

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.

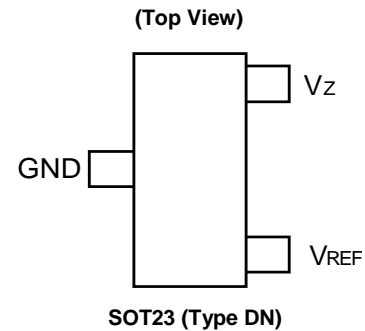
The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

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.

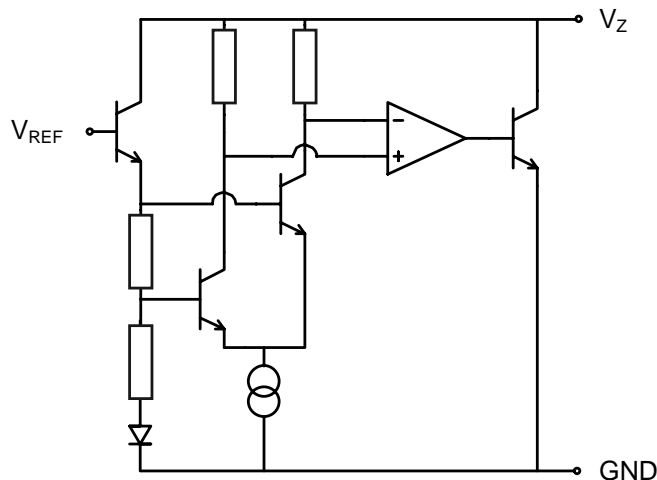
Pin Assignments



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 _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 2.50 | 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:

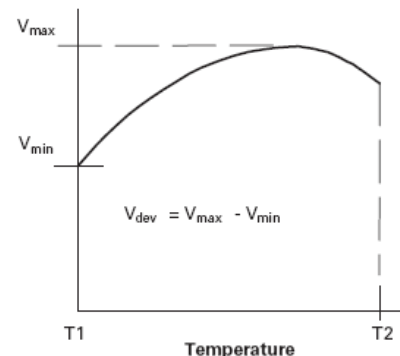
$$V_{REF} \left(\frac{ppm}{^{\circ}C} \right) = \frac{V_{DEV} \times 1000000}{V_{REF} (T1 - T2)}$$

The dynamic output impedance, R_Z, is defined as:

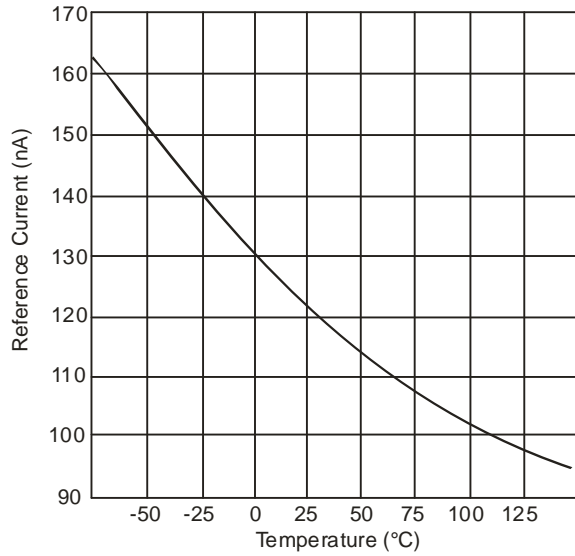
$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

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:

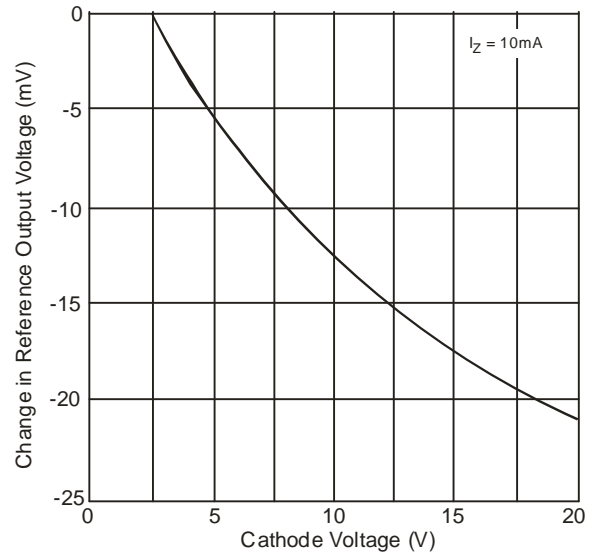
$$R' = R_Z \left(1 + \frac{R1}{R2} \right)$$



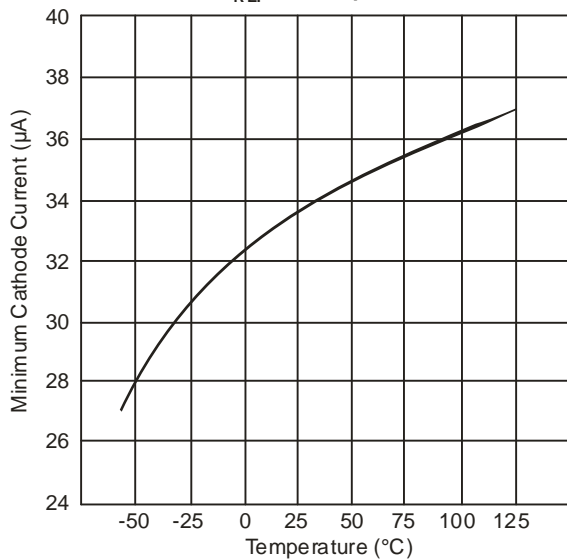
Typical Operating Conditions



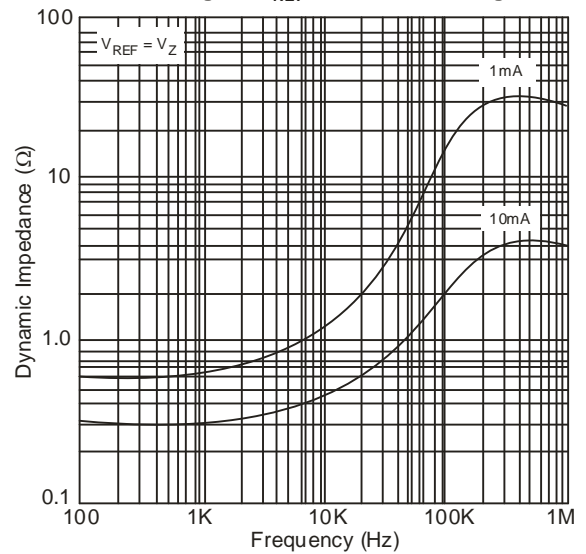
I_{REF} vs. Temperature



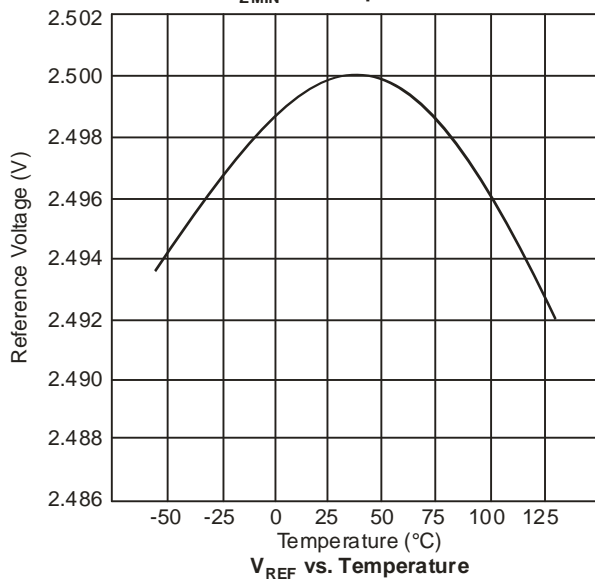
Change in V_{REF} vs. Cathode Voltage



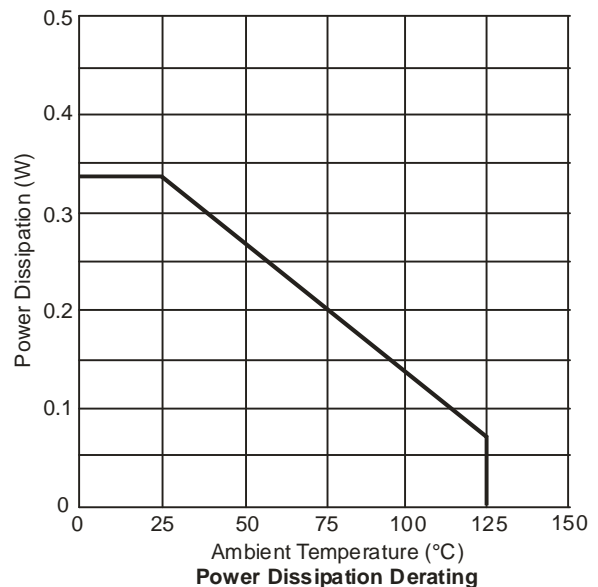
I_{ZMIN} vs. Temperature



Dynamic Impedance vs. Frequency

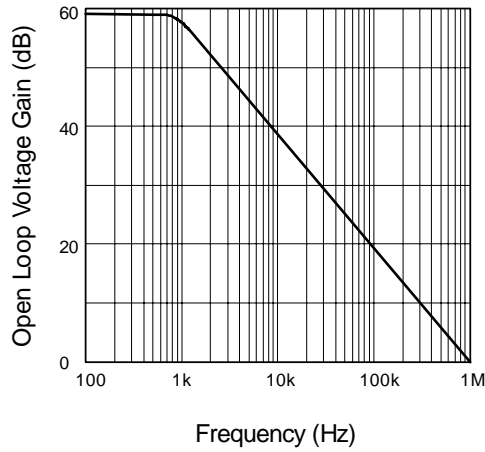


V_{REF} vs. Temperature

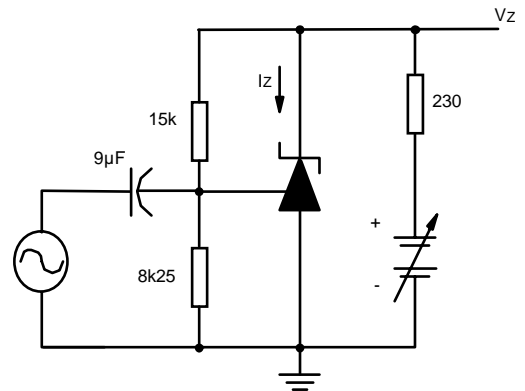


Power Dissipation Derating

Typical Operating Conditions (Cont.)

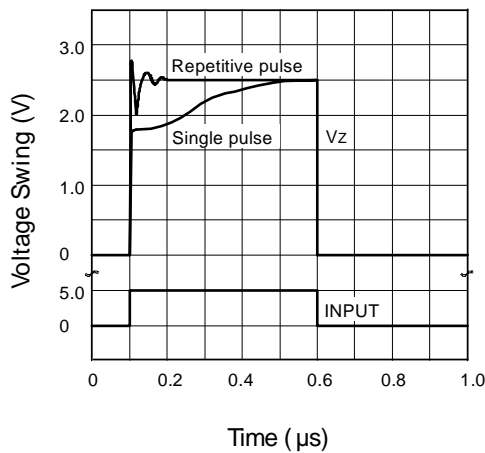


Gain v Frequency

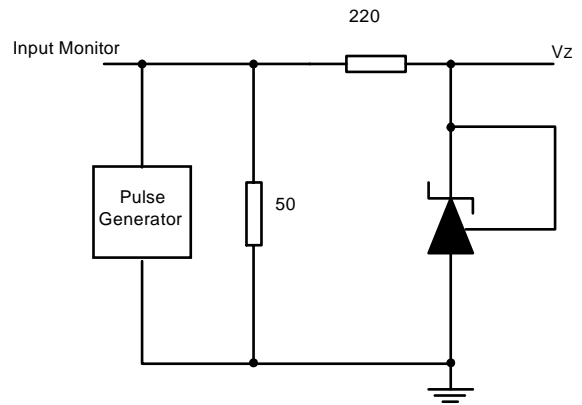


$I_z = 10\text{mA}$, $T_A = 25^\circ\text{C}$

Test Circuit for Open Loop Voltage Gain

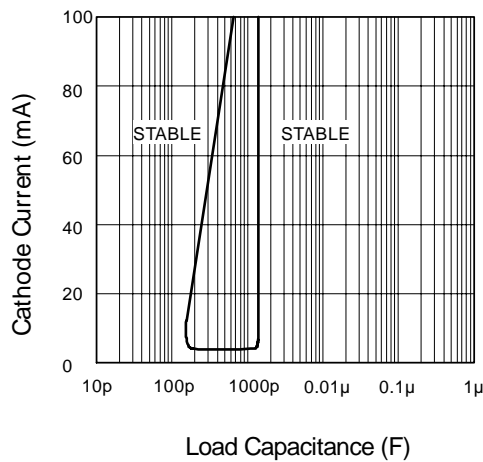


Pulse Response

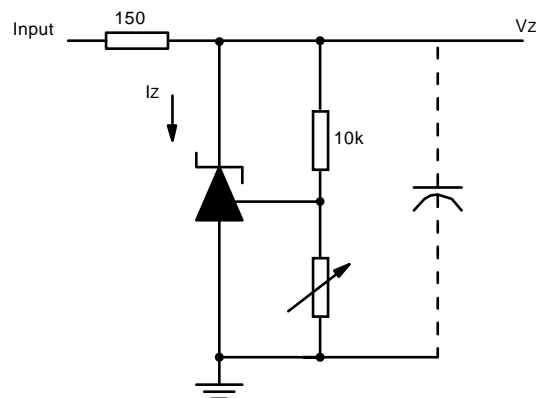


$T_A = 25^\circ\text{C}$

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

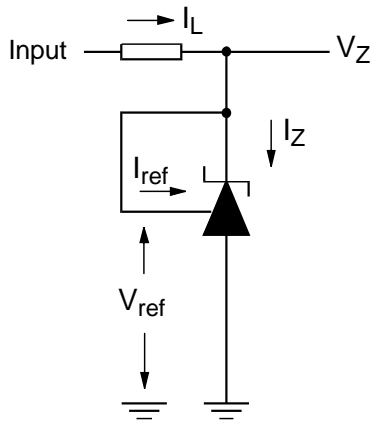


Fig 1 - Test circuit for $V_Z = V_{ref}$

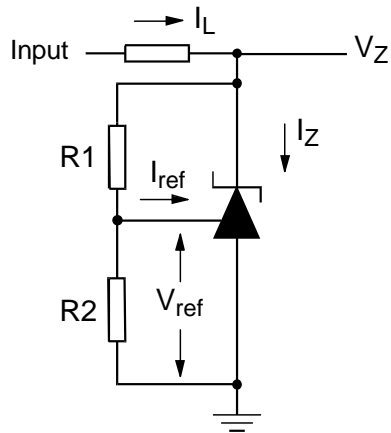


Fig 2 - Test circuit for $V_Z > V_{ref}$

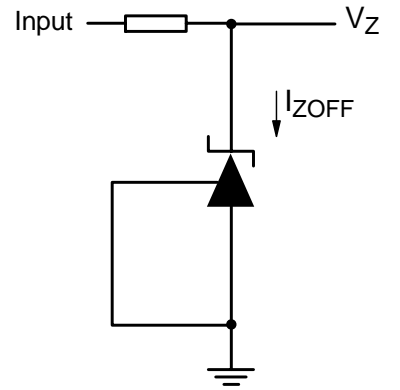
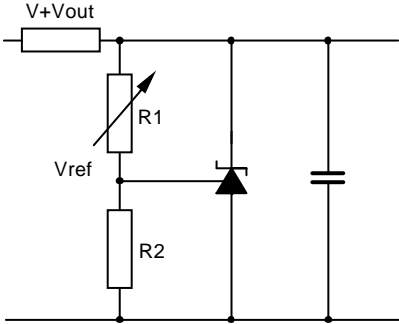


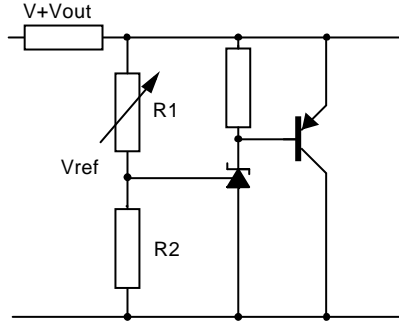
Fig 3 - Test circuit for Off state current†

Application Circuits



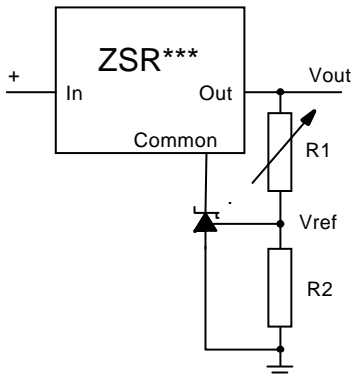
$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

Shunt regulator



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

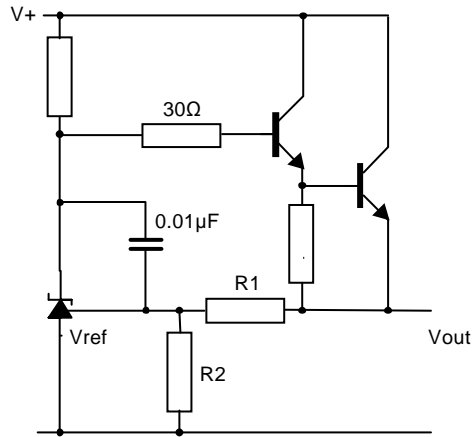
Higher current shunt regulator



$$V_{out_MIN} = V_{ref} + V_{reg}$$

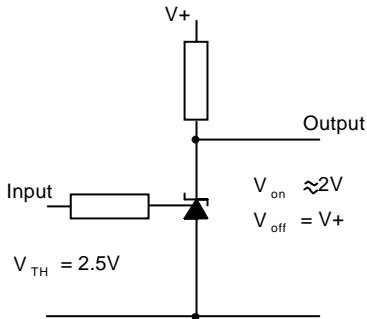
$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

Output control of a three terminal fixed regulator

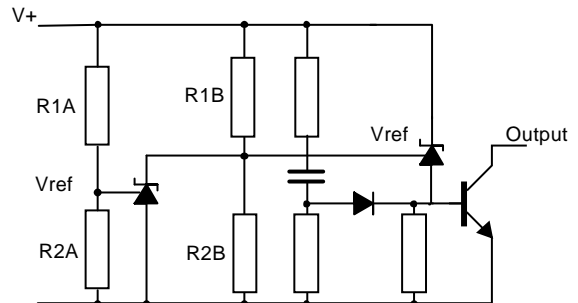


$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

Series regulator



Single supply comparator with temperature compensated threshold

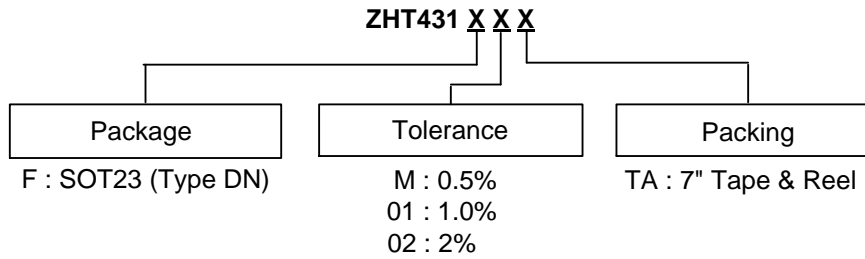


$$\text{Low limit} = \left(1 + \frac{R1B}{R2B} \right) V_{ref}$$

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

Over voltage / under voltage protection circuit

Ordering Information

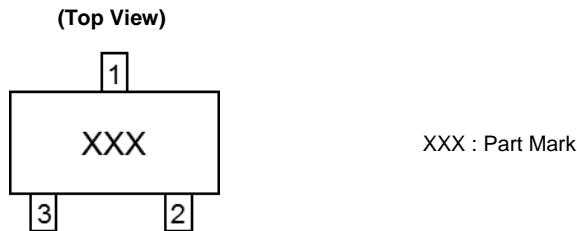


| Part Number | Tolerance (%) | Package (Note 5) | Part Mark | Reel Size (inches) | Quantity per reel | Tape Width | Status (Note 4) |
|-------------|---------------|------------------|-----------|--------------------|-------------------|------------|-----------------|
| ZHT431F01TA | 1 | SOT23 (Type 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

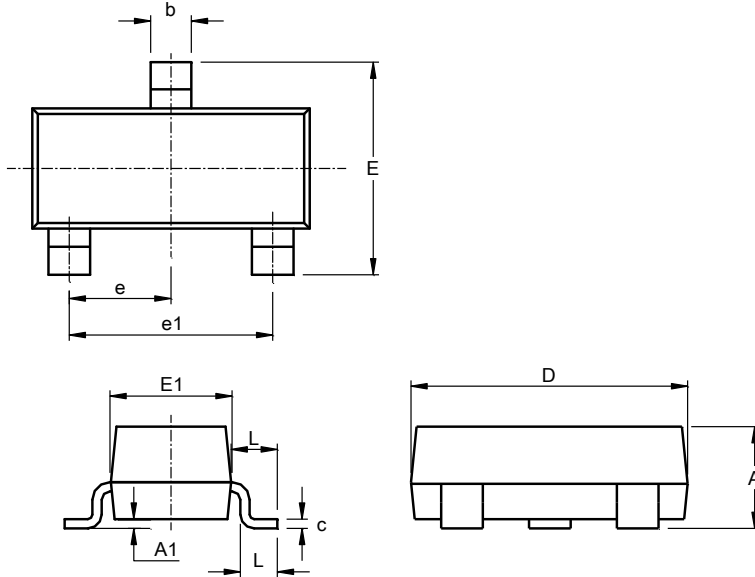
SOT23 (Type DN)



Package Outline Dimensions

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

(1) Package Type: SOT23 (Type DN)

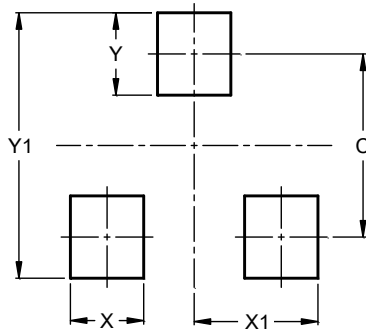


| SOT23 (Type DN) | | | |
|----------------------|----------|------|------|
| Dim | Min | Max | Typ |
| A | 0.89 | 1.12 | 1.00 |
| A1 | 0.01 | 0.10 | 0.05 |
| b | 0.30 | 0.51 | 0.45 |
| c | 0.08 | 0.20 | 0.10 |
| D | 2.80 | 3.04 | 3.00 |
| E | 2.10 | 2.64 | 2.42 |
| E1 | 1.20 | 1.40 | 1.37 |
| e | 0.95 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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