ADJUSTABLE PRECISION ZENER SHUNT REGULATOR

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.

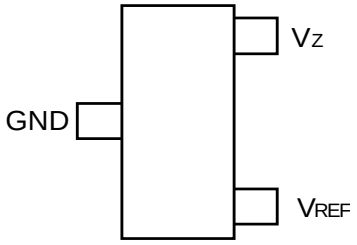
The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

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

(Top View)



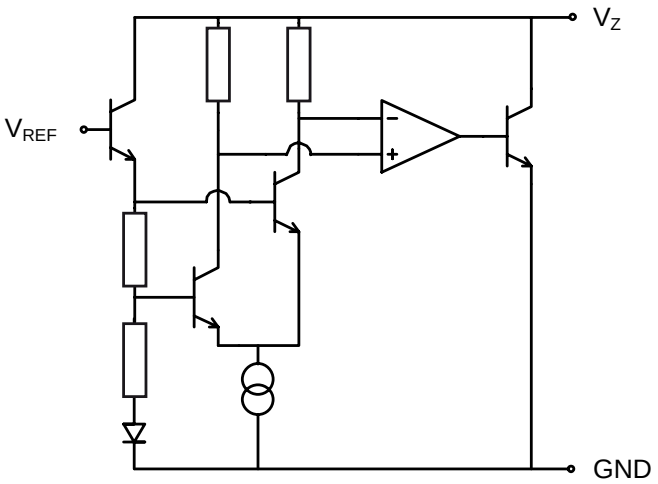
SOT23 (Type DN)

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%	2.45	2.50	2.55	V	I_L = 10mA (Fig.1), $V_Z = V_{REF}$
		1%	2.475	2.50	2.525		
		0.5%	2.4875	2.50	2.5125		
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:

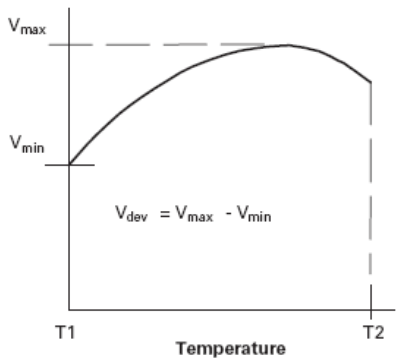
$$V_{REF}\left(\frac{ppm}{°C}\right) = \frac{V_{DEV} x 1000000}{V_{REF}(T1 - T2)}$$

The dynamic output impedance, R_Z, is defined as:

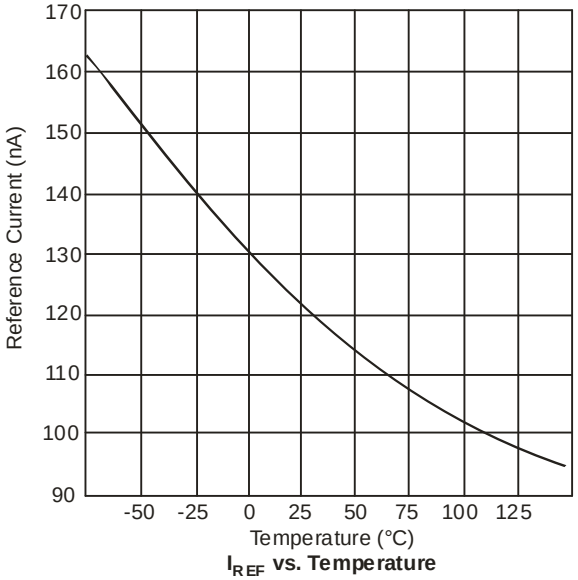
$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

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:

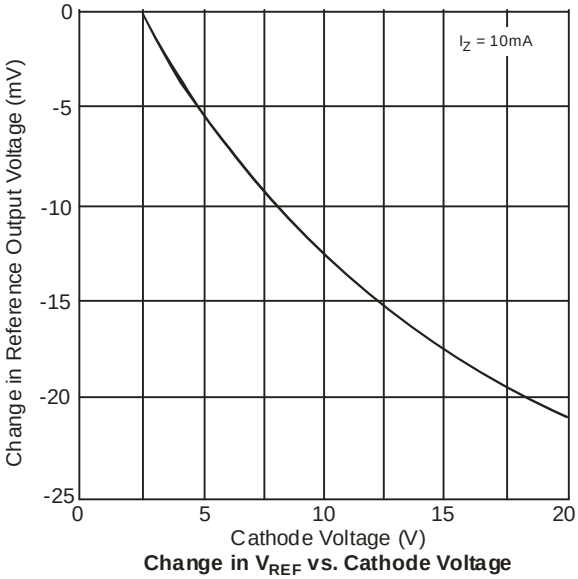
$$R' = R_Z\left(1 + \frac{R1}{R2}\right)$$



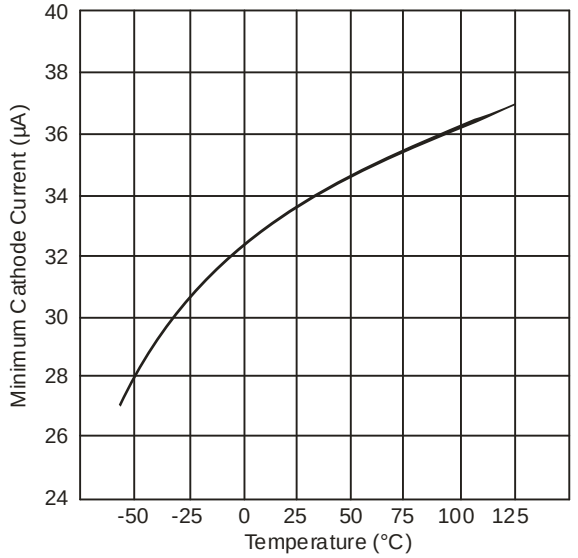
Typical Operating Conditions



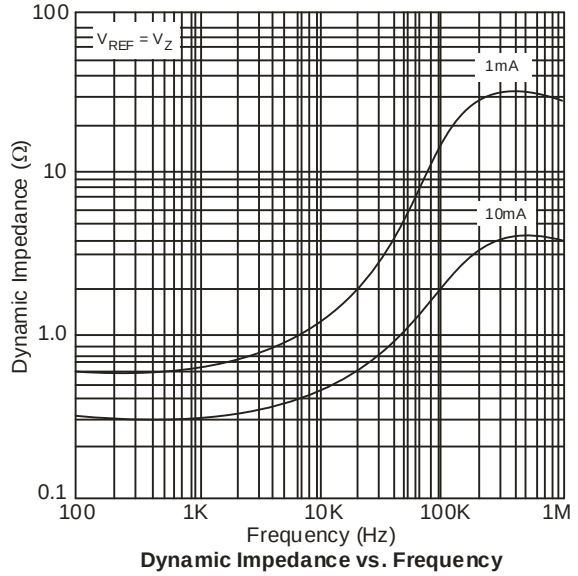
I_{REF} vs. Temperature



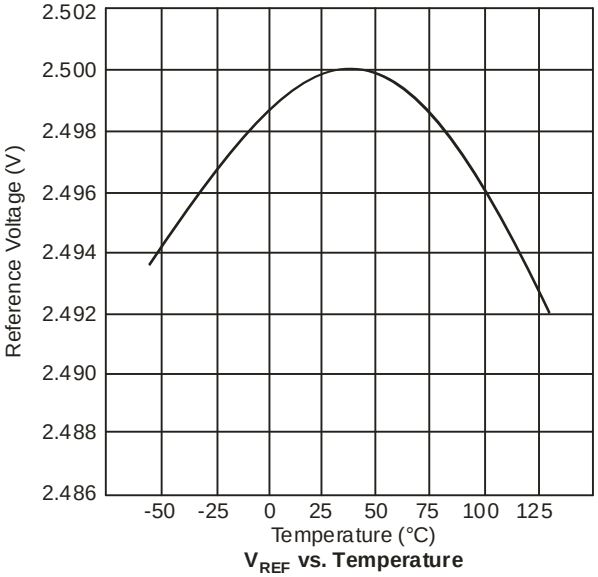
Change in V_{REF} vs. Cathode Voltage



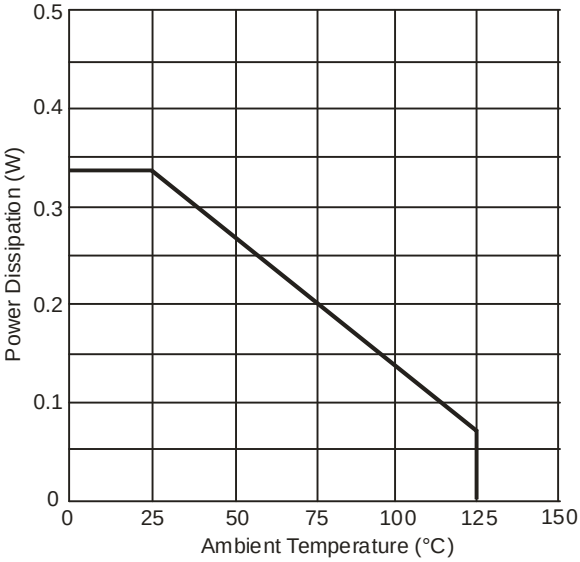
I_{ZMIN} vs. Temperature



Dynamic Impedance vs. Frequency

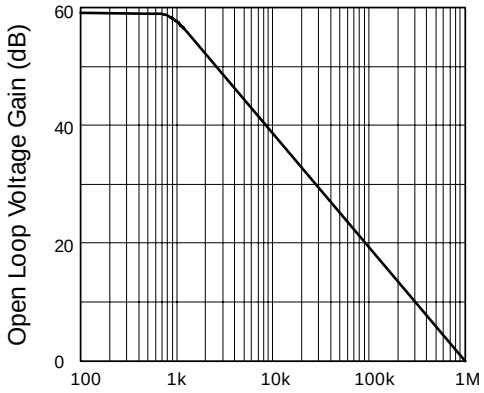


V_{REF} vs. Temperature

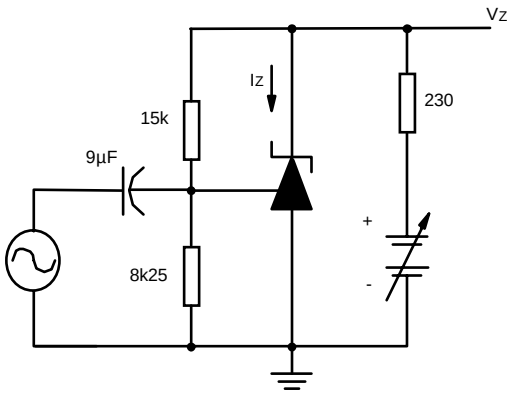


Power Dissipation Derating

Typical Operating Conditions (Cont.)

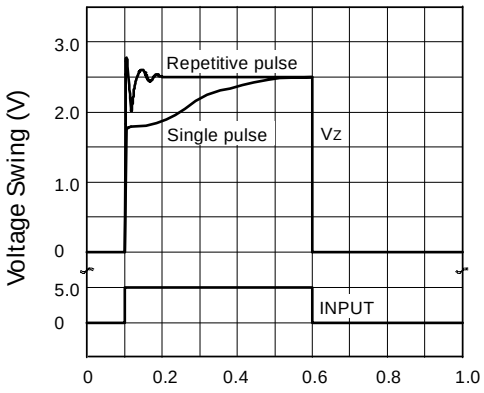


Gain v Frequency

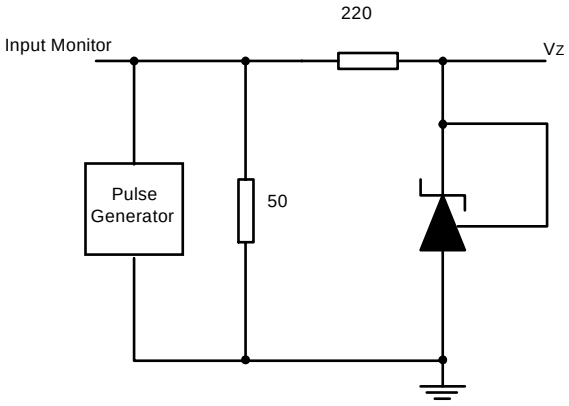


I_Z = 10mA, T_A = 25°C

Test Circuit for Open Loop Voltage Gain

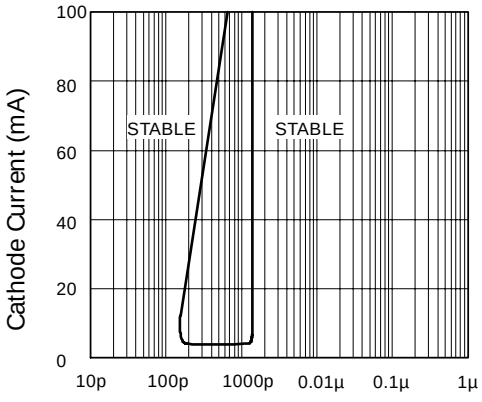


Pulse Response

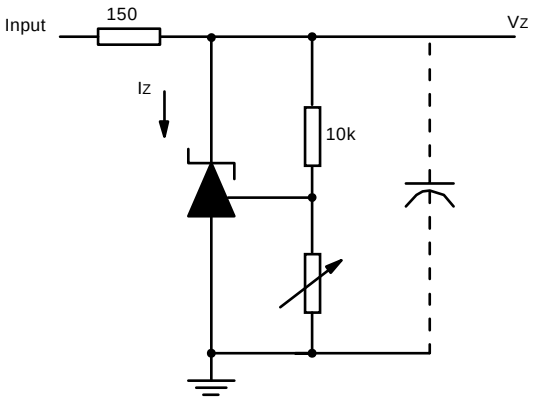


T_A = 25°C

Test Circuit for Pulse Response



Stability Boundary Conditions



$V_{REF} < V_Z < 20V$, I_Z = 10mA, T_A = 25°C

Test Circuit for Stability Boundary Conditions

DC Test Circuits

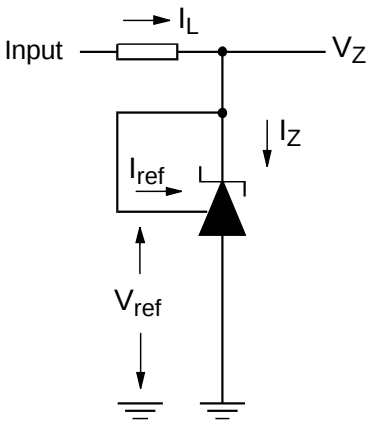


Fig 1 - Test circuit for $V_Z = V_{ref}$

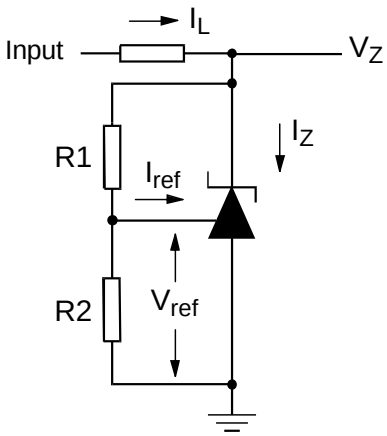


Fig 2 - Test circuit for $V_Z > V_{ref}$

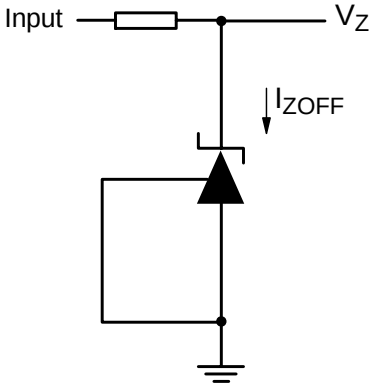
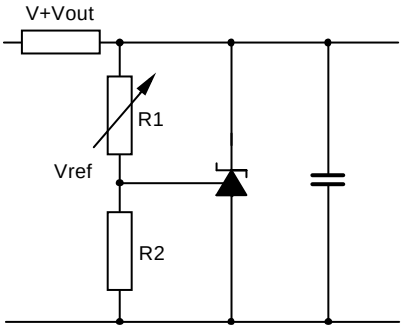


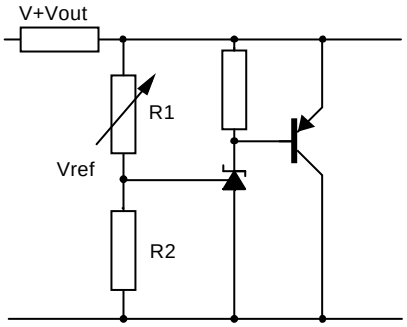
Fig 3 - Test circuit for Off state current†

Application Circuits



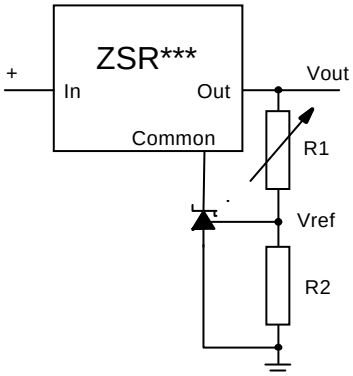
$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

Shunt regulator



$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

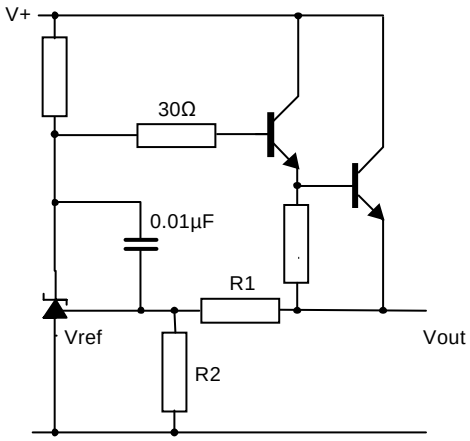
Higher current shunt regulator



$$Vout_{MIN} = Vref + Vreg$$

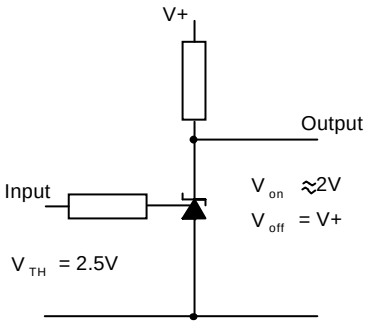
$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

Output control of a three terminal fixed regulator

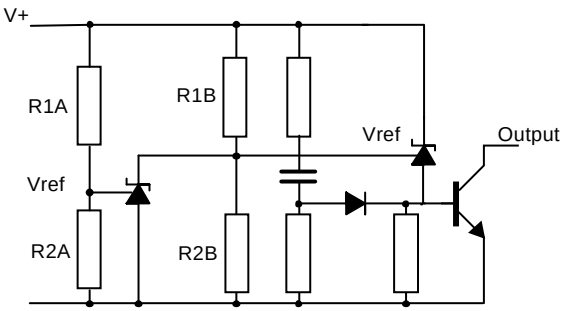


$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

Series regulator



Single supply comparator with temperature compensated threshold

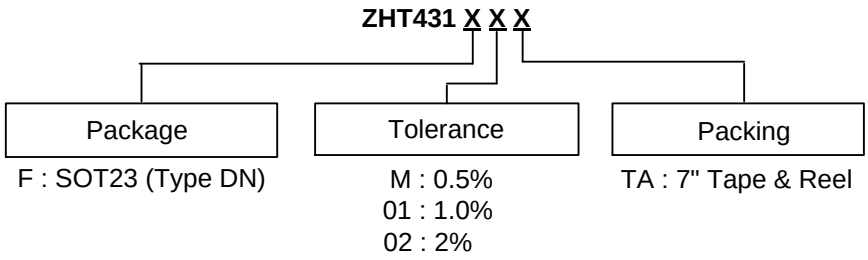


$$Low\ limit = \left(1 + \frac{R1B}{R2B}\right) Vref$$

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

Over voltage / under voltage protection circuit

Ordering Information



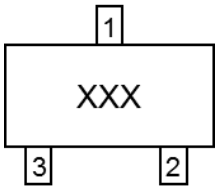
Part Number	Tolerance (%)	Package (Note 5)	Part Mark	Reel Size (inches)	Quantity per reel	Tape Width	Status (Note 4)
ZHT431F01TA	1	SOT23 (Type DN)	43C	7	3000	8mm	In Production
ZHT431F01-7	1	SOT23 (Type DN)	43C	7	3000	8mm	End of Life
ZHT431FMTA	0.5	SOT23 (Type DN)	43P	7	3000	8mm	In Production
ZHT431F02TA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

(Top View)

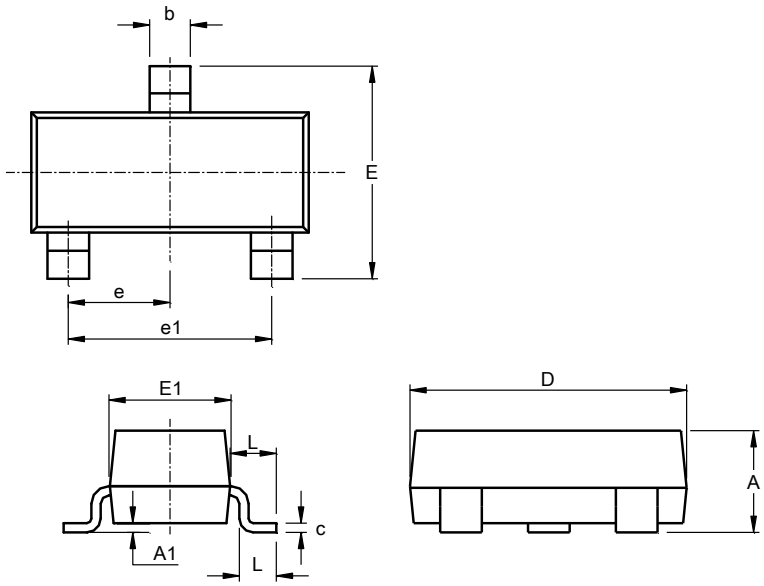


XXX : Part Mark

Package Outline Dimensions

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

(1) Package Type: SOT23 (Type DN)

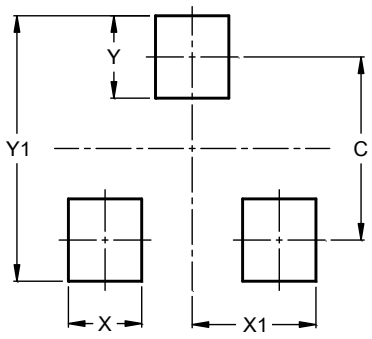


SOT23 (Type DN)			
Dim	**Min**	**Max**	**Typ**
A	0.89	1.12	1.00
A1	0.01	0.10	0.05
b	0.30	0.51	0.45
c	0.08	0.20	0.10
D	2.80	3.04	3.00
E	2.10	2.64	2.42
E1	1.20	1.40	1.37
e	0.95 REF		
e1	1.90 REF		
L	0.25	0.60	0.30
L1	0.45	0.62	0.54
All Dimensions in mm			

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

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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.

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