

Description

The ZHT431 is a three terminal adjustable shunt regulator offering excellent temperature stability and output current handling capability up to 100mA. The device offers extended operating temperature range working from -55 to +125°C.

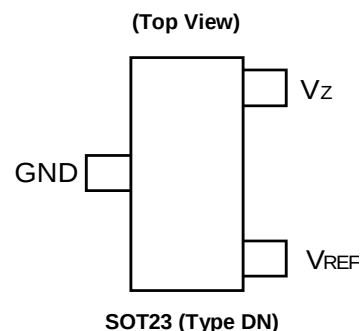
The output voltage may be set to any chosen voltage between 2.5 and 20 volts by selection of two external divider resistors.

The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

Features

- Surface Mount SOT23 (Type DN) Package
- 0.5%, 1% and 2% Tolerance
- Maximum Temperature Coefficient 67ppm/°C
- Temperature Compensated for Operation Over the Full Temperature Range
- Programmable Output Voltage
- 50µA to 100mA Current Sink Capability
- Low Output Noise
- Wide Temperature Range -55 to +125°C
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Pin Assignments

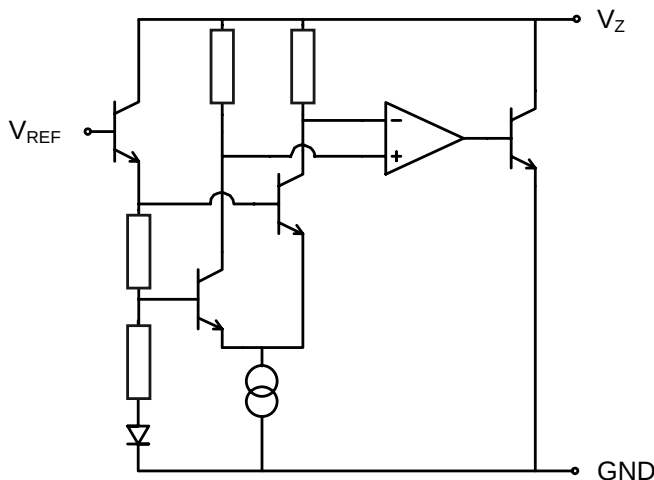


Applications

- Series and Shunt Regulator
- Voltage Monitor
- Over Voltage / Under Voltage Protection
- Switch Mode Power Supplies

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
 2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
 3. Halogen, Antimony and Beryllium-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl), <1000ppm antimony compounds and <1000ppm Beryllium.

Typical Application Circuit



Absolute Maximum Ratings (Voltages to GND Unless Otherwise Stated.)

Parameter	Rating	Unit
Cathode Voltage (V _Z)	20	V
Cathode Current	150	mA
Operating Temperature	-55 to +125	°C
Storage Temperature	-55 to +150	°C
Power Dissipation (T _A = +25°C, T _{JMAX} = +150°C)	330	mW

Recommended Operating Conditions

Parameter	Min	Max	Unit
Cathode Voltage V _{REF}	—	20	V
Cathode Current	0.05	100	mA

Electrical Characteristics (Test conditions unless otherwise specified: T_A = +25°C.)

Symbol	VParameter	Values			Unit	Conditions
		Min.	Typ.	Max.		
V _{REF}	Reference Voltage	2% 1% 0.5%	2.45 2.475 2.4875	2.50 2.50 2.5125	2.55 2.525 2.5125	V I _L = 10mA (Fig.1), V _Z = V _{REF}
V _{DEV}	Deviation of Reference Input Voltage Over Temperature	—	10	30	mV	I _L = 10mA, V _Z = V _{REF} T _A = Full Range (Fig.1)
$\frac{\Delta V_{REF}}{\Delta V_Z}$	Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	—	-1.85	-2.7	mV/V	V _Z from V _{REF} to 10V I _Z = 10mA (Fig.2)
		—	-1.0	-2.0	mV/V	V _Z from 10V to 20V I _Z = 10mA (Fig.2)
I _{REF}	Reference Input Current	—	0.12	1.0	μA	R1 = 10k, R2 = O/C, I _L = 10mA (Fig.2)
ΔI _{REF}	Deviation of Reference Input Current Over Temperature	—	0.04	0.2	μA	R1 = 10k, R2 = O/C, I _L = 10mA, T _A = Full Range (Fig.2)
I _{ZMIN}	Minimum Cathode Current for Regulation	—	35	50	μA	V _Z = V _{REF} (Fig.1)
I _{ZOFF}	Off-state Current	—	—	0.1	μA	V _Z = 20V, V _{REF} = 0V (Fig.3)
R _Z	Dynamic Output Impedance	—	—	0.75	V	V _Z = V _{REF} (Fig.1), f = 0Hz, I _C = 1mA to 100mA

Deviation of reference input voltage, V_{DEV}, is defined as the maximum variation of the reference input voltage over the full temperature range.

The average temperature coefficient of the reference input voltage, V_{REF} is defined as:

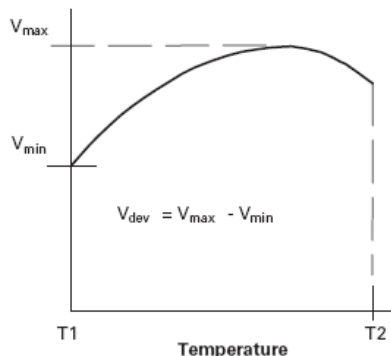
$$V_{REF} \left(\frac{\text{ppm}}{^{\circ}\text{C}} \right) = \frac{V_{DEV} \times 1000000}{V_{REF} (T_1 - T_2)}$$

The dynamic output impedance, R_Z, is defined as:

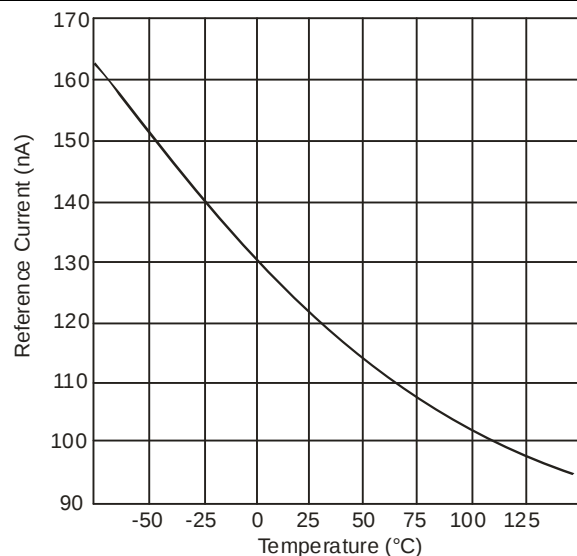
$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

When the device is programmed with two external resistors, R1 and R2, (Fig. 2), the dynamic output impedance of the overall circuit, R', is defined as:

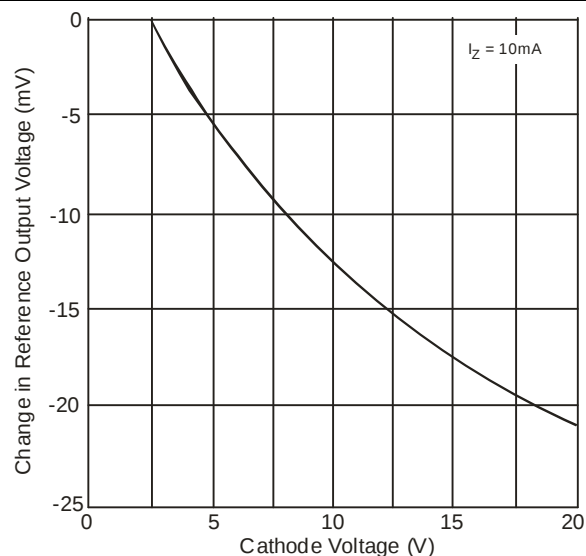
$$R' = R_Z \left(1 + \frac{R_1}{R_2} \right)$$



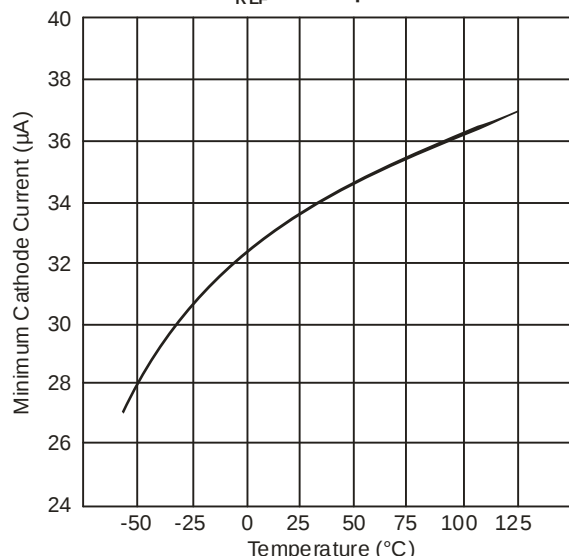
Typical Operating Conditions



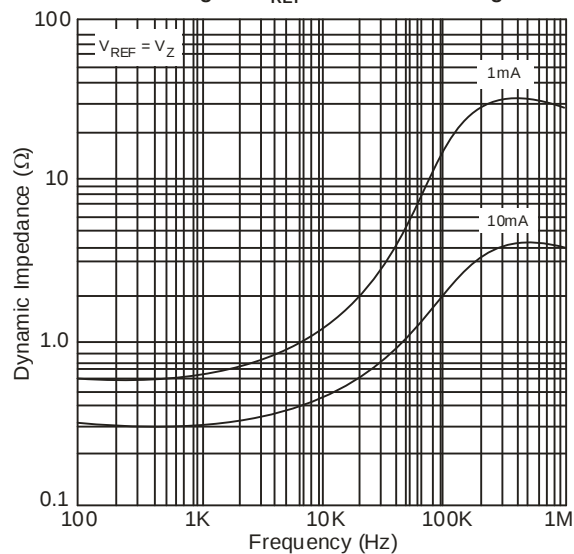
I_{REF} vs. Temperature



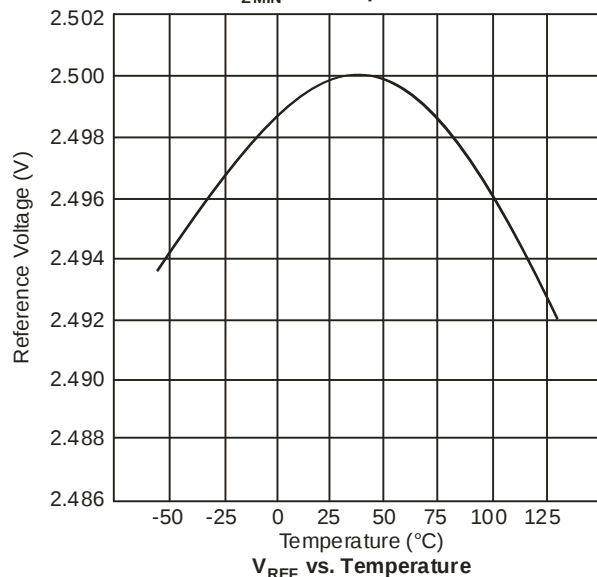
Change in V_{REF} vs. Cathode Voltage



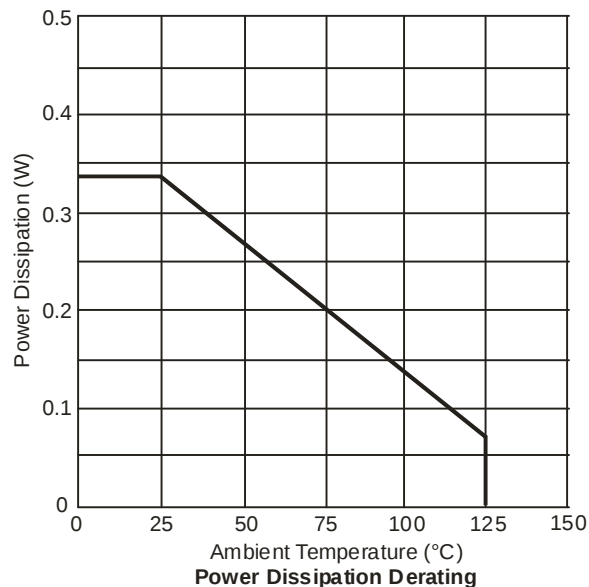
I_{ZMIN} vs. Temperature



Dynamic Impedance vs. Frequency

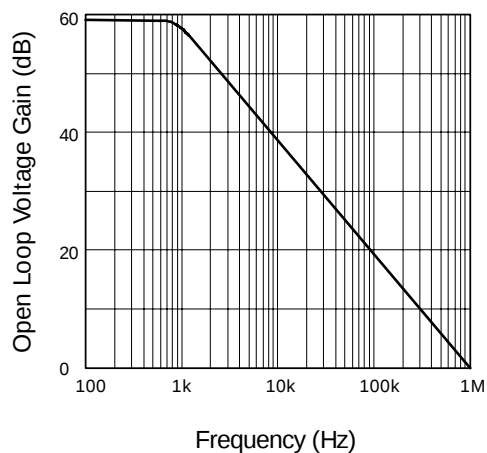


V_{REF} vs. Temperature

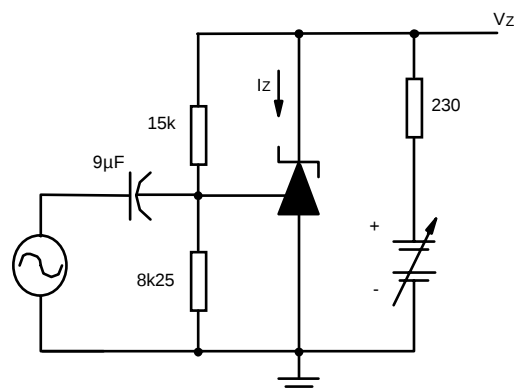


Power Dissipation Derating

Typical Operating Conditions (Cont.)

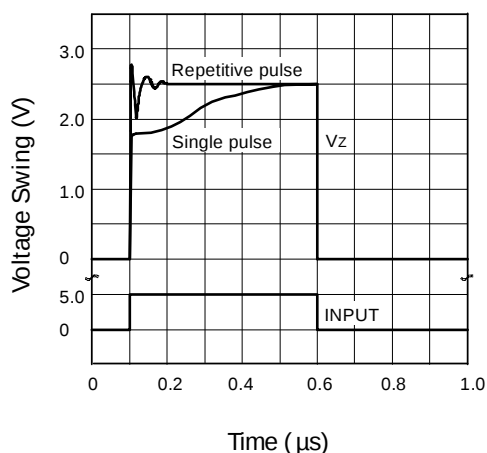


Gain v Frequency

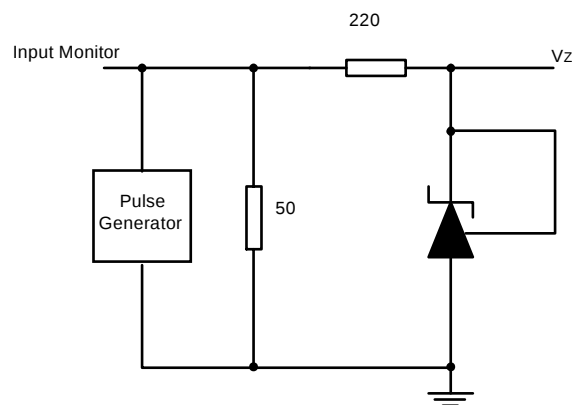


$I_Z = 10\text{mA}$, $T_A = 25^\circ\text{C}$

Test Circuit for Open Loop Voltage Gain

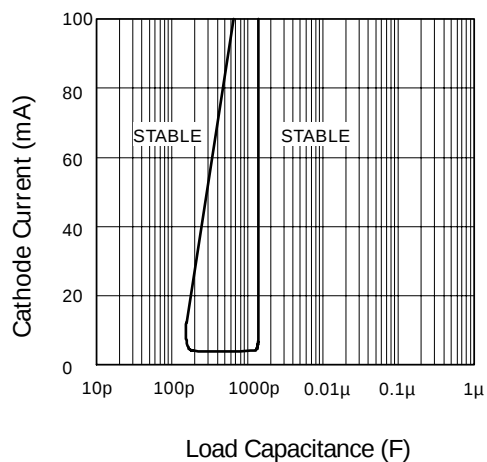


Pulse Response

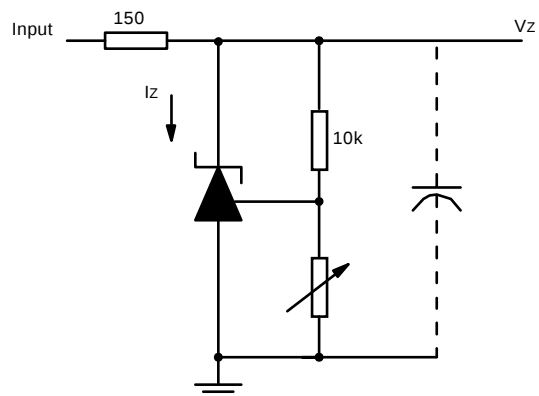


$T_A = 25^\circ\text{C}$

Test Circuit for Pulse Response



Stability Boundary Conditions



$V_{REF} < V_Z < 20\text{V}$, $I_Z = 10\text{mA}$, $T_A = 25^\circ\text{C}$

Test Circuit for Stability Boundary Conditions

DC Test Circuits

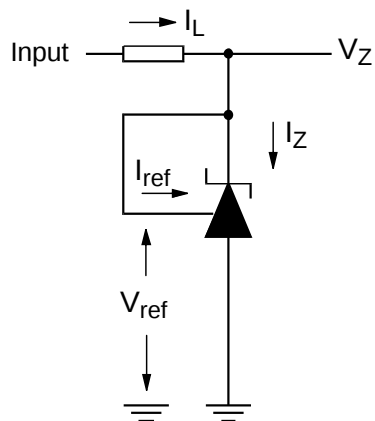


Fig 1 - Test circuit for $V_Z = V_{ref}$

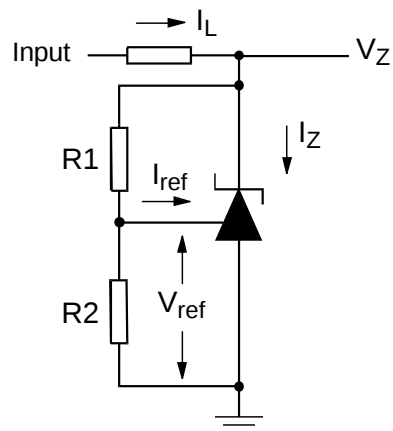


Fig 2 - Test circuit for $V_Z > V_{ref}$

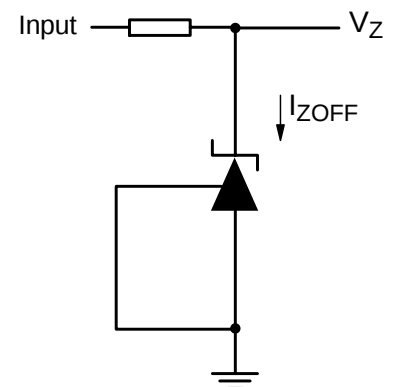
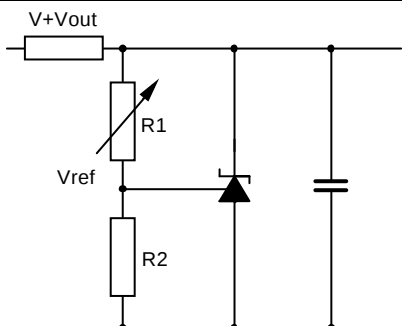


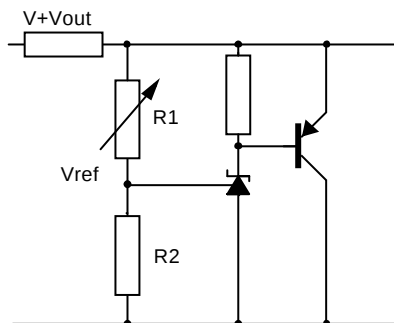
Fig 3 - Test circuit for Off state current†

Application Circuits



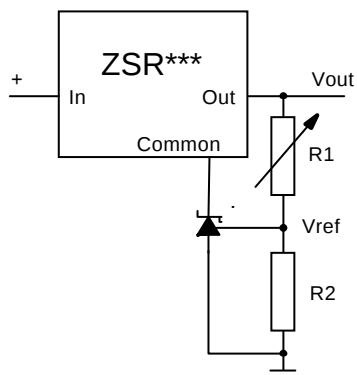
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

Shunt regulator



$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

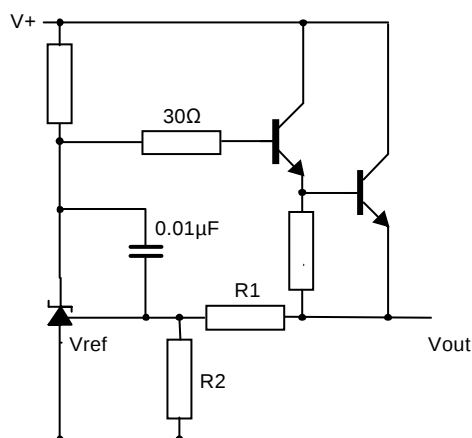
Higher current shunt regulator



$$V_{out\ MIN} = V_{ref} + V_{reg}$$

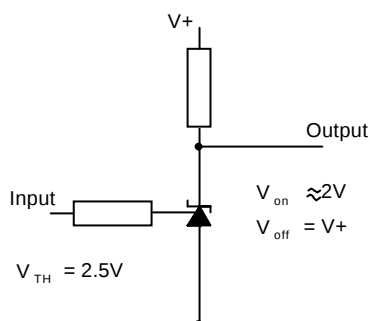
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

Output control of a three terminal fixed regulator

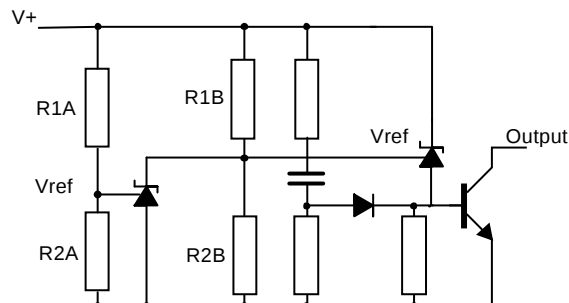


$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

Series regulator



Single supply comparator with temperature compensated threshold



$$\text{Low limit} = \left(1 + \frac{R1B}{R2B}\right) V_{ref}$$

$$\text{High limit} = \left(1 + \frac{R1A}{R2A}\right) V_{ref}$$

Over voltage / under voltage protection circuit

Ordering Information



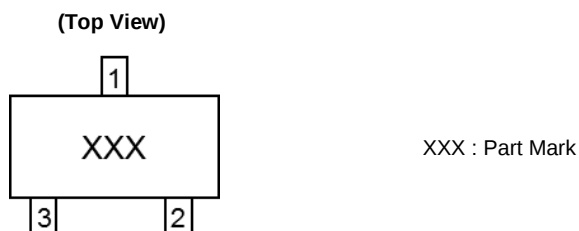
Part Number	Tolerance (%)	Package (Note 5)	Part Mark	Reel Size (inches)	Quantity per reel	Tape Width	Status (Note 4)
ZHT431F01TA	1	SOT23 (Type DN)	43C	7	3000	8mm	In Production
ZHT431F01-7	1	SOT23 (Type DN)	43C	7	3000	8mm	End of Life
ZHT431FMTA	0.5	SOT23 (Type DN)	43P	7	3000	8mm	In Production
ZHT431F02TA	2	SOT23 (Type DN)	43D	7	3000	8mm	In Production

Notes: 4. ZHT431F01-7 is End of Life without any alternative.

5. For packaging details, go to our website at: <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

Marking Information

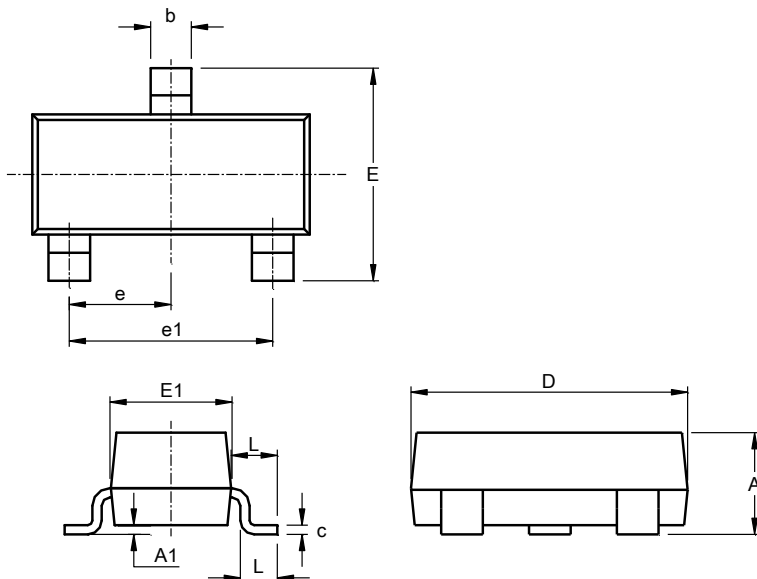
SOT23 (Type DN)



Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for latest version.

(1) Package Type: SOT23 (Type DN)

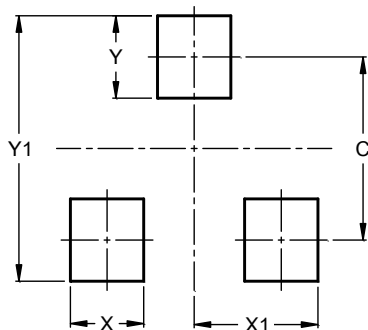


SOT23 (Type DN)			
Dim	Min	Max	Typ
A	0.89	1.12	1.00
A1	0.01	0.10	0.05
b	0.30	0.51	0.45
c	0.08	0.20	0.10
D	2.80	3.04	3.00
E	2.10	2.64	2.42
E1	1.20	1.40	1.37
e	0.95 REF		
e1	1.90 REF		
L	0.25	0.60	0.30
L1	0.45	0.62	0.54
All Dimensions in mm			

Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for latest version.

(1) Package Type: SOT23 (Type DN)



Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

IMPORTANT NOTICE

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel. Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes Incorporated.

LIFE SUPPORT

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or
2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2018, Diodes Incorporated

www.diodes.com