

### 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, fully WEEE and RoHS compliant

#### Applications

- Linear Regulators
- Switching Power Supplies

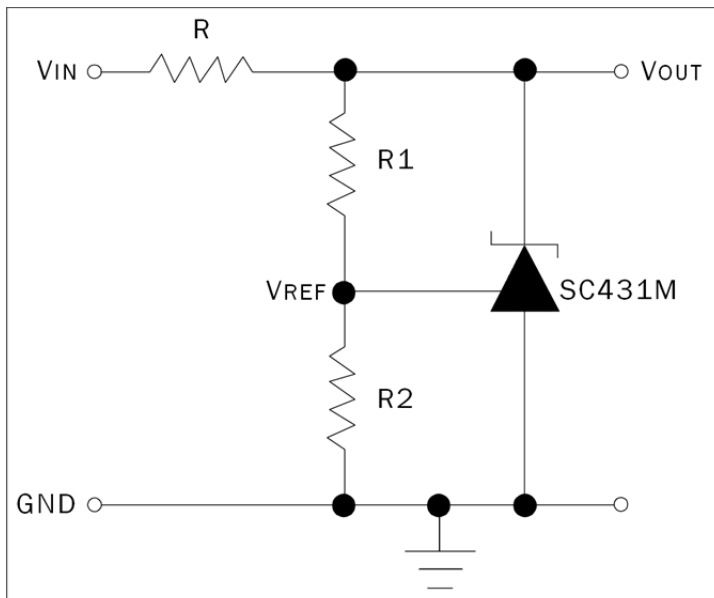
#### Description

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 over  $T_A = -55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  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:

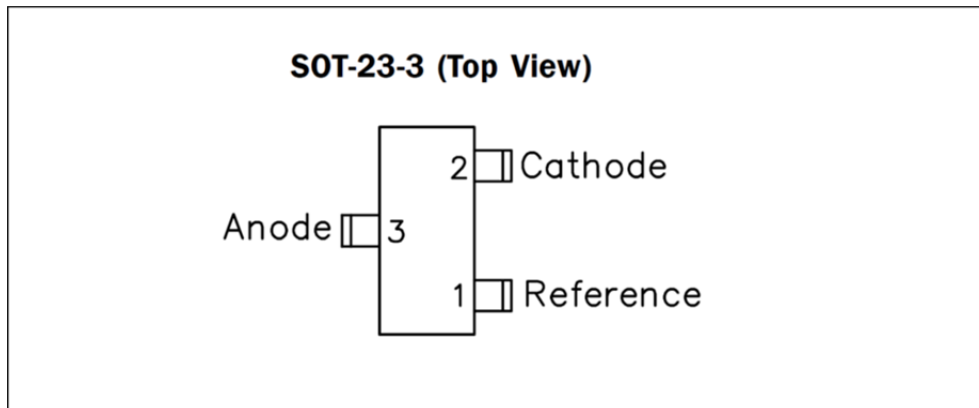
$$R_{min} \geq \frac{V_{IN(max)}}{200mA}$$

(to limit instantaneous turn-on  $I_Z$ )

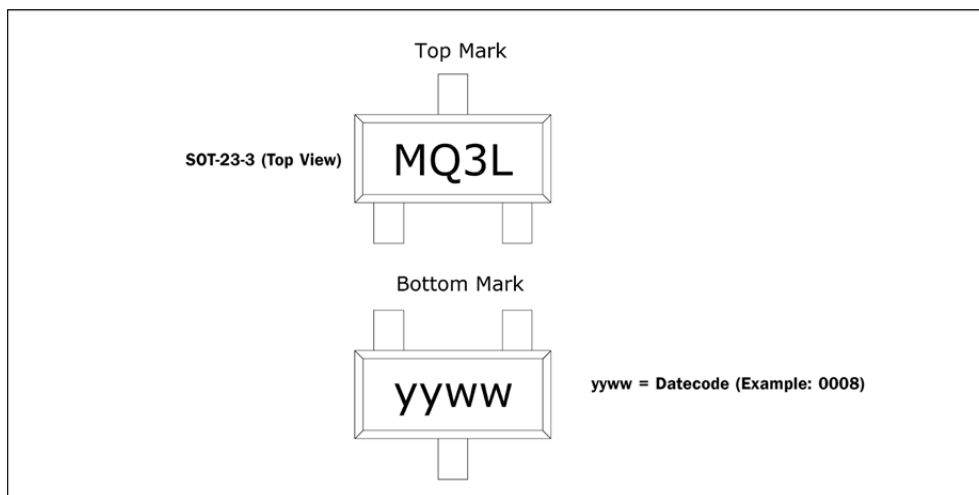
$$R_{min} \geq \frac{V_{IN(max)} - V_{OUT}}{I_{OUT(min)} + 150mA}$$

(to limit  $I_Z$  under normal operating conditions)

## Pin Configuration



## Marking Information



## Ordering Information

Device	Package
SC431MSKQTRT <sup>(1)(2)</sup>	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 fully WEEE and RoHS 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 $T_A = 25^\circ\text{C}$ SOT-23-3	$P_D$	0.37	W
Thermal Resistance SOT-23-3	$\theta_{JA}$	336	$^\circ\text{C}/\text{W}$
Operating Ambient Temperature Range	$T_A$	-55 to +125	$^\circ\text{C}$
Operating Junction Temperature Range	$T_J$	-55 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

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

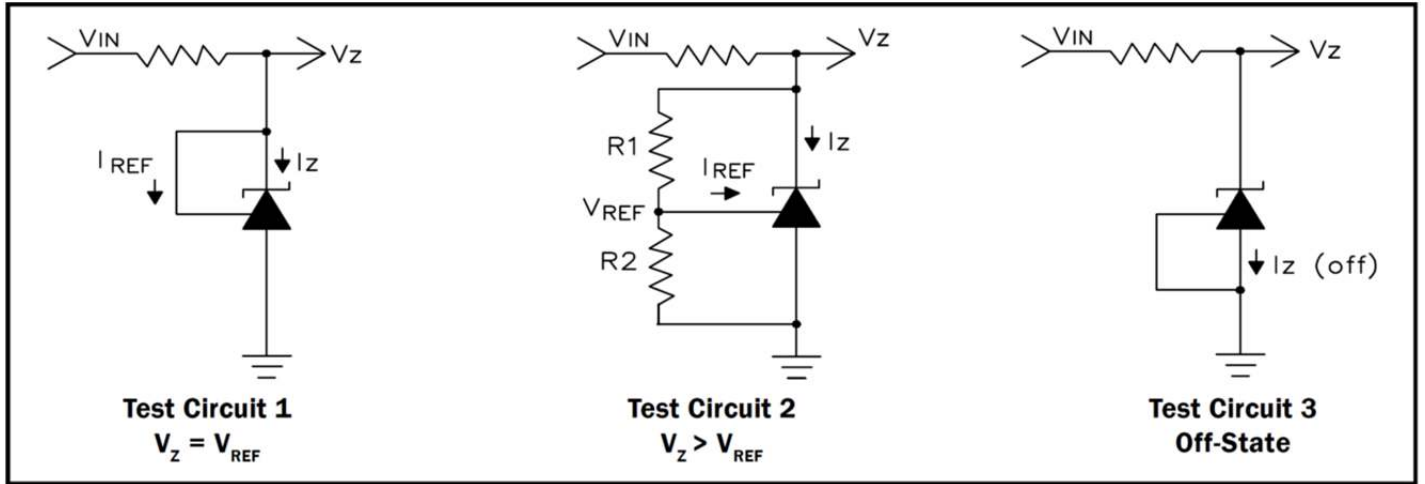
Unless specified:  $T_A = 25^\circ\text{C}$ . Values in **bold** apply over full operating ambient temperature range.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reference Voltage	$V_{REF}$	$V_Z = V_{REF}, I_Z = 10\text{mA}^{(1)}$	2.482	2.495	2.507	V
$V_{REF}$ Temp Deviation	$V_{DEV}$	$V_Z = V_{REF}, I_Z = 10\text{mA}^{(1)}$		<b>8</b>	<b>17</b>	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	$\mu\text{A}$
$I_{REF}$ Temperature Deviation	$I_{REF(DEV)}$	$R1 = 10\text{k}\Omega, R2 = \infty,$ $I_Z = 10\text{mA}^{(2)}$		<b>0.4</b>	<b>1.2</b>	$\mu\text{A}$
Off-State Cathode Current	$I_{Z(OFF)}$	$V_{REF} = 0\text{V}, V_Z = 30\text{V}^{(3)}$		0.04	0.5	$\mu\text{A}$
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	0.5	$\Omega$
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$			130	$\mu\text{A}$

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.

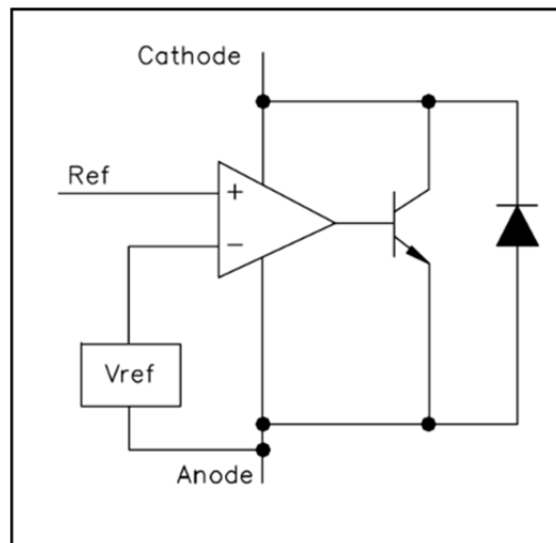
## Test Circuits



## Recommended Operating Conditions

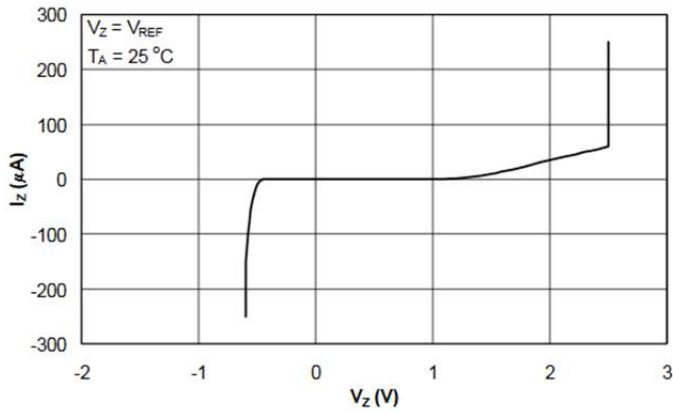
Parameter	Min.	Max.	Units
Cathode Voltage, $V_Z$	$V_{REF}$	30	V
Cathode Current, $I_Z$	0.130	150	mA

## Block Diagram

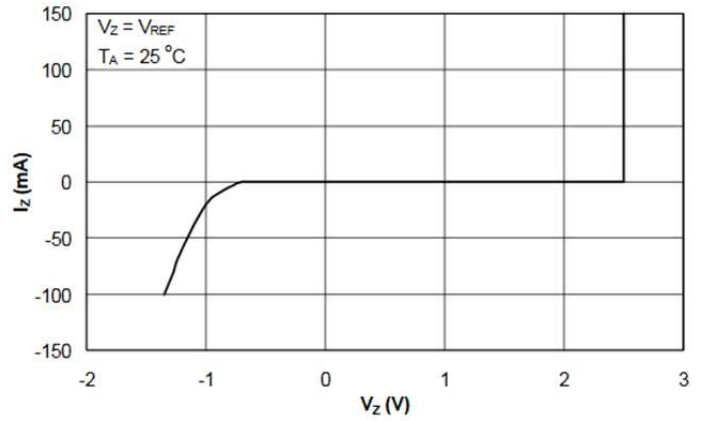


# Typical Characteristics

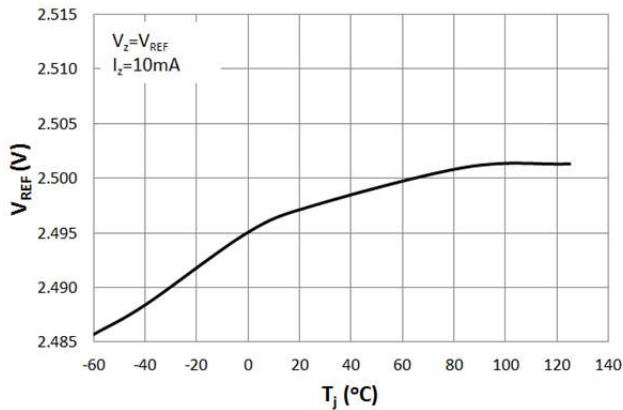
**Figure 1: Cathode Current vs Cathode Voltage**



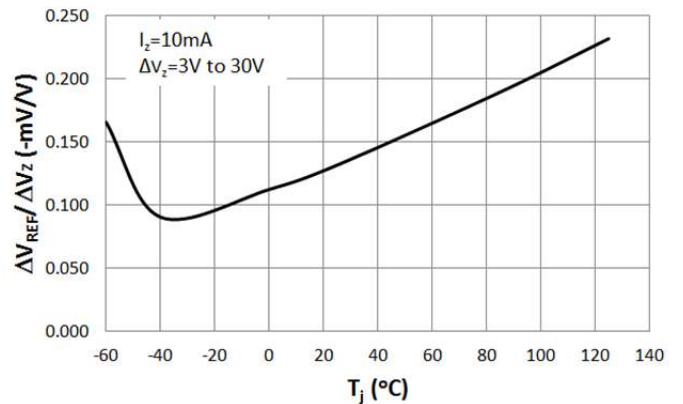
**Figure 2: Cathode Current vs Cathode Voltage**



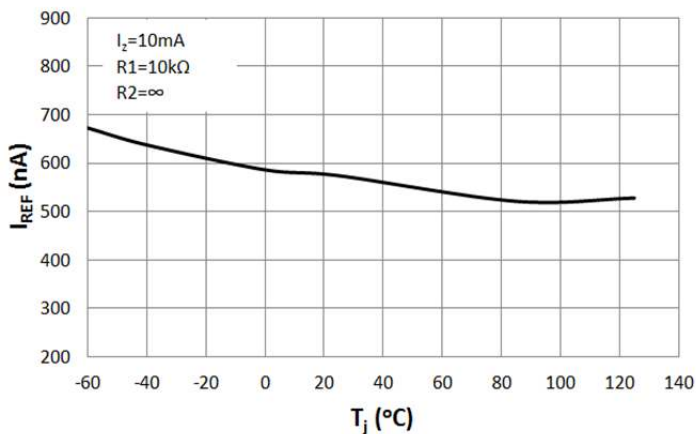
**Figure 3: Reference Voltage vs. Junction Temperature**



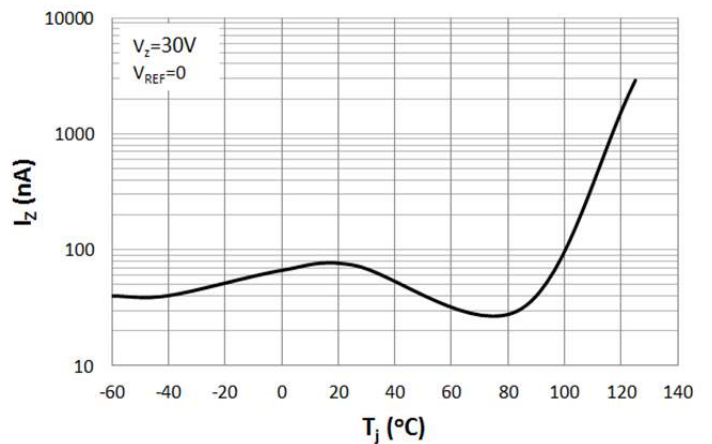
**Figure 4: Ratio of Delta Reference Voltage to Delta Cathode Voltage vs. Junction Temperature**



**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

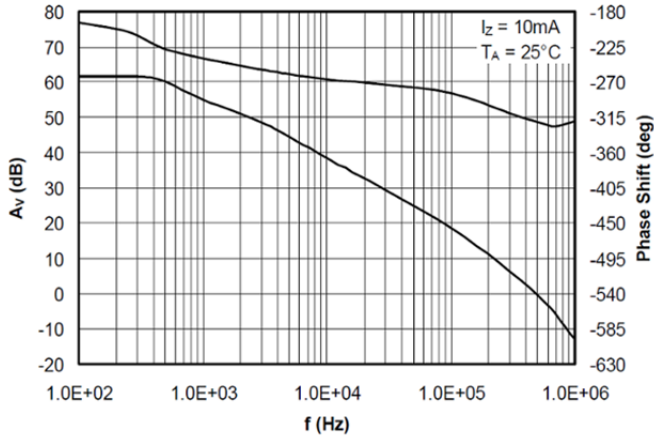


Figure 8: Test Circuit – Small-Signal Gain and Phase

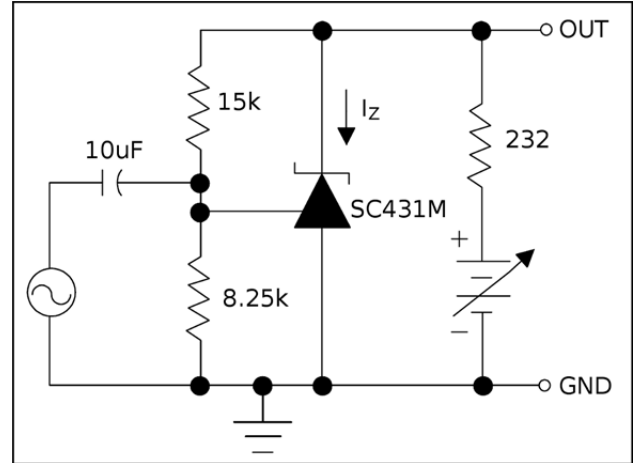


Figure 9: Stability Boundary Condition for Shunt Regulation vs. Cathode Current and Load Capacitance

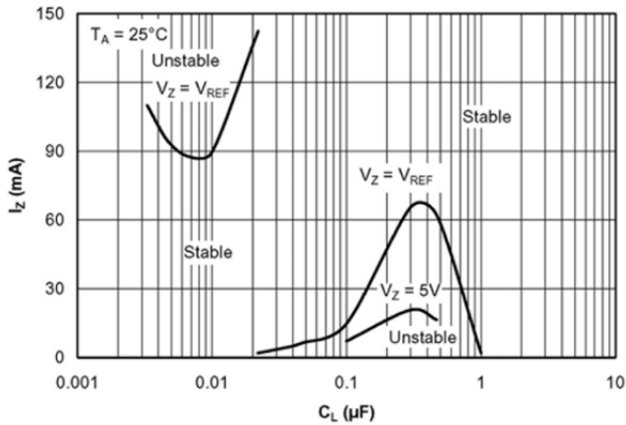


Figure 10: Test Circuit - Stability

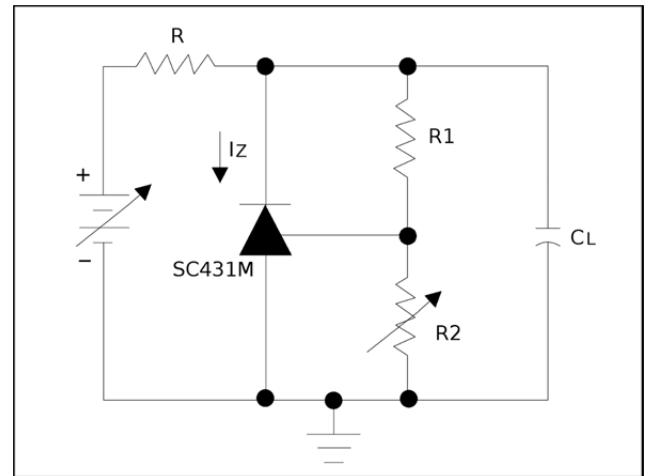
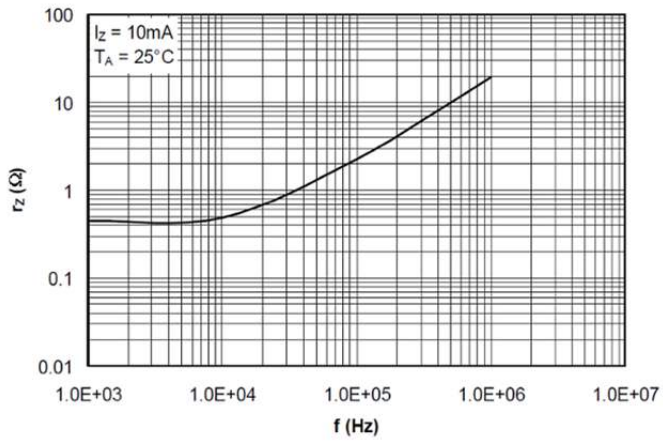
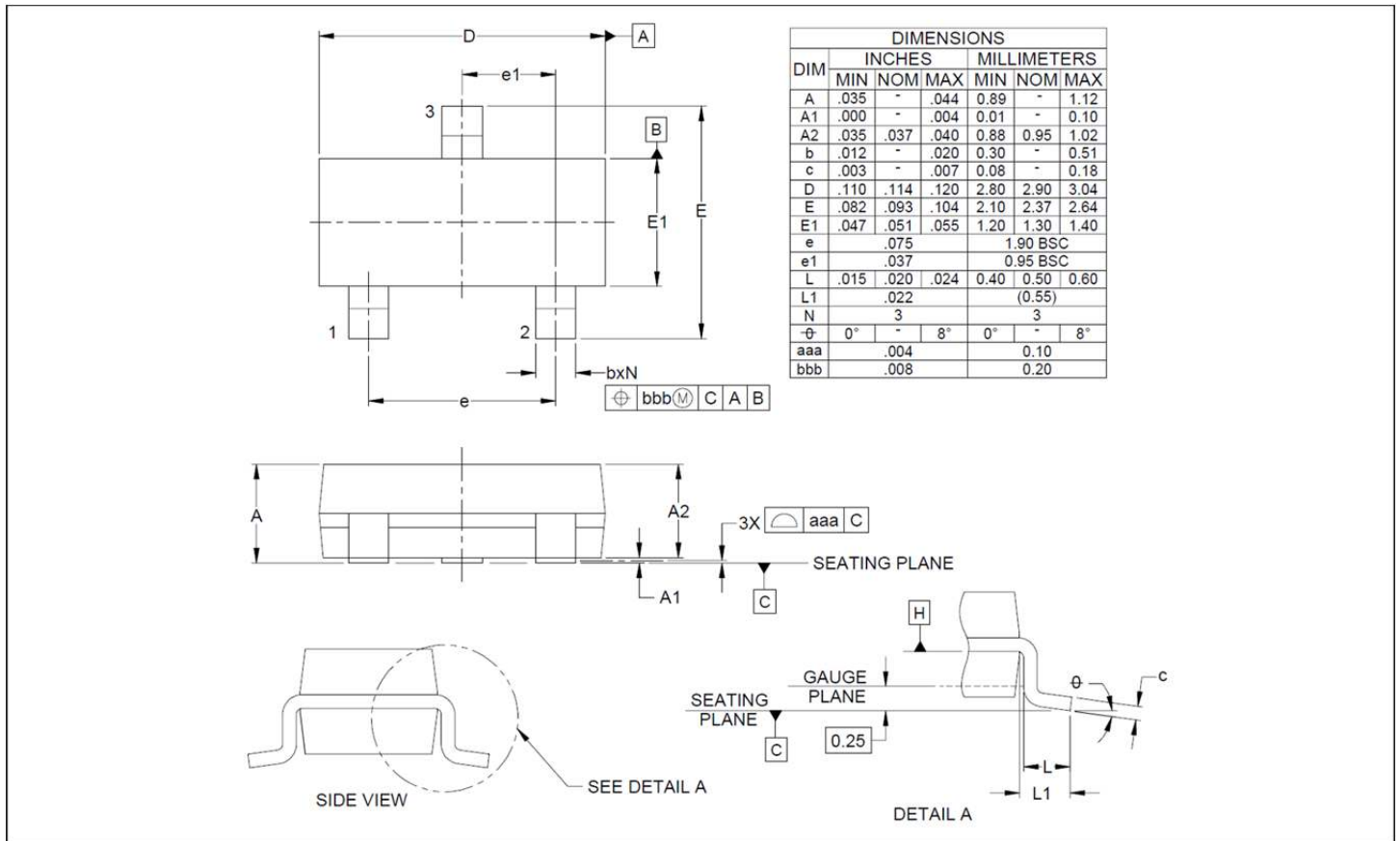


Figure 11: Reference Impedance vs. Frequency



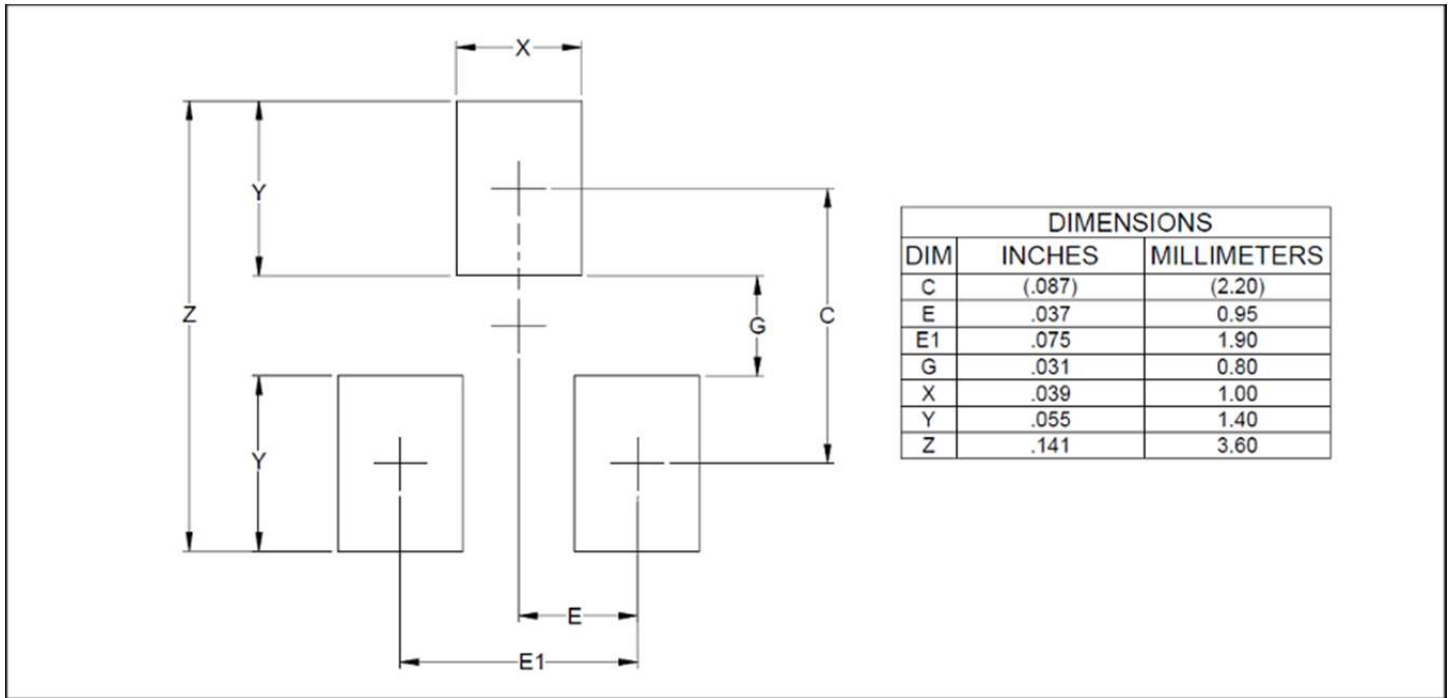
# Outline Drawing – SOT-23-3



- 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



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



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