



**THE DATASHEET OF  
ZHT431F01TA**



## 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.

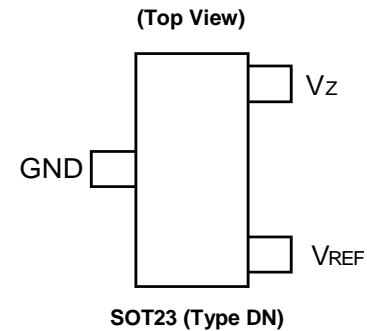
The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

## 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)**

- 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.

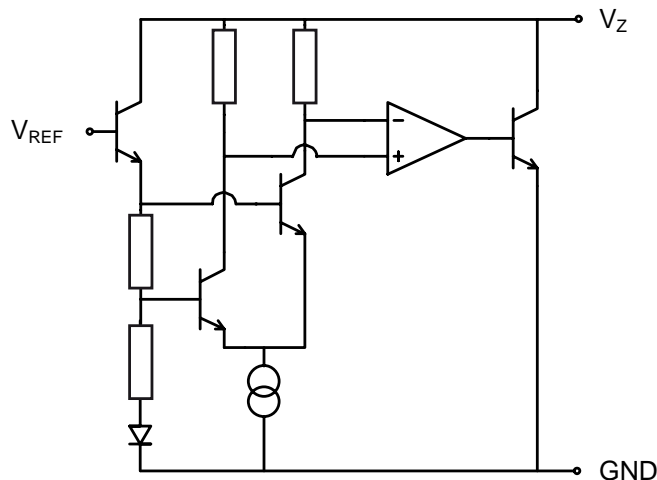
## Pin Assignments



## Applications

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

## Typical Application Circuit



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

Parameter	Rating	Unit
Cathode Voltage (V <sub>Z</sub> )	20	V
Cathode Current	150	mA
Operating Temperature	-55 to +125	°C
Storage Temperature	-55 to +150	°C
Power Dissipation (T <sub>A</sub> = +25°C, T <sub>JMAX</sub> = +150°C)	330	mW

**Recommended Operating Conditions**

Parameter	Min	Max	Unit
Cathode Voltage V <sub>REF</sub>	—	20	V
Cathode Current	0.05	100	mA

**Electrical Characteristics** (Test conditions unless otherwise specified: T<sub>A</sub> = +25°C.)

Symbol	VParameter		Values			Unit	Conditions
			Min.	Typ.	Max.		
V <sub>REF</sub>	Reference Voltage	2% 1% 0.5%	2.45 2.475 2.4875	2.50 2.50 2.50	2.55 2.525 2.5125	V	I <sub>L</sub> = 10mA (Fig.1), V <sub>Z</sub> = V <sub>REF</sub>
V <sub>DEV</sub>	Deviation of Reference Input Voltage Over Temperature		—	10	30	mV	I <sub>L</sub> = 10mA, V <sub>Z</sub> = V <sub>REF</sub> T <sub>A</sub> = 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 <sub>Z</sub> from V <sub>REF</sub> to 10V I <sub>Z</sub> = 10mA (Fig.2)
			—	-1.0	-2.0	mV/V	V <sub>Z</sub> from 10V to 20V I <sub>Z</sub> = 10mA (Fig.2)
I <sub>REF</sub>	Reference Input Current		—	0.12	1.0	μA	R1 = 10k, R2 = O/C, I <sub>L</sub> = 10mA (Fig.2)
ΔI <sub>REF</sub>	Deviation of Reference Input Current Over Temperature		—	0.04	0.2	μA	R1 = 10k, R2 = O/C, I <sub>L</sub> = 10mA, T <sub>A</sub> = Full Range (Fig.2)
I <sub>ZMIN</sub>	Minimum Cathode Current for Regulation		—	35	50	μA	V <sub>Z</sub> = V <sub>REF</sub> (Fig.1)
I <sub>ZOFF</sub>	Off-state Current		—	—	0.1	μA	V <sub>Z</sub> = 20V, V <sub>REF</sub> = 0V (Fig.3)
R <sub>Z</sub>	Dynamic Output Impedance		—	—	0.75	V	V <sub>Z</sub> = V <sub>REF</sub> (Fig.1), f = 0Hz, I <sub>C</sub> = 1mA to 100mA

Deviation of reference input voltage, V<sub>DEV</sub>, 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<sub>REF</sub> is defined as:

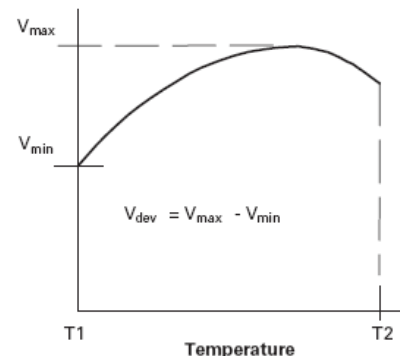
$$V_{REF} \left( \frac{ppm}{^{\circ}C} \right) = \frac{V_{DEV} \times 1000000}{V_{REF} (T1 - T2)}$$

The dynamic output impedance, R<sub>Z</sub>, is defined as:

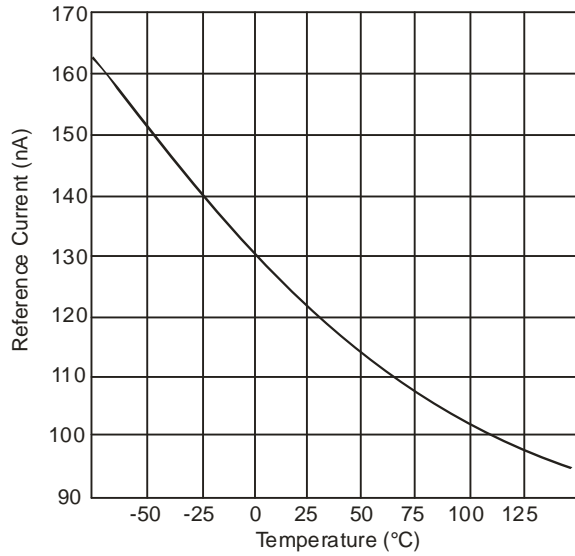
$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

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:

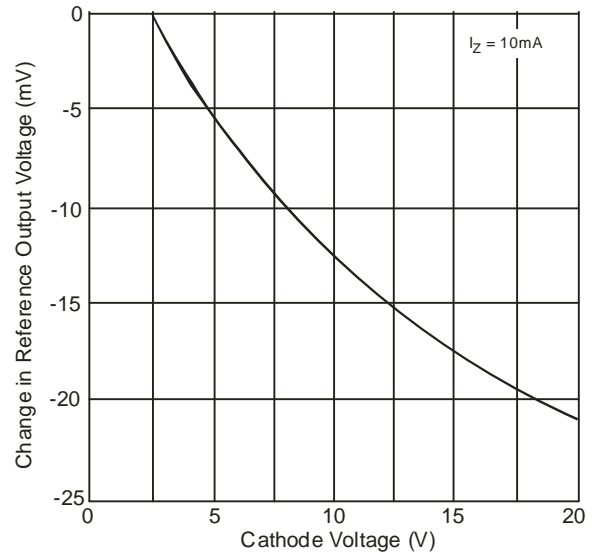
$$R' = R_Z \left( 1 + \frac{R1}{R2} \right)$$



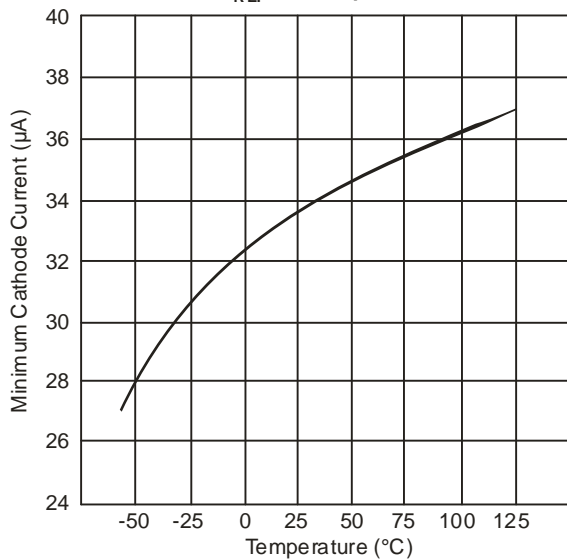
**Typical Operating Conditions**



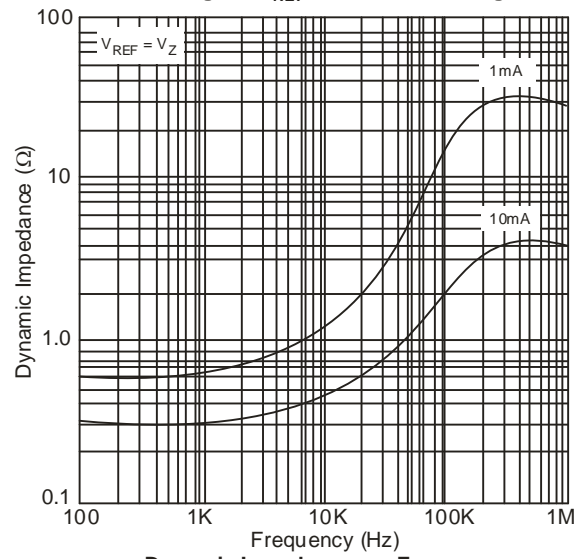
**$I_{REF}$  vs. Temperature**



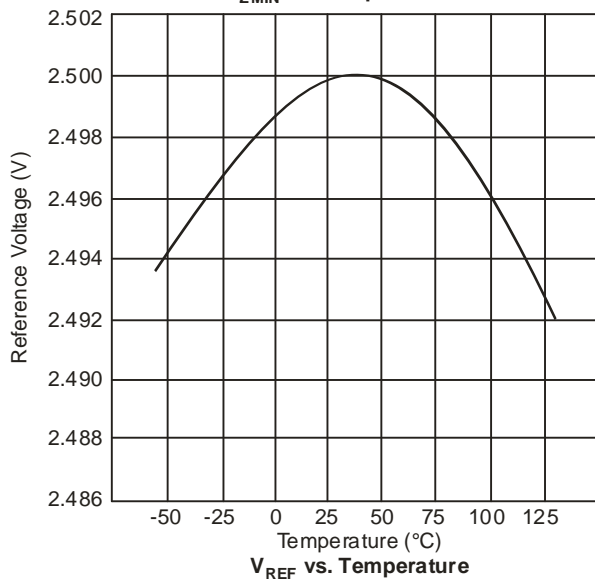
**Change in  $V_{REF}$  vs. Cathode Voltage**



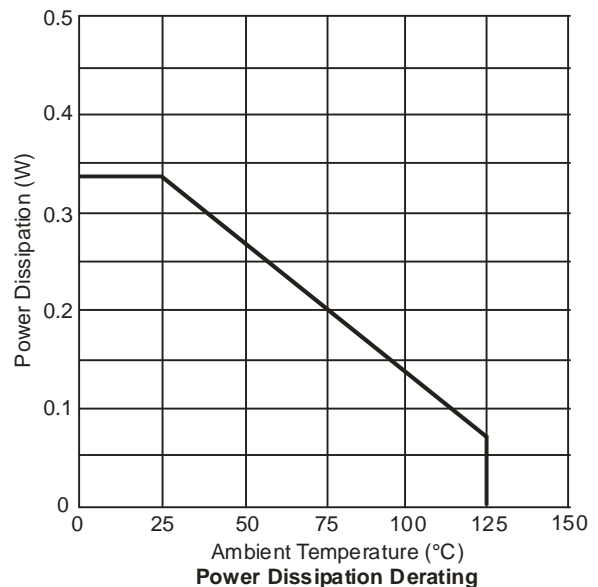
**$I_{ZMIN}$  vs. Temperature**



**Dynamic Impedance vs. Frequency**

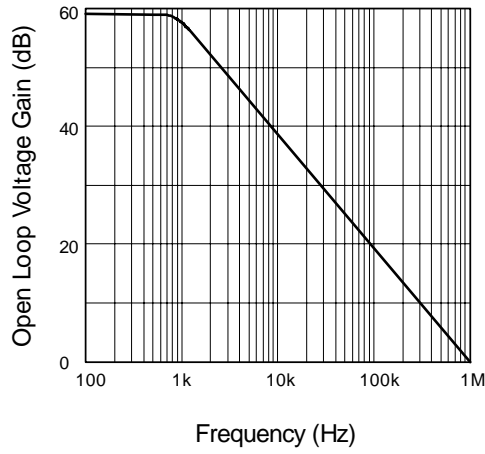


**$V_{REF}$  vs. Temperature**

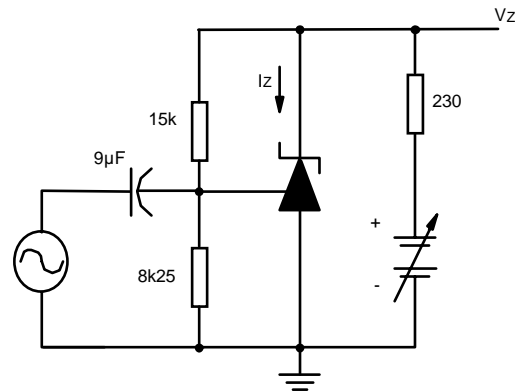


**Power Dissipation Derating**

**Typical Operating Conditions (Cont.)**

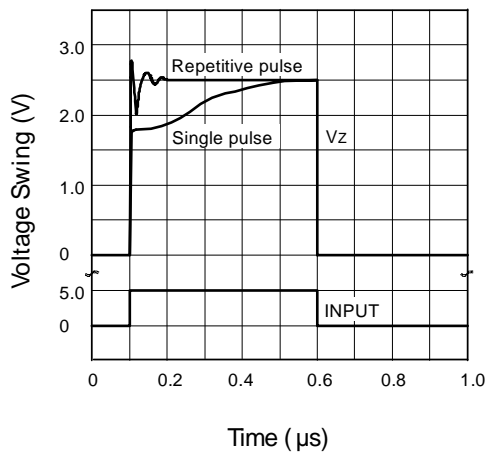


Gain v Frequency

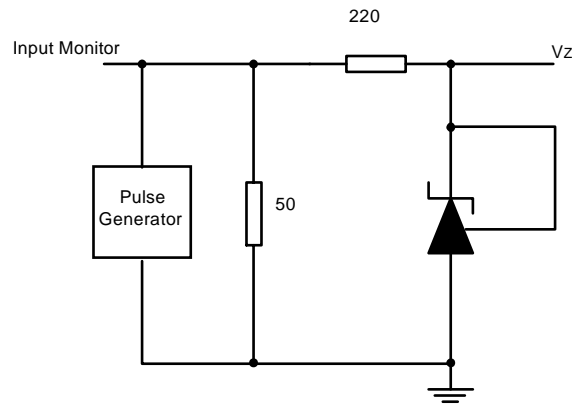


$I_z = 10\text{mA}$ ,  $T_A = 25^\circ\text{C}$

Test Circuit for Open Loop Voltage Gain

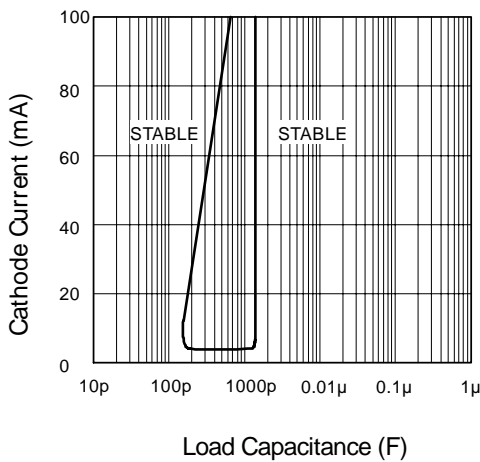


Pulse Response

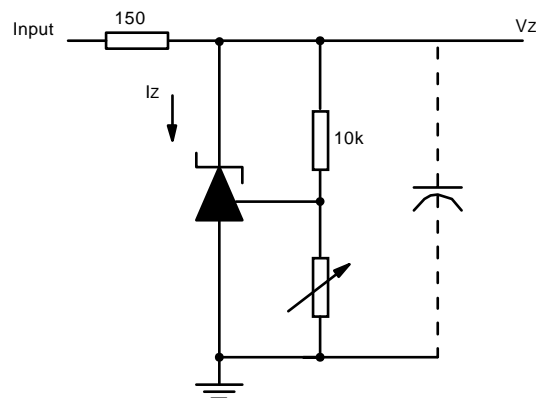


$T_A = 25^\circ\text{C}$

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**

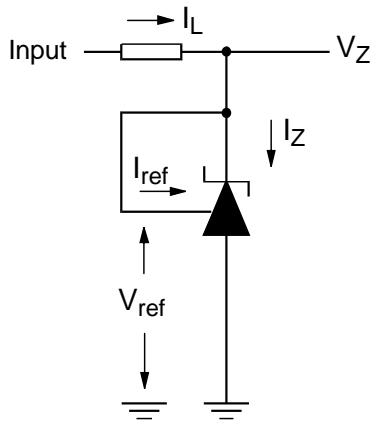


Fig 1 - Test circuit for  $V_Z = V_{ref}$

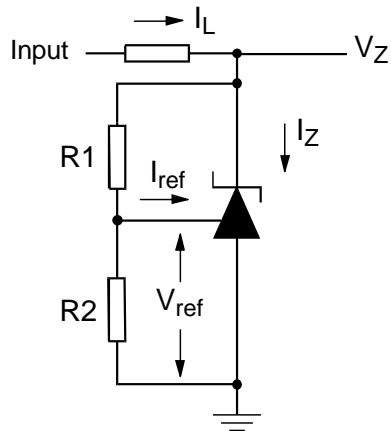


Fig 2 - Test circuit for  $V_Z > V_{ref}$

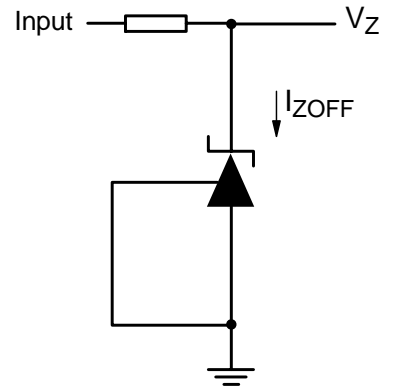
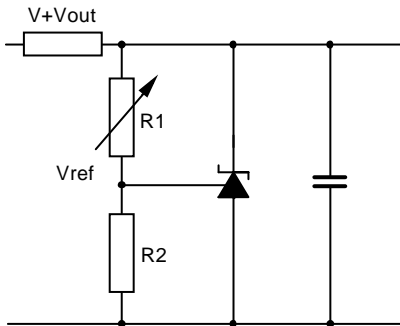


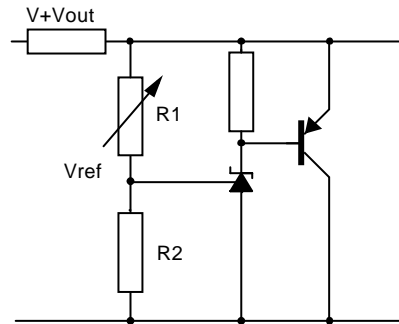
Fig 3 - Test circuit for Off state current†

**Application Circuits**



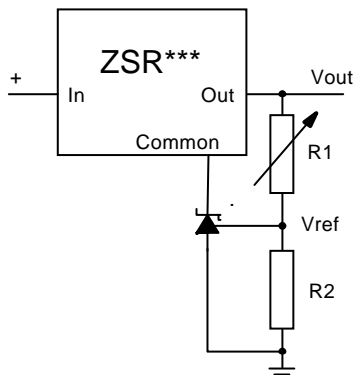
$$V_{out} = \left( 1 + \frac{R1}{R2} \right) V_{ref}$$

Shunt regulator



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

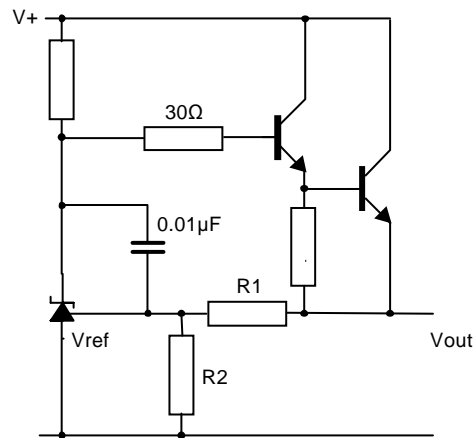
Higher current shunt regulator



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

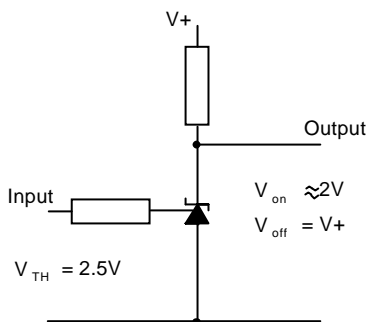
$$V_{out} = \left( 1 + \frac{R1}{R2} \right) V_{ref}$$

Output control of a three terminal fixed regulator

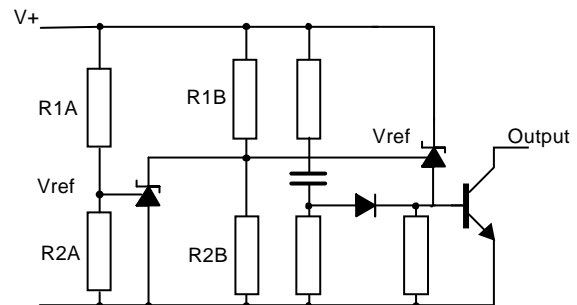


$$V_{out} = \left( 1 + \frac{R1}{R2} \right) V_{ref}$$

Series regulator



Single supply comparator with temperature compensated threshold

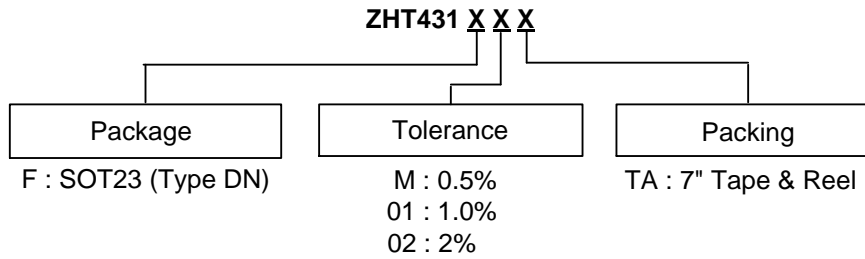


$$\text{Low limit} = \left( 1 + \frac{R1B}{R2B} \right) V_{ref}$$

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

Over voltage / under voltage protection circuit

**Ordering Information**

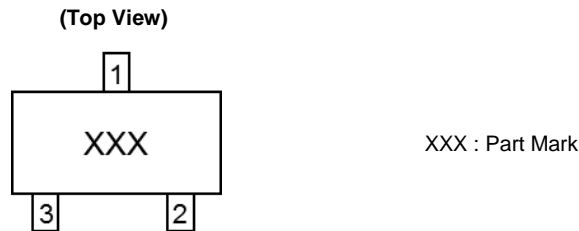


Part Number	Tolerance (%)	Package (Note 5)	Part Mark	Reel Size (inches)	Quantity per reel	Tape Width	Status (Note 4)
ZHT431F01TA	1	SOT23 (Type DN)	43C	7	3000	8mm	In Production
ZHT431F01-7	1	SOT23 (Type DN)	43C	7	3000	8mm	End of Life
ZHT431FMTA	0.5	SOT23 (Type DN)	43P	7	3000	8mm	In Production
ZHT431F02TA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

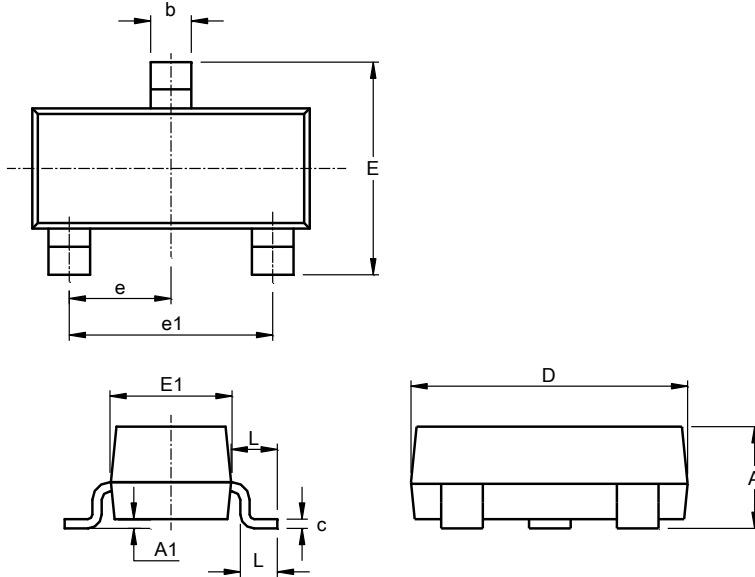
SOT23 (Type DN)



## Package Outline Dimensions

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

### (1) Package Type: SOT23 (Type DN)

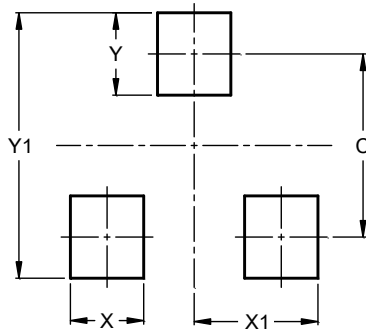


SOT23 (Type DN)			
Dim	Min	Max	Typ
A	0.89	1.12	1.00
A1	0.01	0.10	0.05
b	0.30	0.51	0.45
c	0.08	0.20	0.10
D	2.80	3.04	3.00
E	2.10	2.64	2.42
E1	1.20	1.40	1.37
e	0.95 REF		
e1	1.90 REF		
L	0.25	0.60	0.30
L1	0.45	0.62	0.54
All Dimensions in mm			

## 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

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