

ZHT431
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.

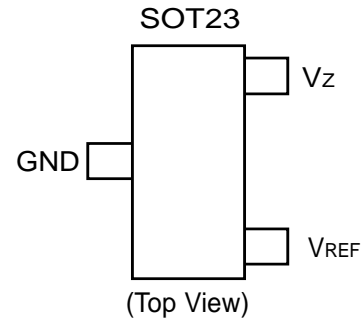
Features

- Surface mount SOT23 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
- Available in “Green” Molding Compound (See page 7)
- Wide temperature range -55 to +125°C

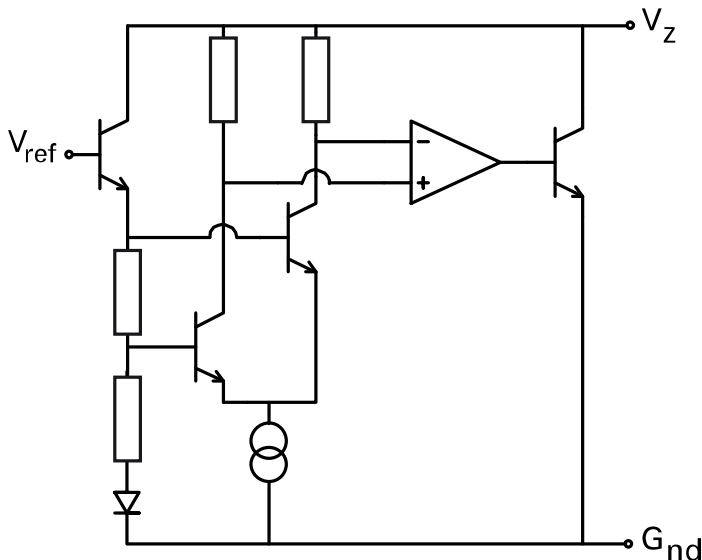
Applications

- Series and shunt regulator
- Voltage monitor
- Over voltage / under voltage protection
- Switch mode power supplies

Pin Assignments



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 _{amb} = 25°C, T _{JMAX} = 150°C) | 330 | mW |

Recommended Operating Conditions

| Parameter | Min | Max | Units |
|----------------------------------|------|-----|-------|
| Cathode Voltage V _{REF} | - | 20 | V |
| Cathode Current | 0.05 | 100 | mA |

Electrical Characteristics (Test conditions unless otherwise specified: T_{amb} = 25°C)

| Symbol | Parameter | | Values | | | Units | Conditions |
|-------------------------------------|---|------------------|--------|-------|------|-------|---|
| | | | Min. | Typ. | Max. | | |
| V _{REF} | Reference Voltage | 2% 1% 0.5% | 2.45 | 2.50 | 2.55 | 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 _{amb} =full range (Fig1) |
| $\frac{\Delta V_{REF}}{\Delta V_Z}$ | 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. | mV/V |
| 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 _{amb} =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:

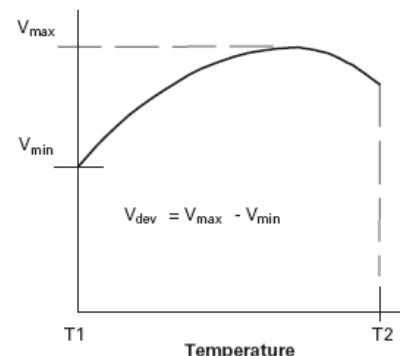
$$V_{REF} \left(\frac{ppm}{^{\circ}C} \right) = \frac{V_{DEV} \times 1000000}{V_{REF} (T1 - T2)}$$

The dynamic output impedance, R_Z, is defined as:

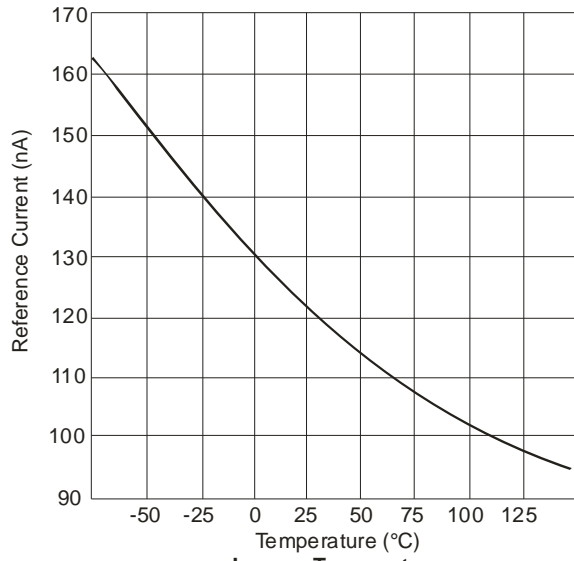
$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

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:

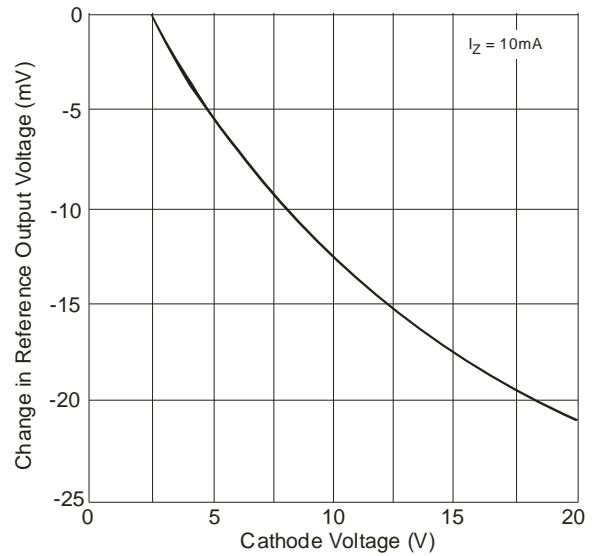
$$R' = R_Z \left(1 + \frac{R1}{R2} \right)$$



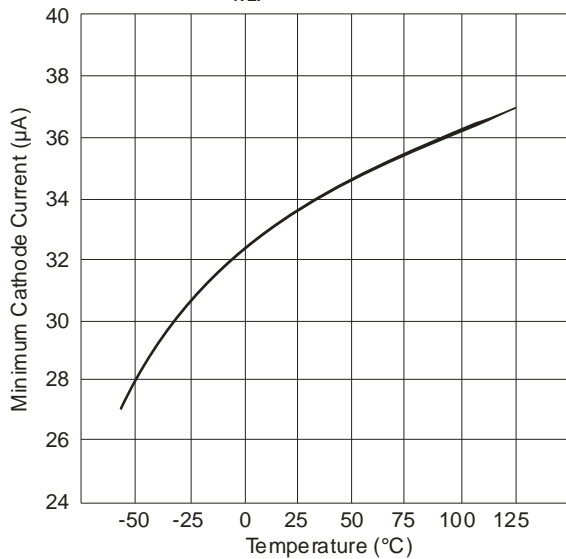
Typical Operating Conditions



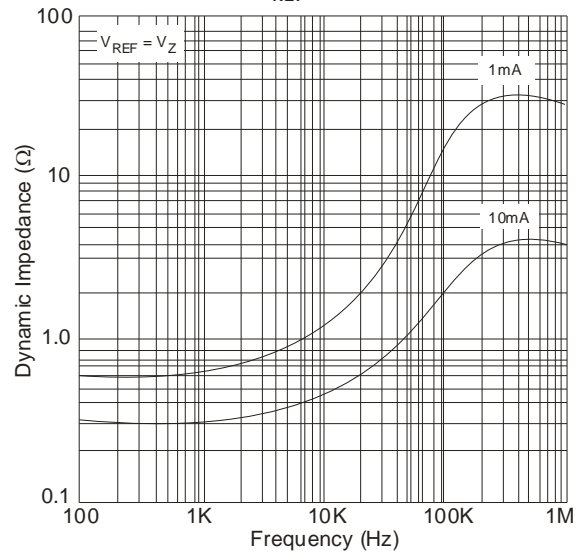
I_{REF} vs. Temperature



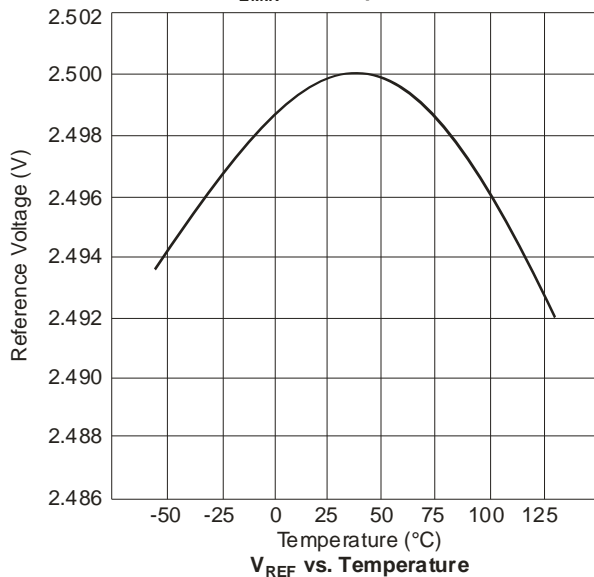
Change in V_{REF} vs. Cathode Voltage



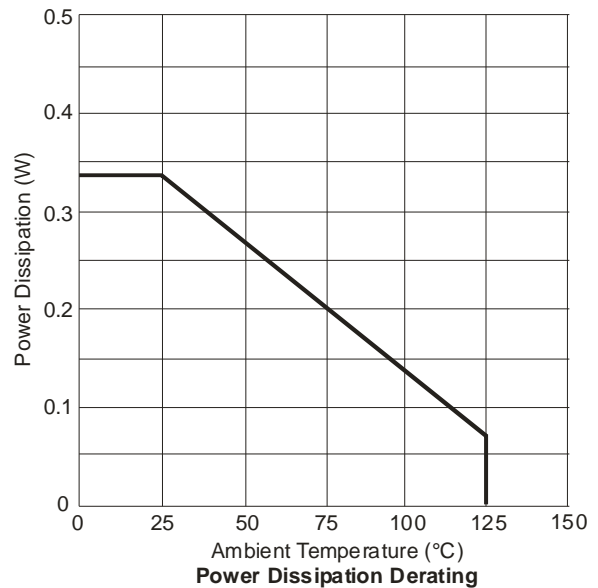
I_{ZMIN} vs. Temperature



Dynamic Impedance vs. Frequency

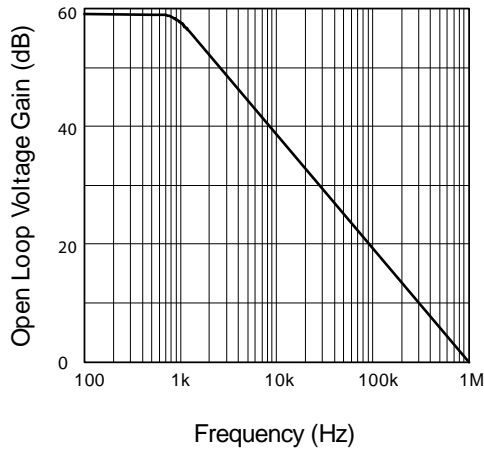


V_{REF} vs. Temperature

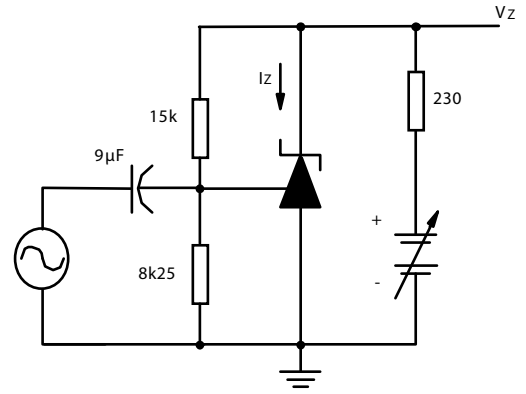


Power Dissipation Derating

Typical Operating Conditions (Cont.)

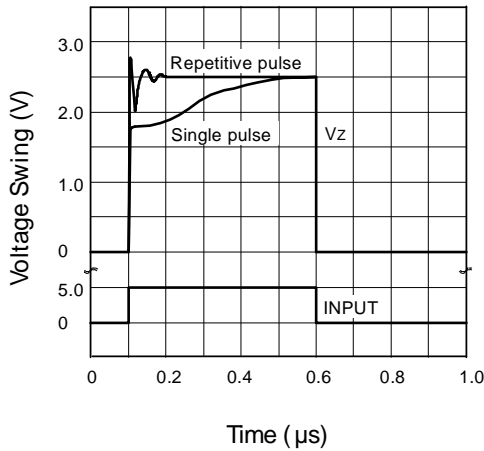


Gain v Frequency

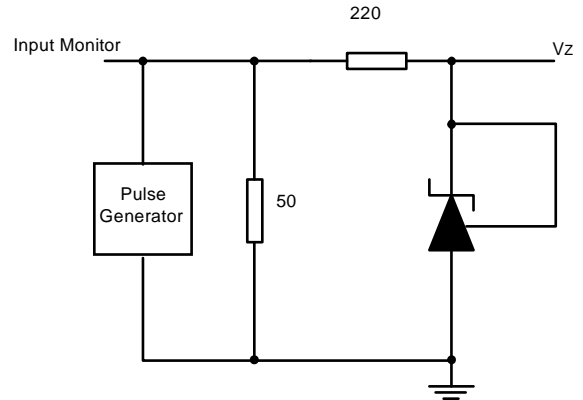


$I_Z = 10\text{mA}$, $T_A = 25^\circ\text{C}$

Test Circuit for Open Loop Voltage Gain

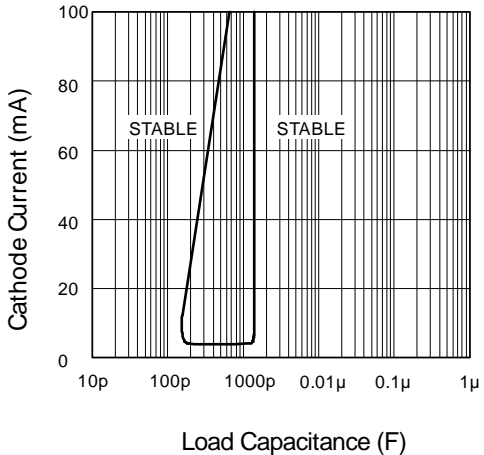


Pulse Response

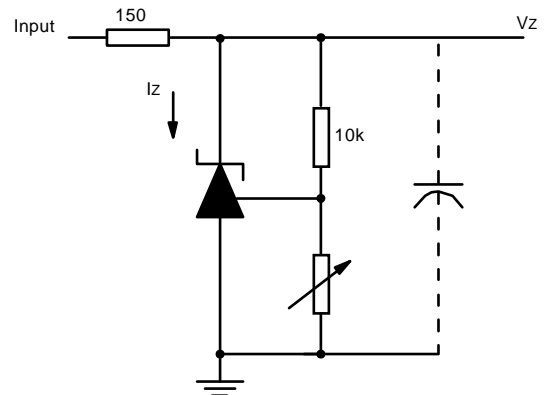


$T_A = 25^\circ\text{C}$

Test Circuit for Pulse Response



Stability Boundary Conditions



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

Test Circuit for Stability Boundary Conditions

DC Test Circuits

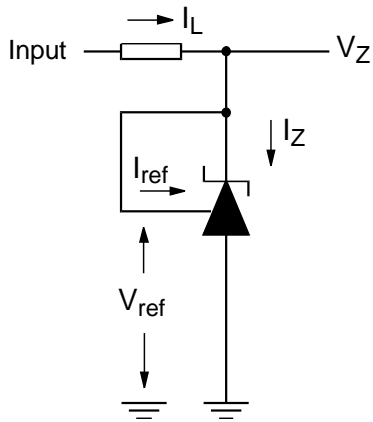


Fig 1 - Test circuit for $V_Z = V_{ref}$

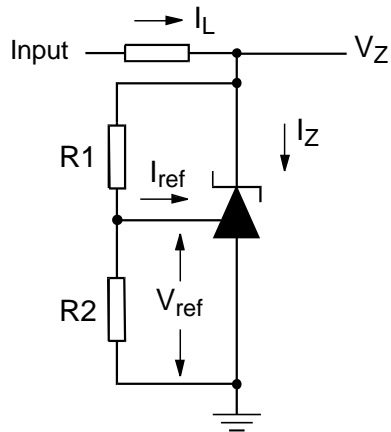


Fig 2 - Test circuit for $V_Z > V_{ref}$

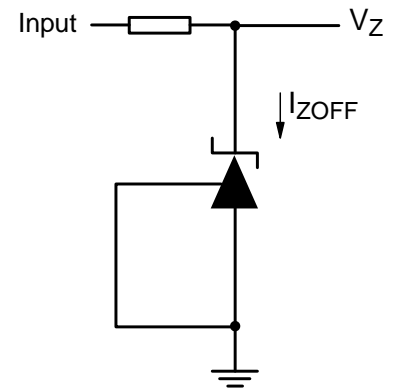
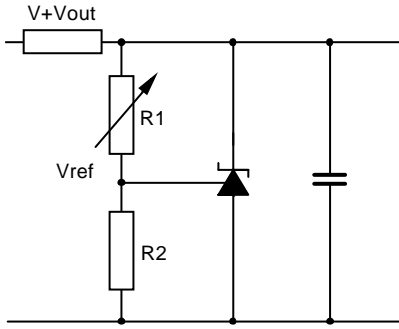


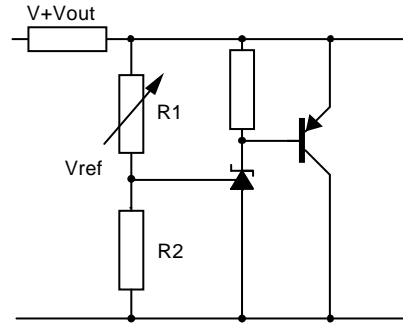
Fig 3 - Test circuit for Off state current†

Application Circuits



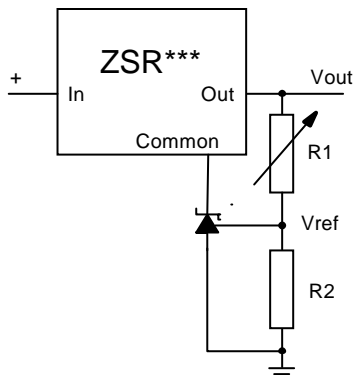
$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

Shunt regulator



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

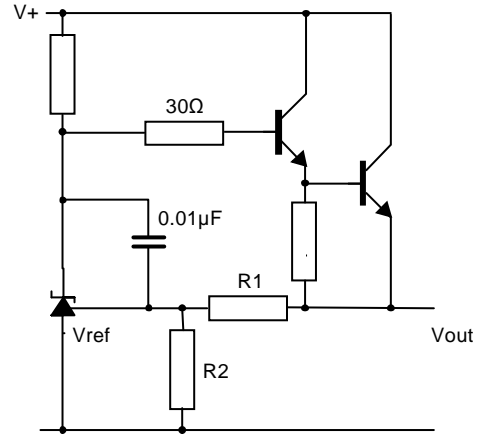
Higher current shunt regulator



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

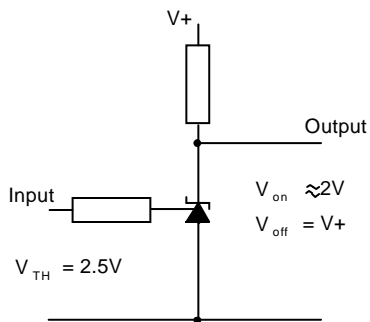
$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

Output control of a three terminal fixed regulator

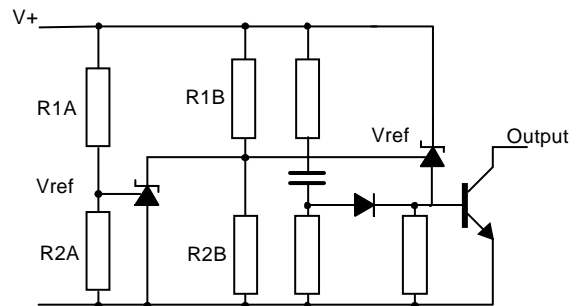


$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

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

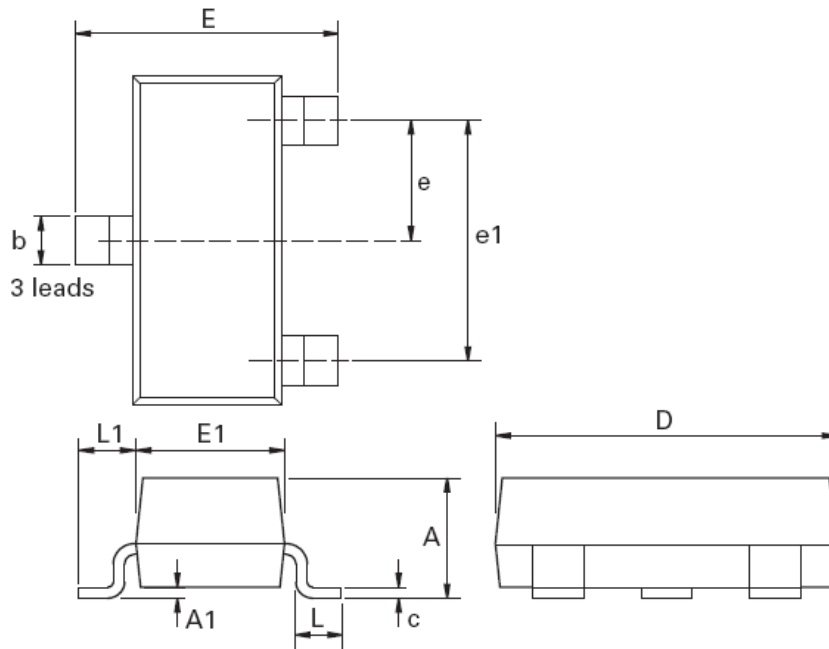
Ordering Information

| Ordering Reference | Tolerance (%) | Package | Part Mark | Status | Reel Size (inches) | Quantity per reel | Tape Width |
|--------------------------|---------------|---------|-----------|--------|--------------------|-------------------|------------|
| ZHT431F01TA ¹ | 1 | SOT23 | 43C | Active | 7 | 3000 | 8mm |
| ZHT431F01-7 ² | 1 | SOT23 | 43C | Active | 7 | 3000 | 8mm |
| ZHT431FM TA ¹ | 0.5 | SOT23 | 43P | Active | 7 | 3000 | 8mm |
| ZHT431F02TA ¹ | 2 | SOT23 | 43D | Active | 7 | 3000 | 8mm |

Notes: 1. A 'Green' molding compound is used from date code 1010. For further details, refer to http://www.diodes.com/quality/lead_free.html
2. All date codes of the '-7' option use 'Green' molding compound.

Package Outline Dimensions

SOT23



| Dim. | Millimeters | | Inches | | Dim. | Millimeters | | Inches | |
|------|-------------|------|--------|-------|------|-------------|------|-----------|--------|
| | Min. | Max. | Min. | Max. | | Min. | Max. | Min. | Max. |
| A | - | 1.12 | - | 0.044 | e1 | 1.90 NOM | | 0.075 NOM | |
| A1 | 0.01 | 0.10 | 0.0004 | 0.004 | E | 2.10 | 2.64 | 0.083 | 0.104 |
| b | 0.30 | 0.50 | 0.012 | 0.020 | E1 | 1.20 | 1.40 | 0.047 | 0.055 |
| c | 0.085 | 0.20 | 0.003 | 0.008 | L | 0.25 | 0.60 | 0.0098 | 0.0236 |
| D | 2.80 | 3.04 | 0.110 | 0.120 | L1 | 0.45 | 0.62 | 0.018 | 0.024 |
| e | 0.95 | NOM | 0.037 | NOM | - | - | - | - | - |

Note: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

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