

**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.

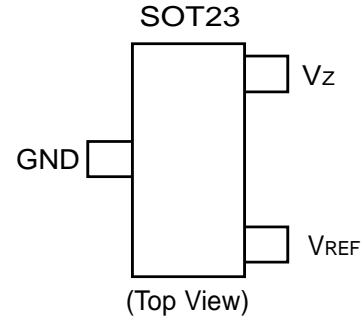
**Features**

- 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

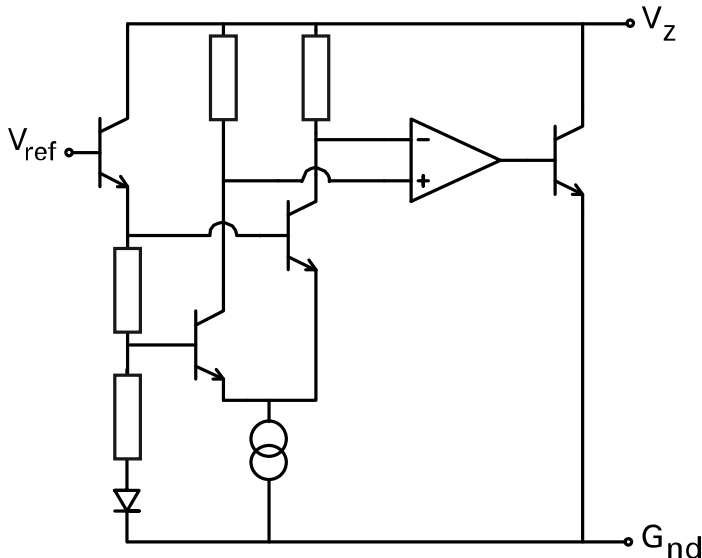
**Applications**

- 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 <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>amb</sub> = 25°C, T <sub>JMAX</sub> = 150°C)	330	mW

**Recommended Operating Conditions**

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

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

Symbol	Parameter		Values			Units	Conditions
			Min.	Typ.	Max.		
V <sub>REF</sub>	Reference Voltage	2% 1% 0.5%	2.45	2.50	2.55	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>amb</sub> =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 <sub>Z</sub> from V <sub>REF</sub> to 10V I <sub>Z</sub> =10mA (Fig.2)
					-1.0	-2.	mV/V
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>amb</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:

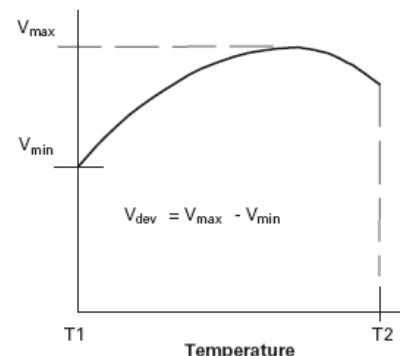
$$V_{REF} \left( \frac{ppm}{^\circ C} \right) = \frac{V_{DEV} \times 1000000}{V_{REF} (T1 - T2)}$$

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

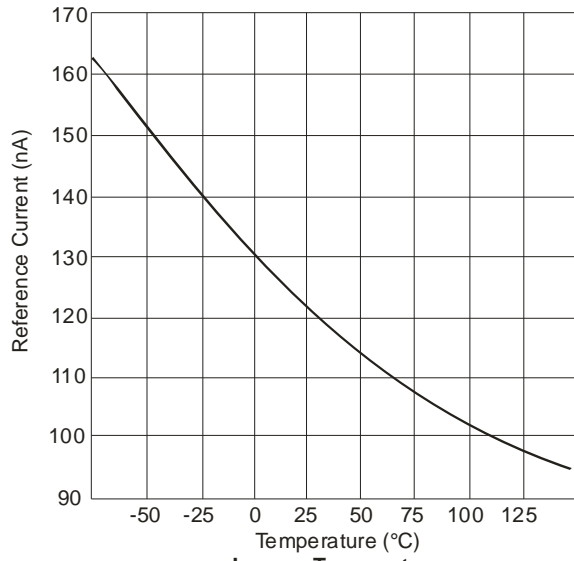
$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

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:

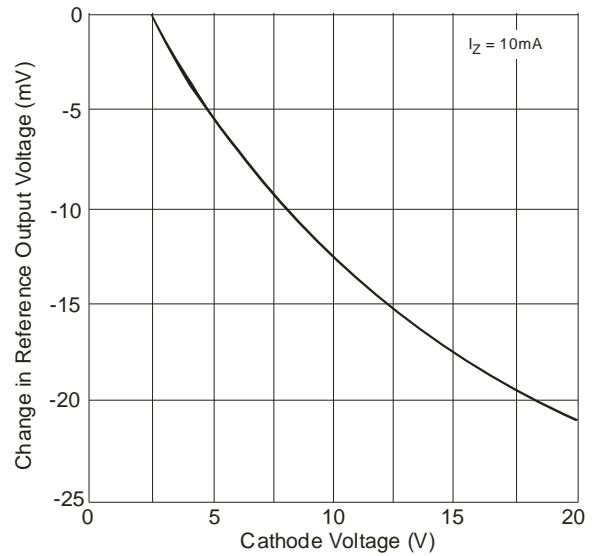
$$R' = R_Z \left( 1 + \frac{R1}{R2} \right)$$



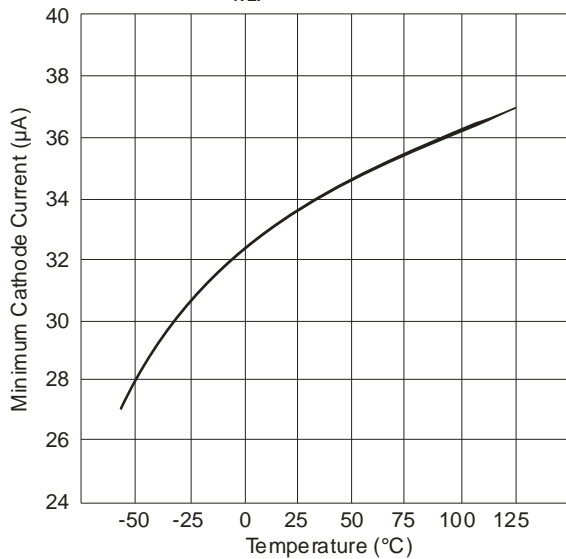
**Typical Operating Conditions**



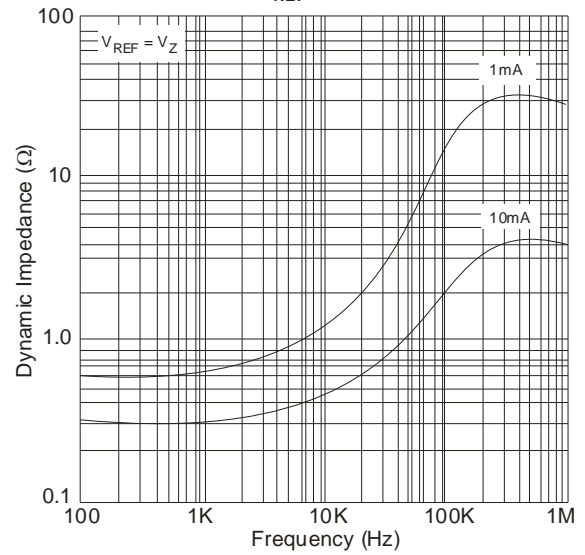
**$I_{REF}$  vs. Temperature**



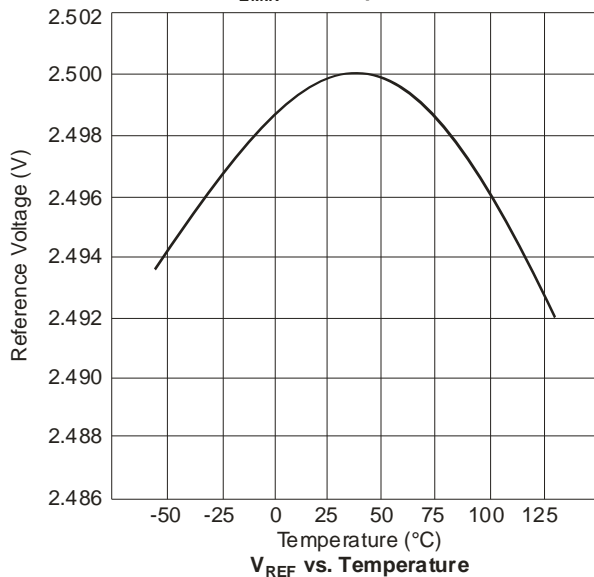
**Change in  $V_{REF}$  vs. Cathode Voltage**



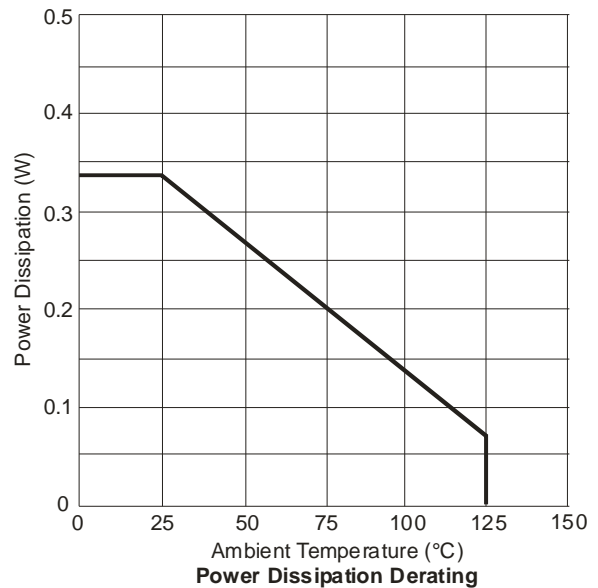
**$I_{ZMIN}$  vs. Temperature**



**Dynamic Impedance vs. Frequency**

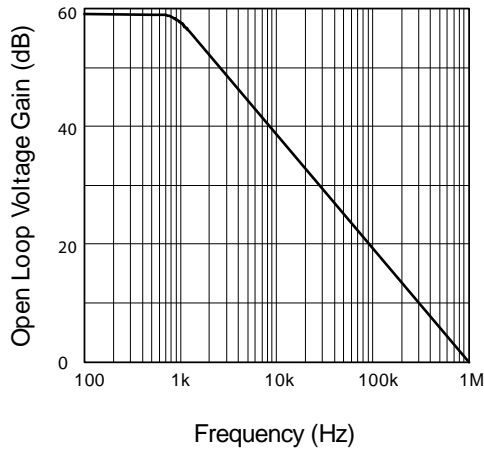


**$V_{REF}$  vs. Temperature**

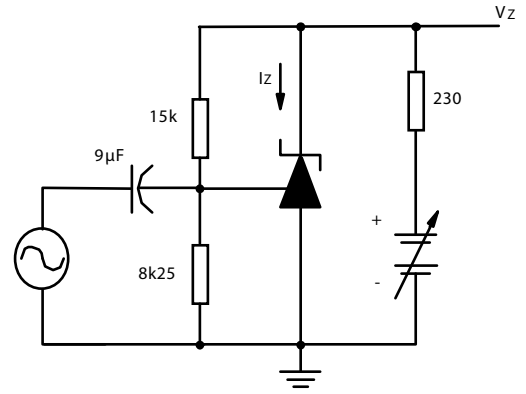


**Power Dissipation Derating**

**Typical Operating Conditions (Cont.)**

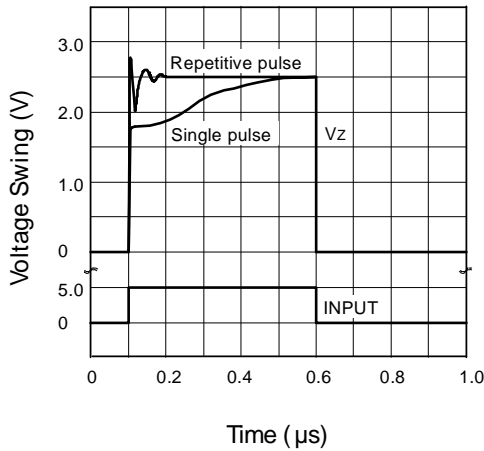


Gain v Frequency

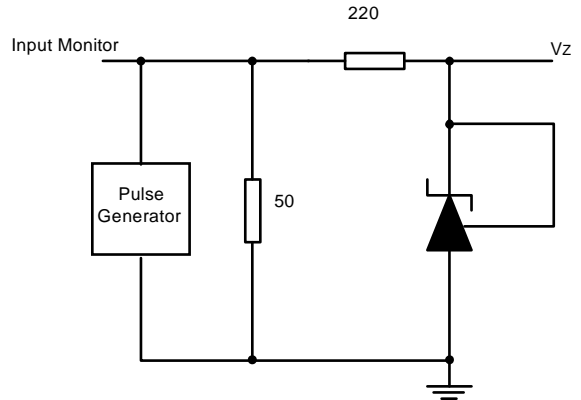


$I_Z = 10\text{mA}$ ,  $T_A = 25^\circ\text{C}$

Test Circuit for Open Loop Voltage Gain

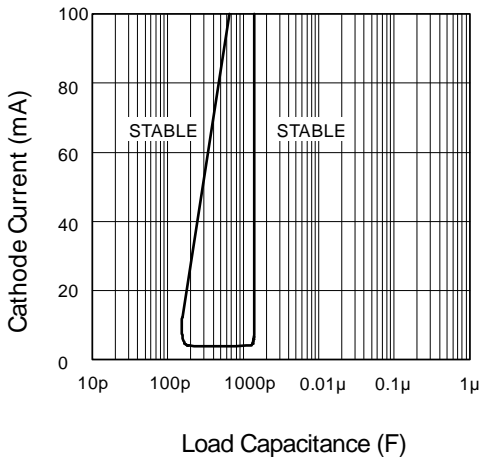


Pulse Response

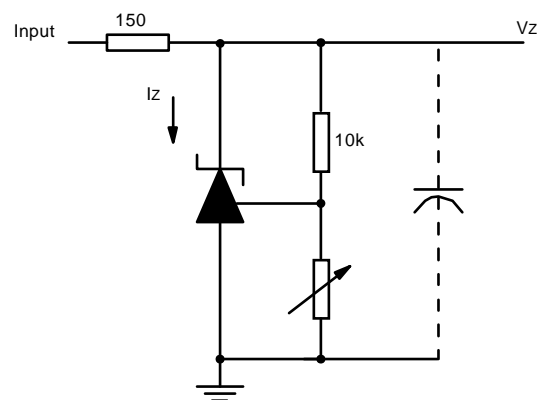


$T_A = 25^\circ\text{C}$

Test Circuit for Pulse Response



Stability Boundary Conditions



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

Test Circuit for Stability Boundary Conditions

**DC Test Circuits**

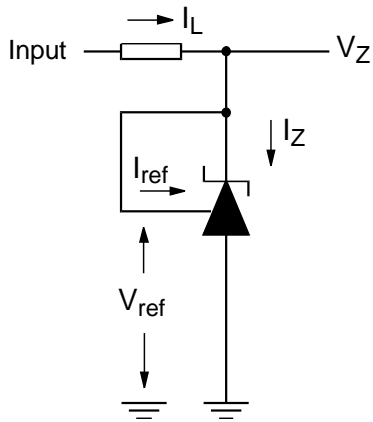


Fig 1 - Test circuit for  $V_Z = V_{ref}$

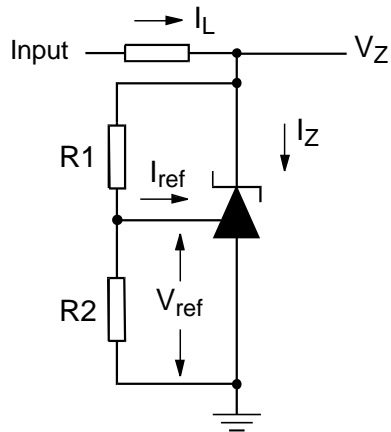


Fig 2 - Test circuit for  $V_Z > V_{ref}$

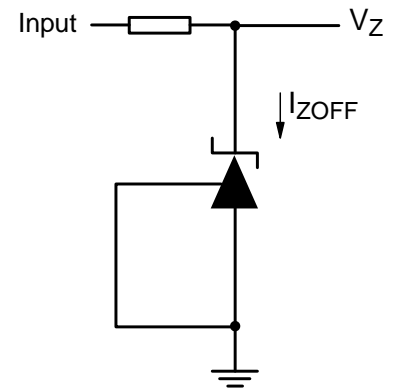
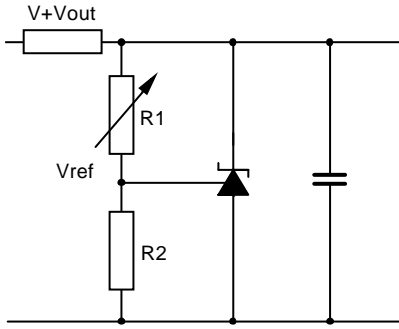


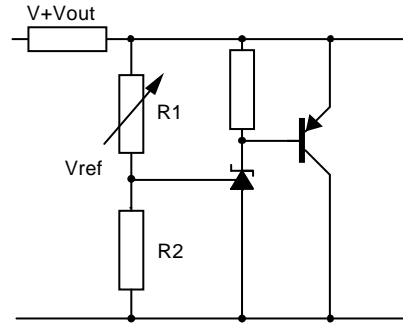
Fig 3 - Test circuit for Off state current†

**Application Circuits**



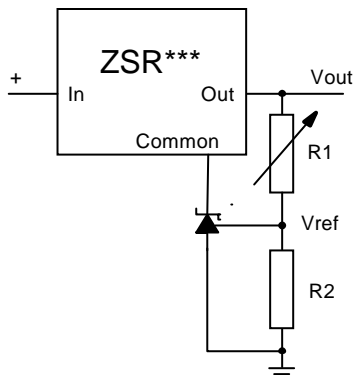
$$V_{out} = \left( 1 + \frac{R1}{R2} \right) V_{ref}$$

Shunt regulator



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

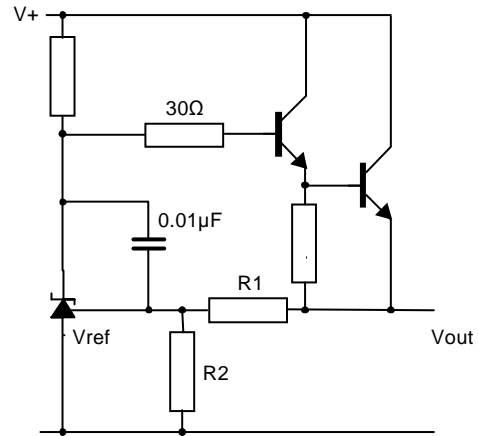
Higher current shunt regulator



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

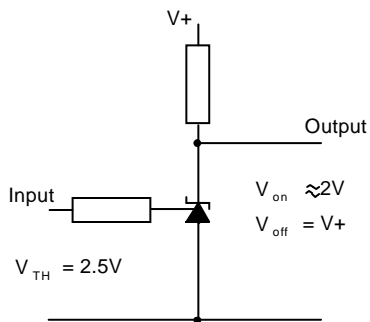
$$V_{out} = \left( 1 + \frac{R1}{R2} \right) V_{ref}$$

Output control of a three terminal fixed regulator

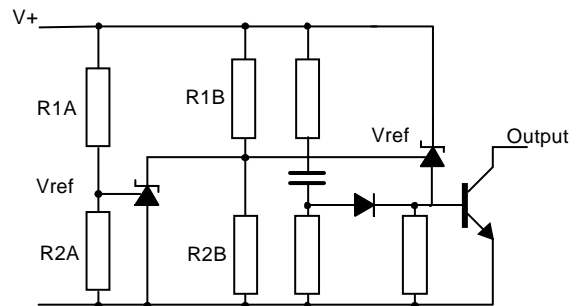


$$V_{out} = \left( 1 + \frac{R1}{R2} \right) V_{ref}$$

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

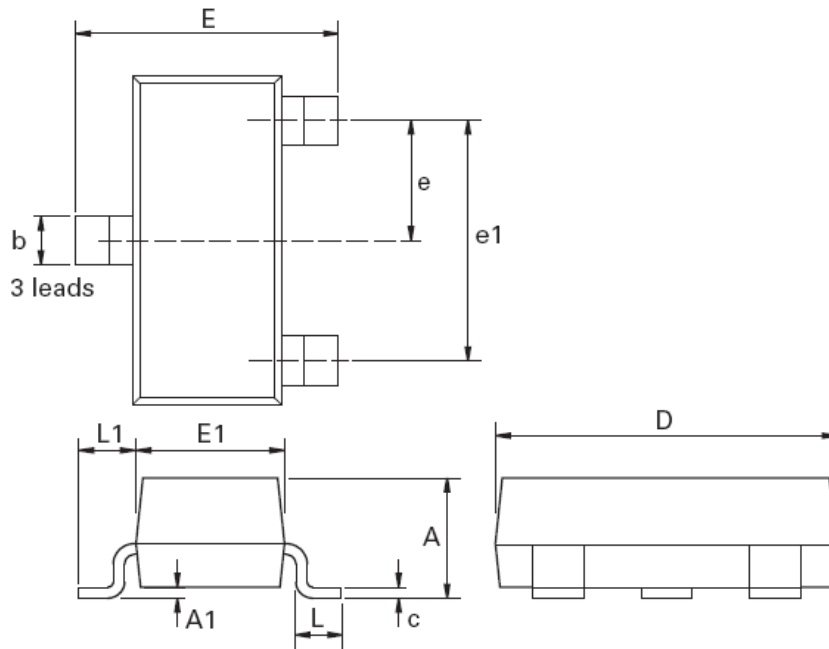
**Ordering Information**

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