Adjustable Shunt Regulator

HIGH-RELIABILITY PRODUCTS

Features

- Wide operating current range 130μA to 150mA
- Low dynamic output impedance 0.25Ω typ.
- Trimmed bandgap ± 0.5%
- Alternate for TL1431, TL431, LM431& AS431
- Military temperature range
- Available in SOT-23-3 package
- Pb-free, Halogen Free, RoHS / WEEE compliant

Applications

- Linear Regulators
- Switching Power Supplies

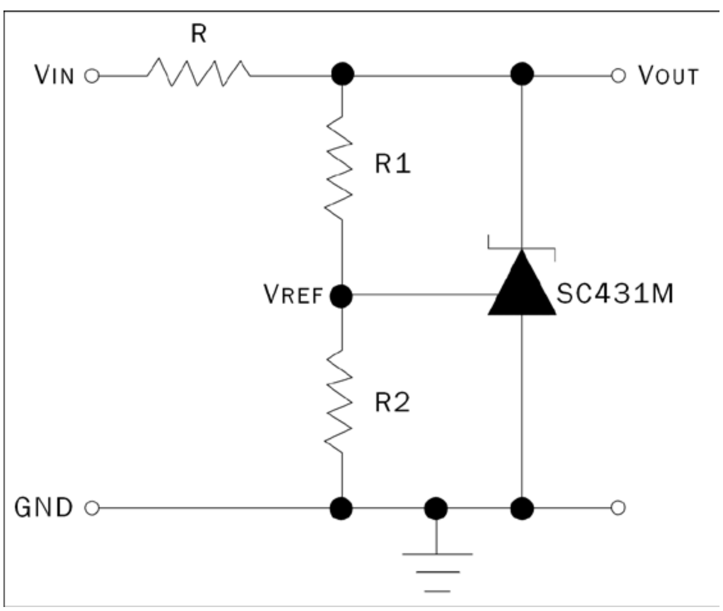
Description

The SC431M 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 SC431M has a typical dynamic output impedance of 0.25Ω. Active output circuitry provides a very sharp turn on characteristic, making the SC431M an excellent replacement for Zener diodes.

The SC431M shunt regulator is available with a 0.5% voltage tolerance at room temperature and comes in a SOT-23-3 package.

Typical Application Circuit



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:

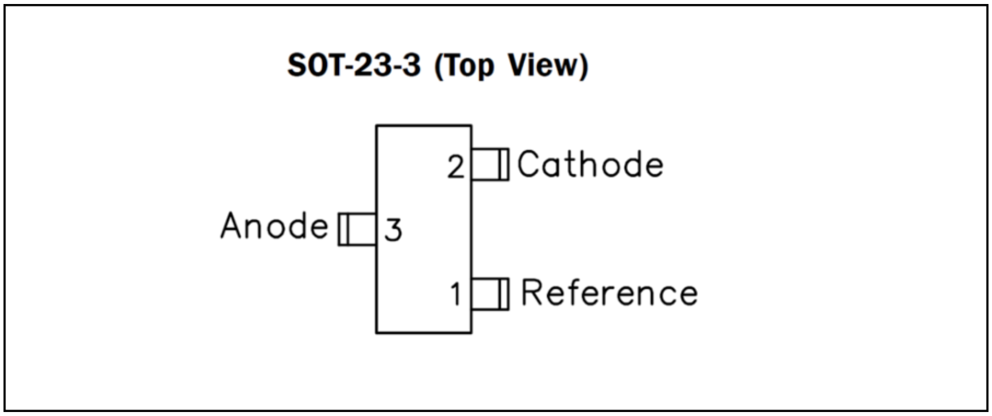
$$R_{min} \geq \frac{V_{IN(max)}}{200mA}$$

(to limit instantaneous turn-on I_Z)

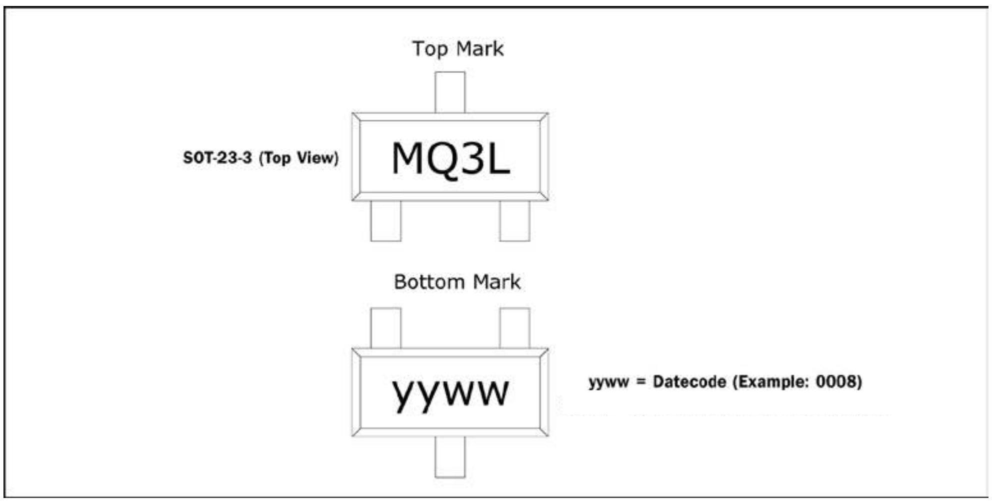
$$R_{min} \geq \frac{V_{IN(max)} - V_{OUT}}{I_{OUT(min)} + 150mA}$$

(to limit I_Z under normal operating conditions)

Pin Configuration



Marking Information



Ordering Information

Device	Package
SC431MSKQTRT [(1)(2)]	SOT-23-3

Notes:
(1): Only available in tape and reel packaging. A reel contains 3,000 devices. Consult factory for smaller quantities.
(2): This product is Pb-free, Halogen Free, RoHS / WEEE compliant.

Absolute Maximum Ratings

Parameter	Symbol	Value	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°C SOT-23-3	P_D	0.37	W
Thermal Resistance SOT-23-3	θ_{JA}	336	°C/W
Operating Ambient Temperature Range	T_A	-55 to +125	°C
Operating Junction Temperature Range	T_J	-55 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

Notes:
(1): If multiple diodes conduct in the forward direction at any instant, the sum of the currents must not exceed this rating.
(2): ESD Gun return path to Ground Reference Plane (GRP)
(3): Any one diode to ambient.

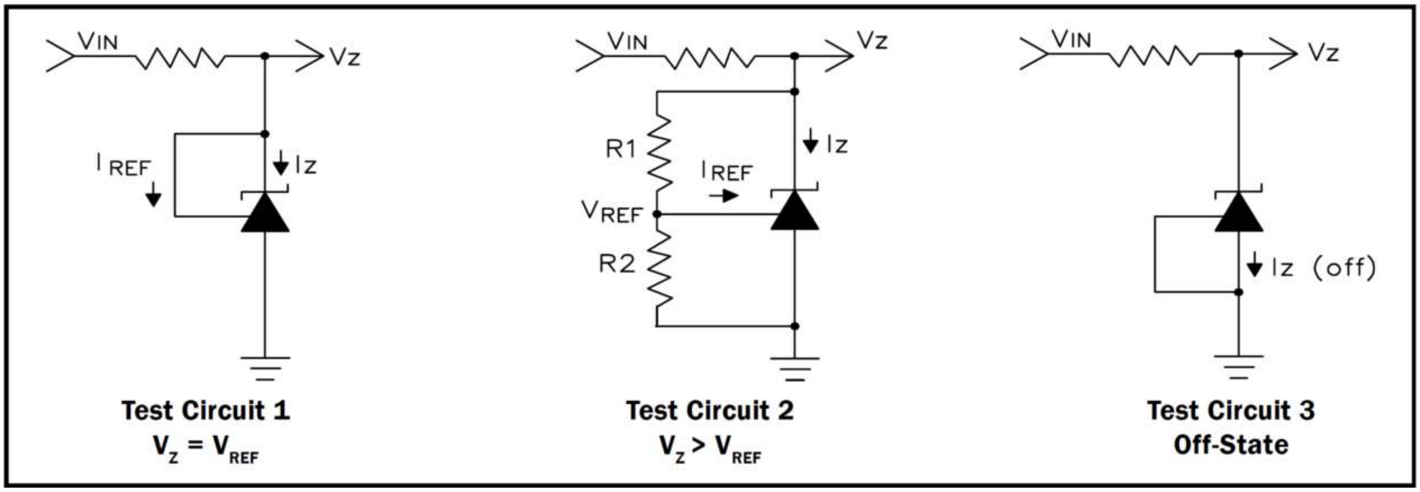
Electrical Characteristics

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reference Voltage	V_{REF}	$V_Z = V_{REF}$, I_Z = 10mA(1)	2.482	2.495	2.507	V
V_{REF} Temp Deviation	V_{DEV}	$V_Z = V_{REF}$, I_Z = 10mA(1)		**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	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	0.5	µA
Dynamic Output Impedance	r_Z	f < 1kHz, $V_Z = V_{REF}$ I_Z = 130µA to 100mA(1)		0.25	0.5	Ω
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}$(1)			130	µA

Notes:
(1): See Test Circuit 1 on page 4.
(2): See Test Circuit 2 on page 4.
(3): See Test Circuit 3 on page 4.

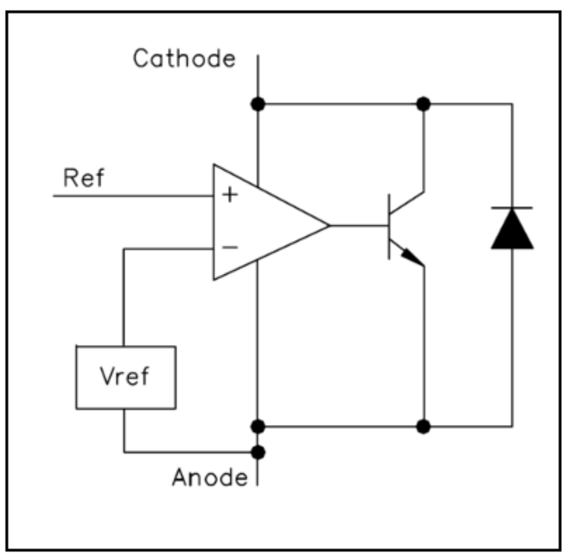
Test Circuits



Recommended Operating Conditions

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

Block Diagram



Typical Characteristics

Figure 1: Cathode Current vs Cathode Voltage

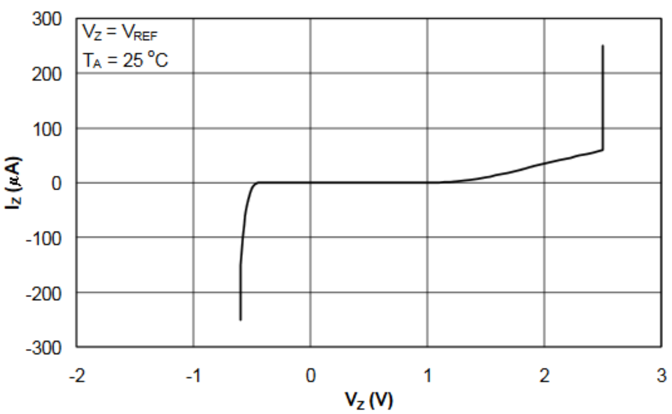


Figure 2: Cathode Current vs Cathode Voltage

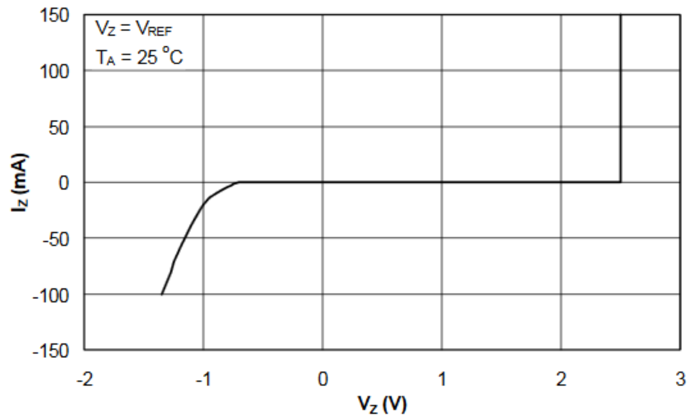


Figure 3: Reference Voltage vs. Junction Temperature

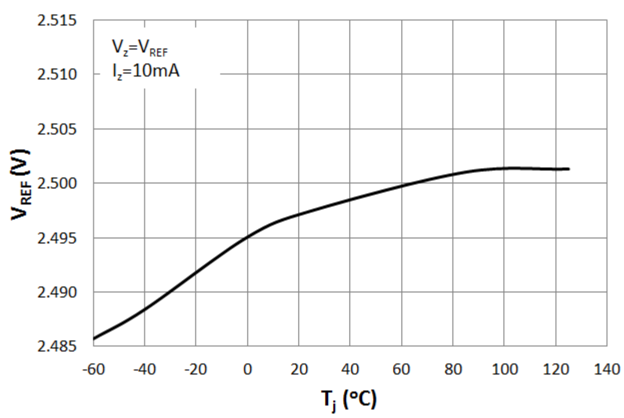


Figure 4: Ratio of Delta Reference Voltage to Delta Cathode Voltage vs. Junction Temperature

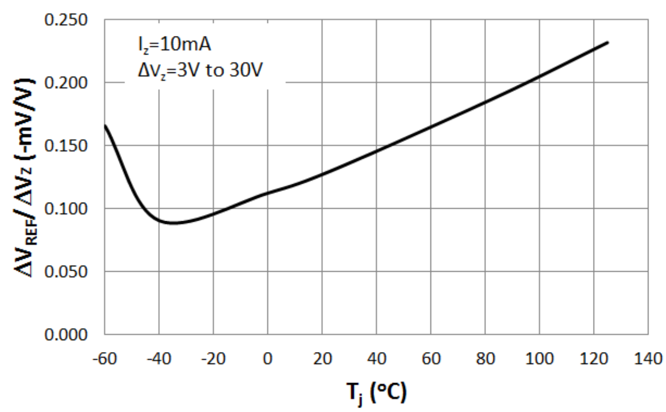


Figure 5: Reference Input Current vs. Junction Temperature

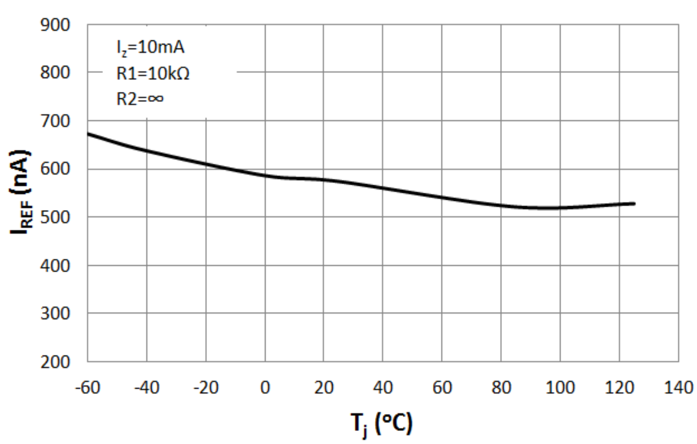
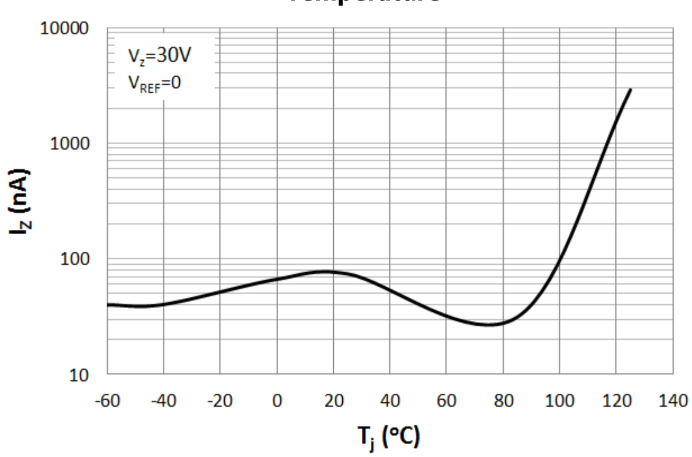


Figure 6: Off-State Cathode Current vs. Junction Temperature



Typical Characteristics (Cont.)

Figure 7: Small-Signal Gain and Phase Shift vs. Frequency

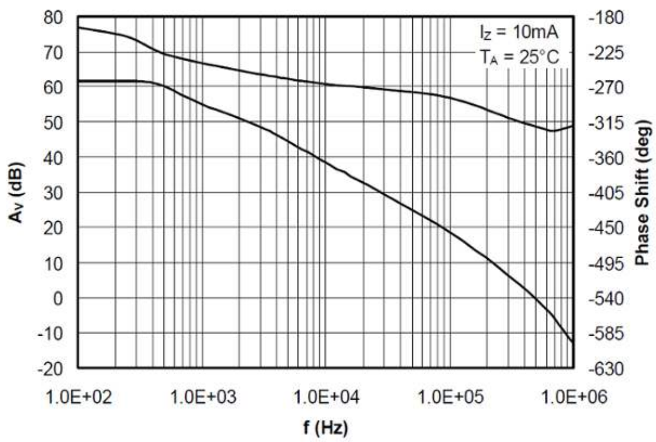


Figure 8: Test Circuit – Small-Signal Gain and Phase

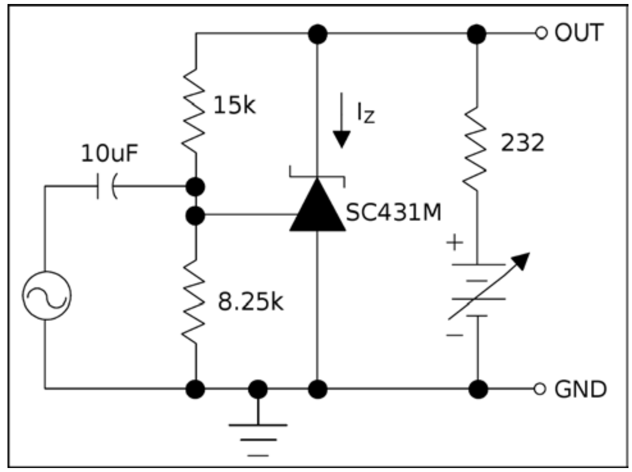


Figure 9: Stability Boundary Condition for Shunt Regulation vs. Cathode Current and Load Capacitance

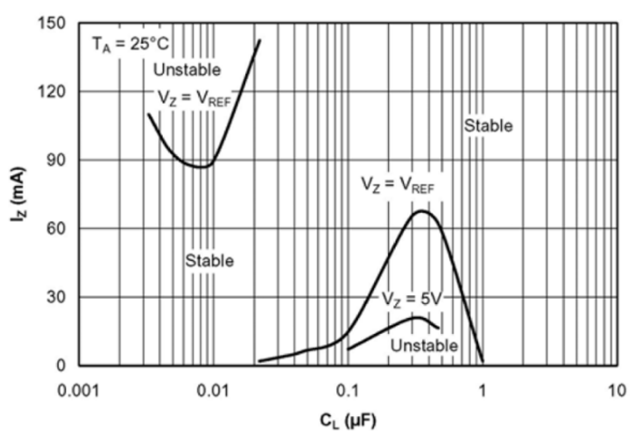


Figure 10: Test Circuit - Stability

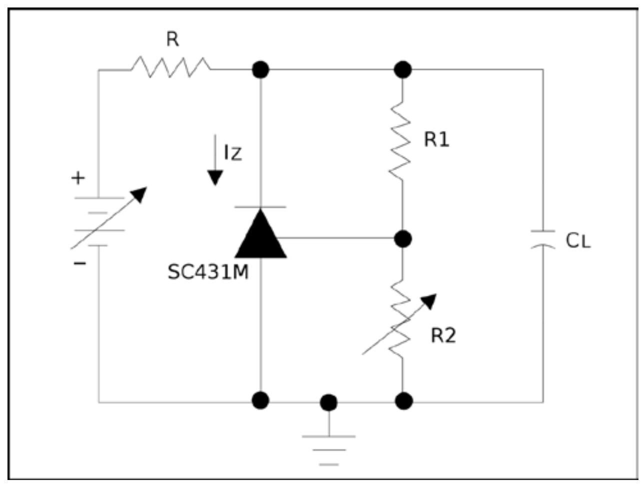
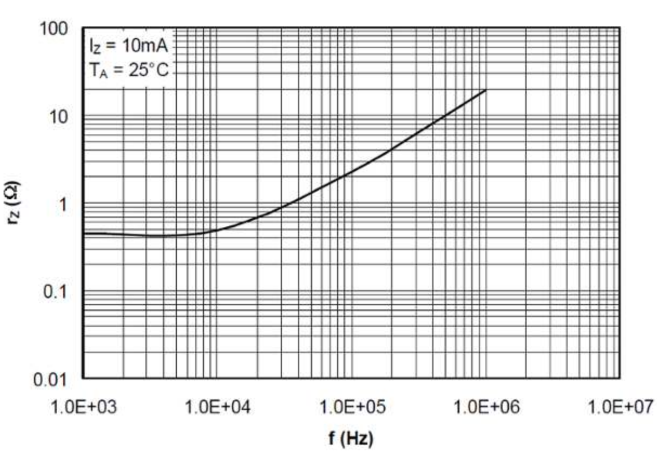
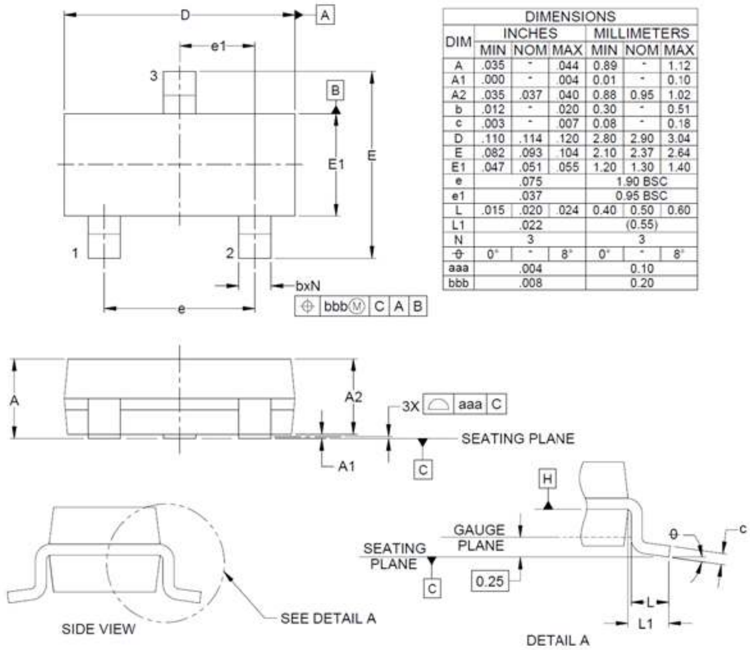


Figure 11: Reference Impedance vs. Frequency



Outline Drawing – SOT-23-3



DIMENSIONS						
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		

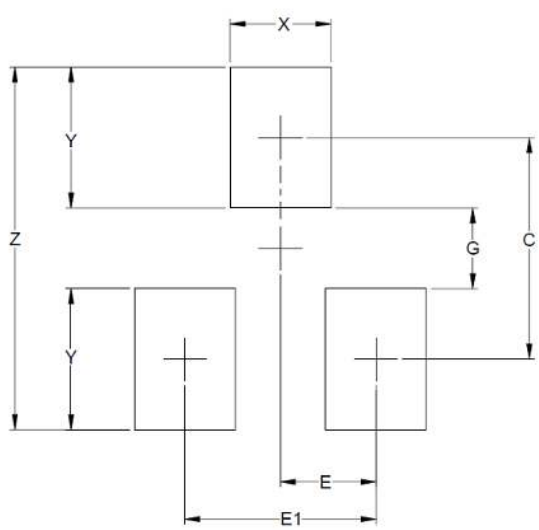
Notes:

(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 that your company's manufacturing guidelines are met.

(2) Reference IPC-SM-782A

Important Notice

Contact Information

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