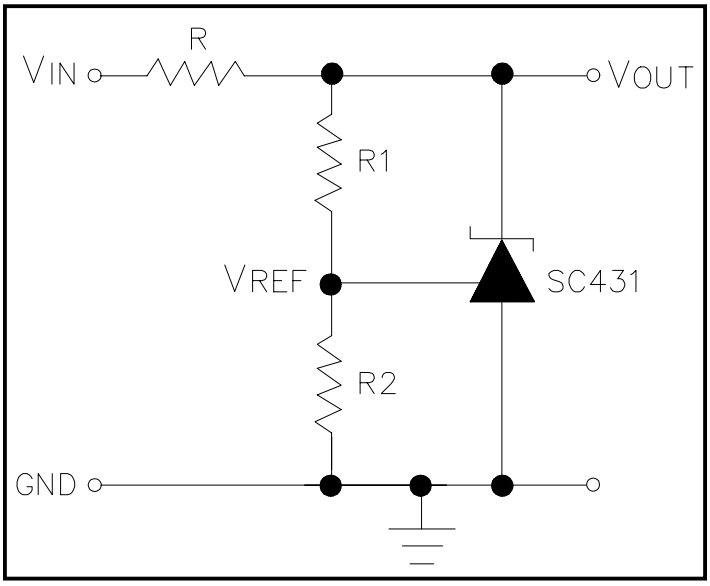
POWER MANAGEMENT

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°C to +85°C and 0.5% over T_A = -40°C to +125°C) and two package options (SOT-23-3 and SO-8). 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 130µA to 150mA
- Low dynamic output impedance 0.25 Ω typ.
- Trimmed bandgap design ± 0.5%
- Alternate for TL1431, TL431, LM431 & AS431
- Industrial temperature range
- Available in SOT-23-3 and SO-8 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 (130µA) 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:

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

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

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
Continous Cathode Current	I_Z	150	mA
Reference Input Current	I_{REF}	10	mA
Power Dissipation at T_A = 25°C SOT-23-3 SO-8	P_D	 0.37 0.78	W
Thermal Resistance SOT-23-3 SO-8	θ_{JA}	 336 163	°C/W
Operating Ambient Temperature Range SC431Cx-.5, SC431Cx-1, SC431Cx-2 SC431CxQ	T_A	 -40 to +85 -40 to +125	°C
Operating Junction Temperature Range	T_J	-40 to +150	°C
Storage Temperature Range	T_{STG}	-65 to +150	°C
Lead Temperature (Soldering) 10 seconds	T_{LEAD}	300	°C
ESD Rating (Human Body Model)	V_{ESD}	2	kV

Electrical Characteristics

Unless specified:T_A = 25°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 = 10mA(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 = 10mA(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 = 10mA, ΔV_Z = 10V to V_{REF}		-0.5	-2.7		-0.5	-2.7	mV/V
		I_Z = 10mA, ΔV_Z =30V to 10V		-1.0	-2.0		-1.0	-2.0	
Reference Input Current	I_{REF}	R1 = 10kΩ, R2 = ∞, I_Z = 10mA(2)		0.5	4		0.5	4	µA
I_{REF} Temperature Deviation	$I_{REF(DEV)}$	R1 = 10kΩ, R2 = ∞, I_Z =10mA(2)		**0.4**	**1.2**		**0.4**	**1.2**	µA
Off-State Cathode Current	$I_{Z(OFF)}$	V_{REF} = 0V, V_Z =30V(3)		0.04	0.50		0.04	0.50	µA
Dynamic Output Impedance	r_Z	f < 1kHz, $V_Z = V_{REF}$ I_Z = 130µA to 100mA(1)		0.25	0.50		0.25	0.50	Ω
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}$(1)			130			130	µA

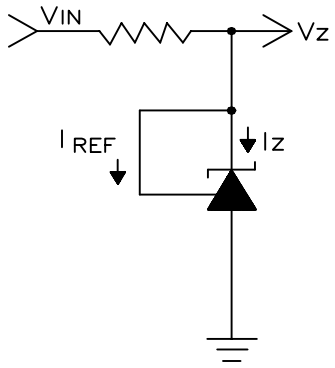
Electrical Characteristics (Cont.)

Unless specified:T_A = 25°C. Values in **bold** apply over full operating ambient temperature range.

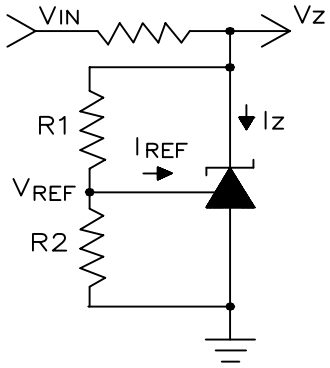
			SC431Cx-2			
Parameter	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Units**
Reference Voltage	V_{REF}	$V_Z = V_{REF}$, I_Z = 10mA(1)	2.445	2.495	2.545	V
V_{REF} Temp Deviation	V_{DEV}	$V_Z = V_{REF}$, I_Z = 10mA(1)		**15**	**30**	mV
Ratio of Change in V_{REF} to Change in V_Z	$\frac{\Delta V_{REF}}{\Delta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

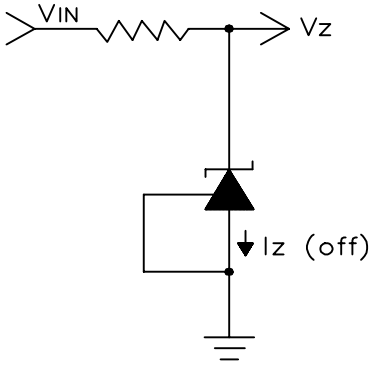
Test Circuits



Test Circuit 1
$V_Z = V_{REF}$



Test Circuit 2
$V_Z > V_{REF}$



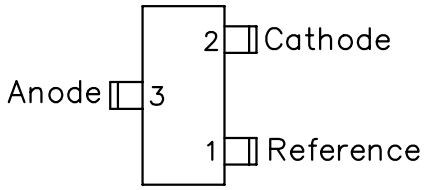
Test Circuit 3
Off-State

Recommended Operating Conditions

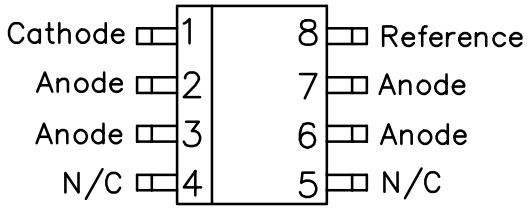
	Min	Max	Symbol
Cathode Voltage, V_Z	V_{REF}	30	V
Cathode Current, I_Z	0.130	150	mA

Pin Configurations

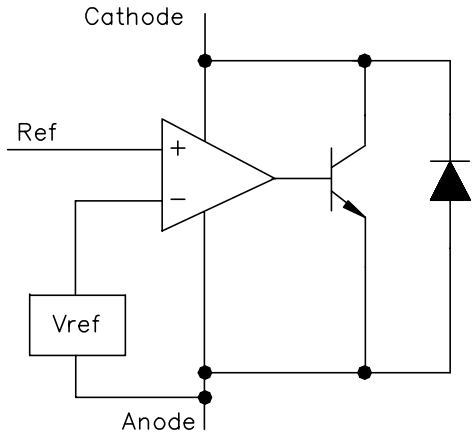
SOT-23-3 (Top View)



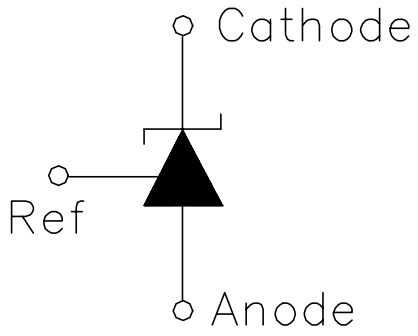
SO-8 (Top View)



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),(3)	SC431CSK-.5 TRT	SC431CSKQTRT	SC431CSK-1.TRT	SC431CSK-2.TRT
SO-8(2)	SC431CS-.5 TR	SC431CSQTR	SC431CS-1.TR	SC431CS-2.TR

Notes:

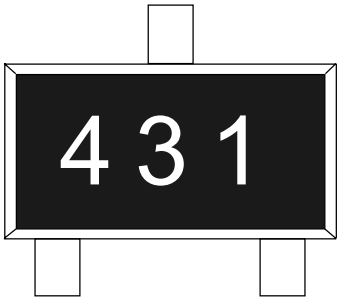
(1) Only available in tape and reel packaging. A reel contains 3000 devices.

(2) Only available in tape and reel packaging. A reel contains 2500 devices.

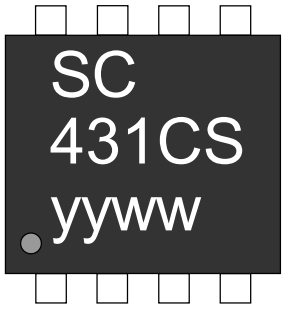
(3) "T" at end of part number indicates "lead free". This product is fully WEEE and RoHS compliant.

Marking Information

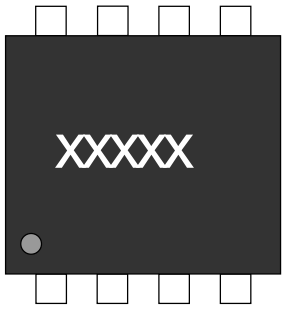
SOT-23-3 (Top View)



SO-8 (Top View)



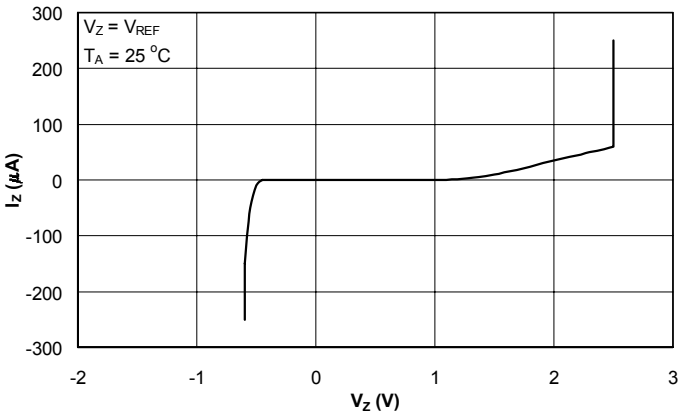
SO-8 (Bottom View)



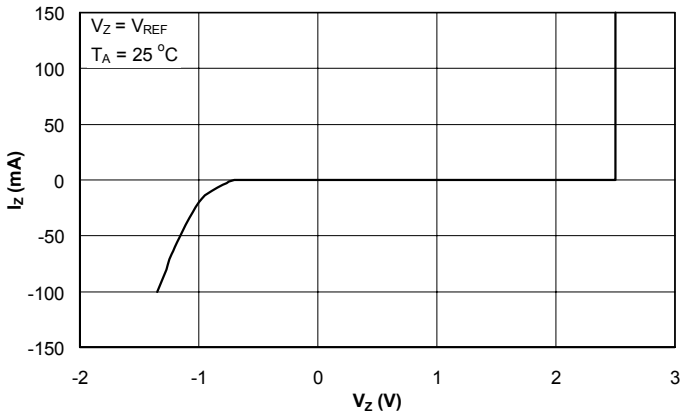
yyww = Datecode (Example: 0008)
xxxxx = Semtech Lot # (Example: 00101)

Typical Characteristics

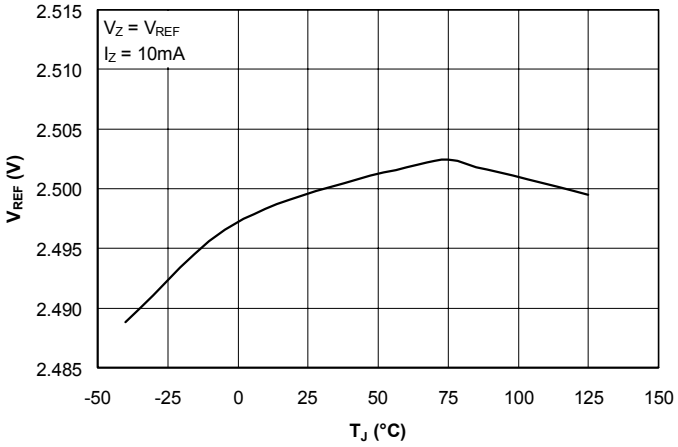
Cathode Current vs. Cathode Voltage



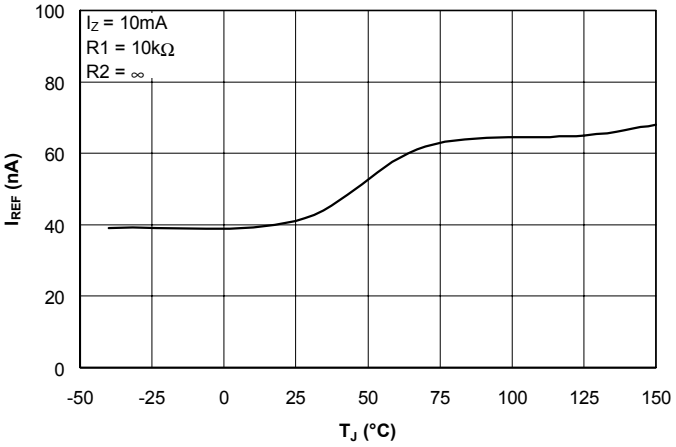
Cathode Current vs. Cathode Voltage



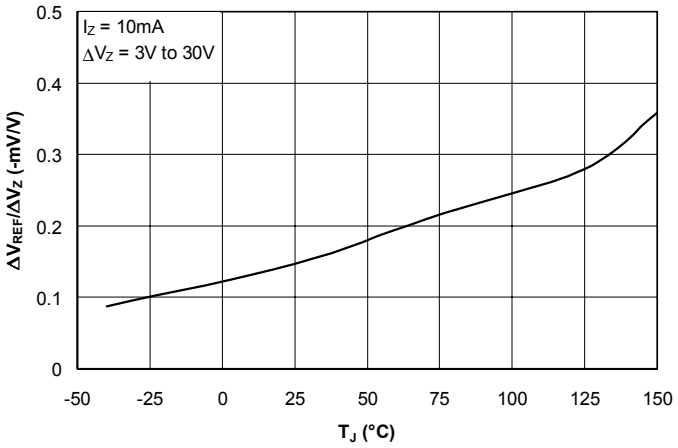
Reference Voltage vs. Junction Temperature



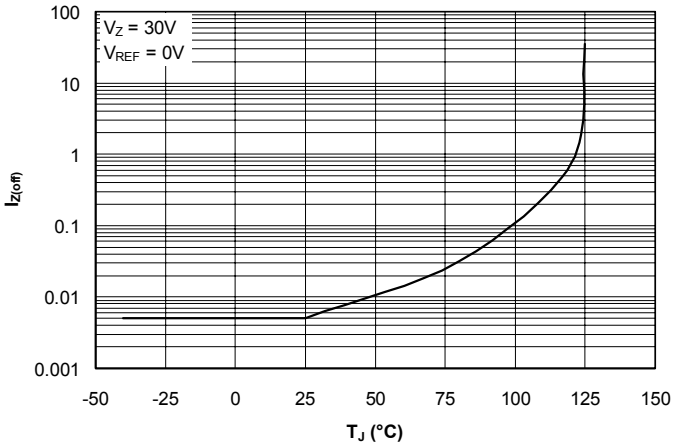
Reference Input Current vs. Junction Temperature



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

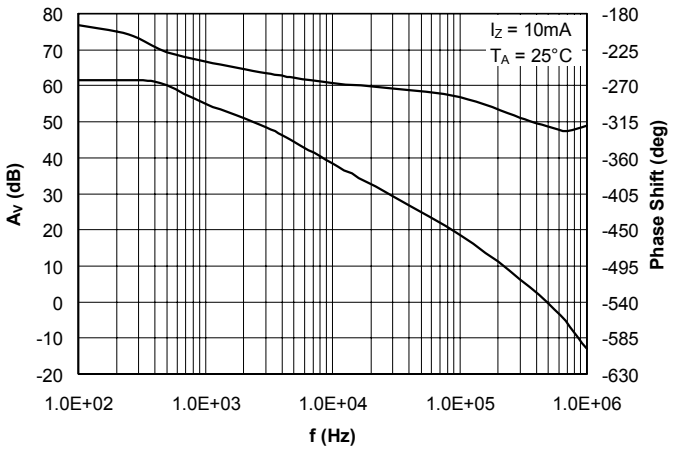


Off-State Cathode Current vs. Junction Temperature

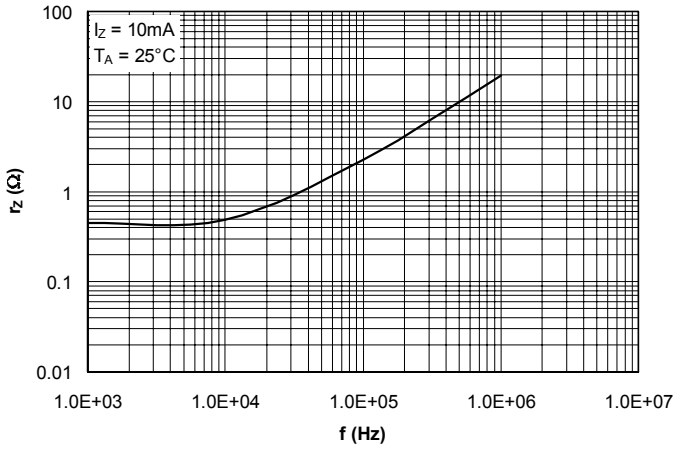


Typical Characteristics (Cont.)

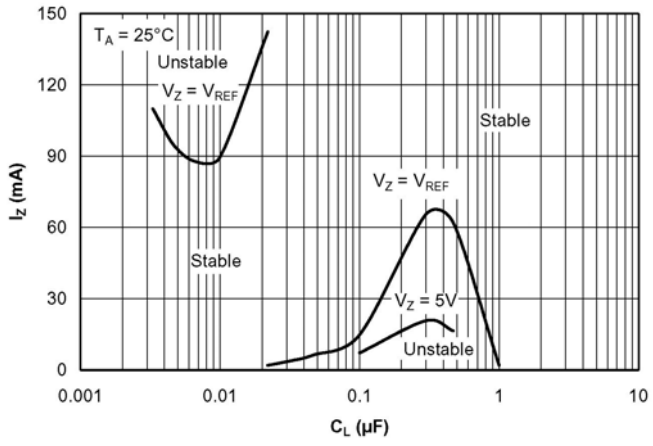
Small-Signal Gain and Phase Shift vs. Frequency



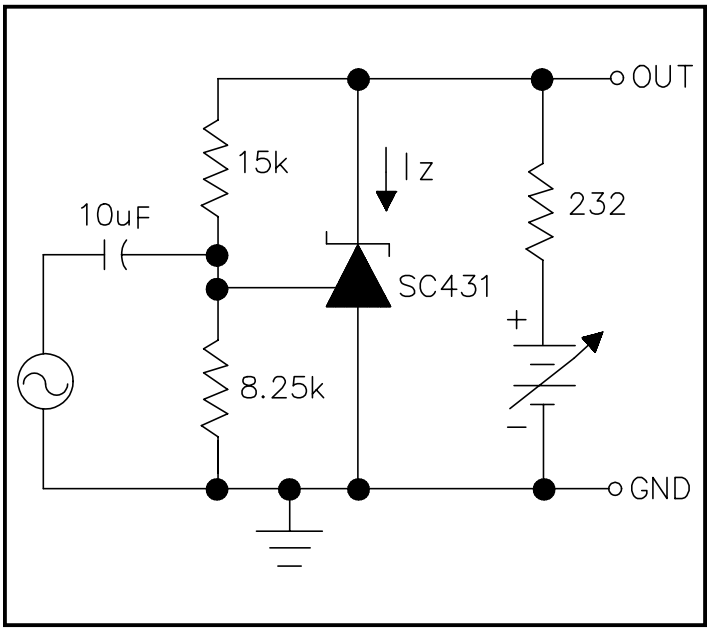
Reference Impedance vs. Frequency



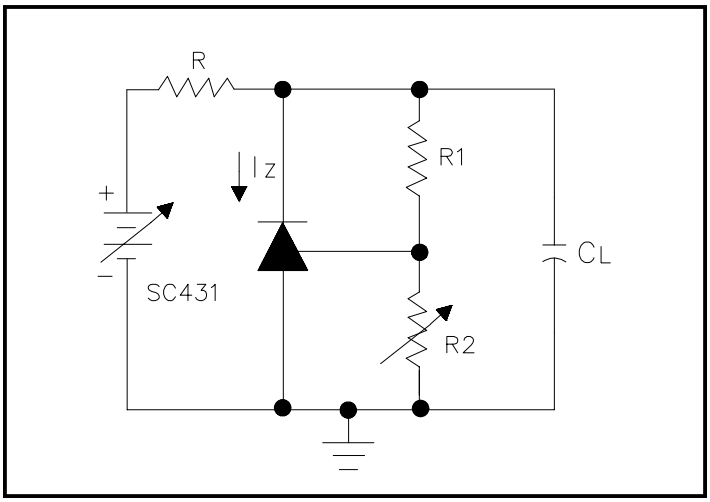
Stability Boundary Condition For Shunt Regulation vs. Cathode Current and Load Capacitance



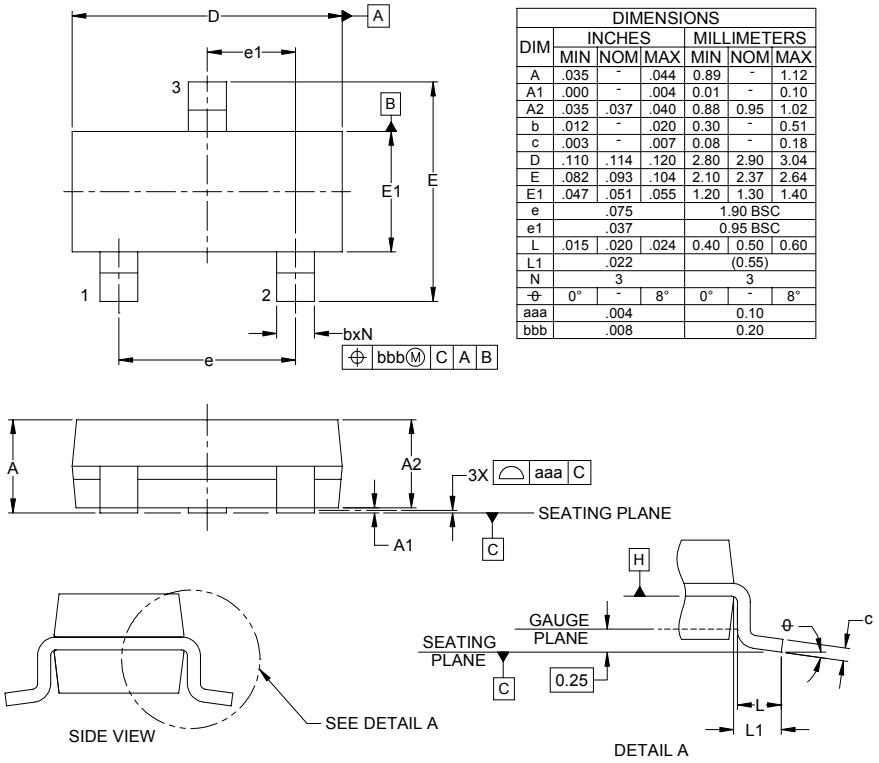
Test Circuit - Small-Signal Gain and Phase



Test Circuit - Stability



Outline Drawing - SOT-23-3

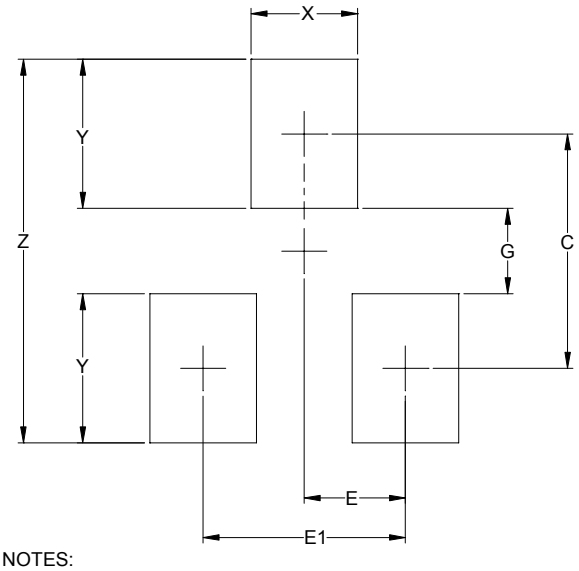


DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.035	-	.044	0.89	-	1.12
A1	.000	-	.004	0.01	-	0.10
A2	.035	.037	.040	0.88	0.95	1.02
b	.012	-	.020	0.30	-	0.51
c	.003	-	.007	0.08	-	0.18
D	.110	.114	.120	2.80	2.90	3.04
E	.082	.093	.104	2.10	2.37	2.64
E1	.047	.051	.055	1.20	1.30	1.40
e	.075			1.90 BSC		
e1	.037			0.95 BSC		
L	.015	.020	.024	0.40	0.50	0.60
L1	.022			(0.55)		
N	3			3		
θ	0°	-	8°	0°	-	8°
aaa	.004			0.10		
bbb	.008			0.20		

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

Land Pattern - SOT-23-3

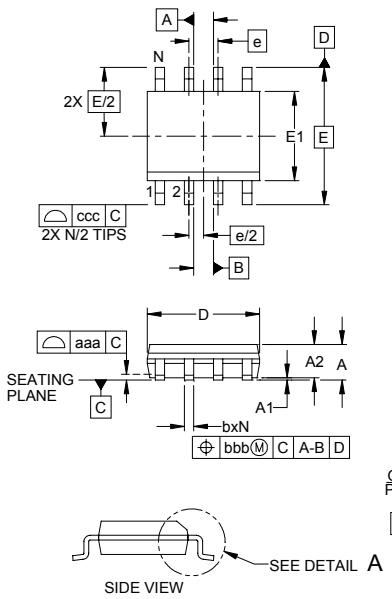


DIMENSIONS		
DIM	INCHES	MILLIMETERS
C	(.087)	(2.20)
E	.037	0.95
E1	.075	1.90
G	.031	0.80
X	.039	1.00
Y	.055	1.40
Z	.141	3.60

NOTES:

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.
2. REFERENCE IPC-SM-782A.

Outline Drawing - SO-8

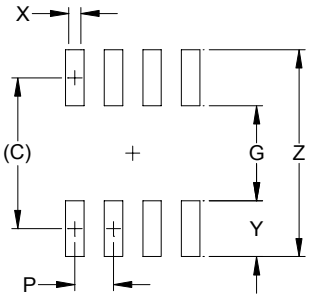


DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.053	-	.069	1.35	-	1.75
A1	.004	-	.010	0.10	-	0.25
A2	.049	-	.065	1.25	-	1.65
b	.012	-	.020	0.31	-	0.51
c	.007	-	.010	0.17	-	0.25
D	.189	.193	.197	4.80	4.90	5.00
E1	.150	.154	.157	3.80	3.90	4.00
E	.236 BSC			6.00 BSC		
e	.050 BSC			1.27 BSC		
h	.010	-	.020	0.25	-	0.50
L	.016	.028	.041	0.40	0.72	1.04
L1	(.041)			(1.04)		
N	8			8		
θ1	0°	-	8°	0°	-	8°
aaa	.004			0.10		
bbb	.010			0.25		
ccc	.008			0.20		

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
4. REFERENCE JEDEC STD MS-012, VARIATION AA.

Land Pattern - SO-8



DIM	INCHES	MILLIMETERS
C	(.205)	(5.20)
G	.118	3.00
P	.050	1.27
X	.024	0.60
Y	.087	2.20
Z	.291	7.40

NOTES:

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.
2. REFERENCE IPC-SM-782A, RLP NO. 300A.

Contact Information

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Power Management Products Division
200 Flynn Road, Camarillo, CA 93012
Phone: (805)498-2111 FAX (805)498-3804