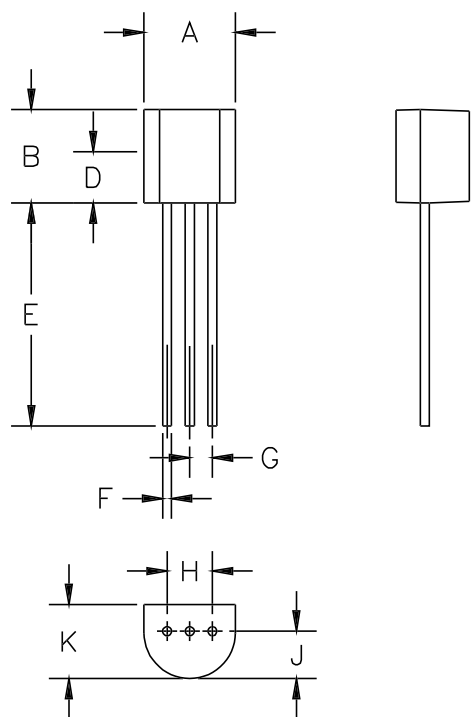
(1) Grid placement courtyard is 8 x 8 elements (4mm x 4mm) in accordance with the international grid detailed in IEC Publication 97.

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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