ZR431

ADJUSTABLE PRECISION ZENER SHUNT REGULATOR

Description

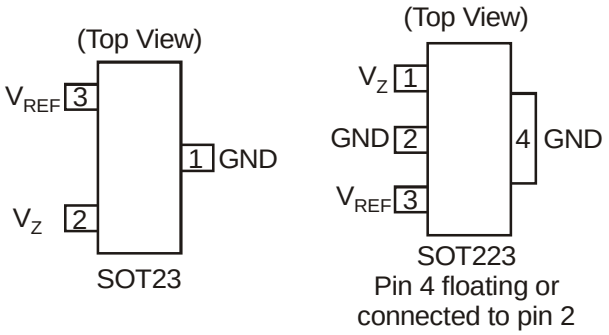
The ZR431 is a three terminal adjustable shunt regulator offering excellent temperature stability and output current handling capability up to 100mA. The output voltage may be set to any chosen voltage between 2.5 and 20 volts by selection of two external divider resistors.

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

Features

- Surface mount SOT223 and SOT23 packages
- 2%, 1 % and 0.5% tolerance
- Max. temperature coefficient 55 ppm/°C
- Temperature compensated for operation
- over the full temperature range
- Programmable output voltage
- 50µA to 100mA current sink capability
- Low output noise
- All package options available in “Green” Molding Compound (No Br, Sb) and Lead Free Finish/ RoHS Compliant (Note 1)

Pin Assignments

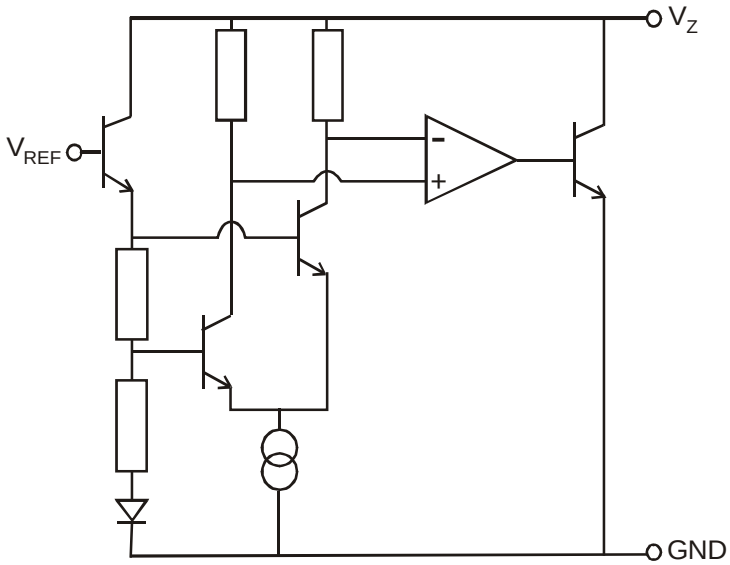


Applications

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

Notes: 1. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied. Please visit our website at http://www.diodes.com/products/lead_free.html.

Typical Application Circuit



Absolute Maximum Ratings (Note 2)

Symbol	Parameter		Rating	Unit
V_Z	Cathode Voltage		20	V
I_Z	Cathode Current		150	mA
T_A	Operating Temperature		-40 to +85	°C
T_{ST}	Storage Temperature		-55 to +125	°C
P_D	Power Dissipation (Notes 3, 4)	SOT23	330	mW
		SOT223	2	W

Notes: 2. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability. Unless otherwise stated voltages specified are relative to the ANODE pin.
3. T_J, max =150°C.
4. Ratings apply to ambient temperature at 25°C.

Recommended Operating Conditions (T_A = 25°C)

Symbol	Parameter	Min	Max	Unit
V_Z	Cathode Voltage	V_{REF}	20	V
I_Z	Cathode Current	0.05	100	mA

Electrical Characteristics (T_A = 25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
V_{REF}	Reference voltage (Note 5) 2% 1 % 0.5%	I_L = 10mA (Fig 1), $V_Z = V_{REF}$	2.45 2.475 2.487	2.50 2.50 2.50	2.55 2.525 2.513	V
V_{DEV}	Deviation of reference input voltage over temperature	I_L = 10mA, $V_Z = V_{REF}$ T_A = Full range (Fig 1)		8.0	17	mV
$\frac{\Delta V_{REF}}{\Delta V_Z}$	Ratio of the change in reference voltage to the change in cathode voltage	V_Z from V_{REF} to 10V I_Z = 10mA (fig 2)		-1.85	-2.7	mV/V
		V_Z from 10V to 20V I_Z = 10mA (Fig 2)		-1.0	-2.0	
I_{REF}	Reference input current	R1 = 10k, R2 = O/C, I_L = 10mA (Fig 2)		0.12	1.0	µA
ΔI_{REF}	Deviation of reference input current over temperature	R1 = 10k, R2 = O/C, I_L = 10mA T_A = Full range (Fig 2)		0.04	0.2	µA
$I_{Z(MIN)}$	Minimum cathode current for regulation	$V_Z = V_{REF}$ (Fig 1)		35	50	µA
$I_{Z(OFF)}$	Off-state current	V_Z = 20V, V_{REF} = 0V (Fig 3)			0.1	µA
R_Z	Dynamic output impedance	$V_Z = V_{REF}$ (Fig 1), f = 0Hz			0.75	Ω

Note 5: 0.5% and 1% SOT23 only

For definitions of reference voltage temperature coefficient and dynamic output impedance see NOTES following DC TEST CIRCUITS

DC Test Circuits

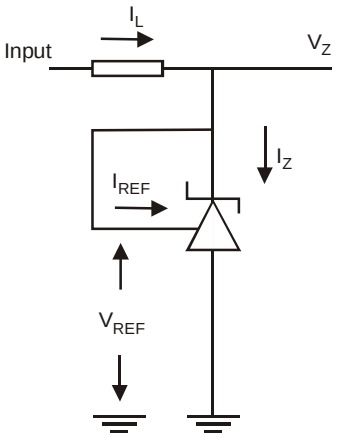


Fig. 1 Test Circuit for $V_Z = V_{REF}$

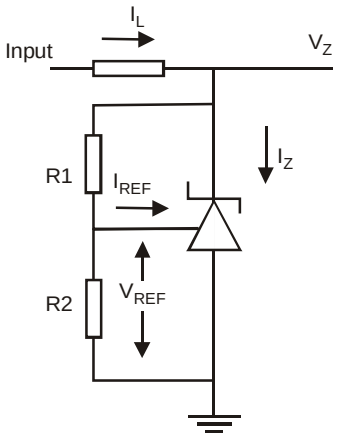


Fig. 2 Test Circuit for $V_Z > V_{REF}$

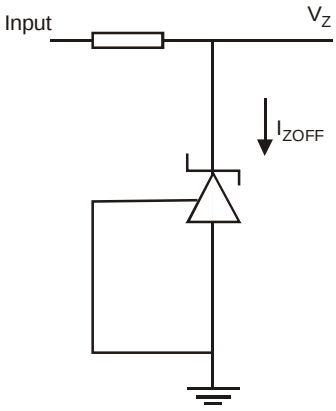
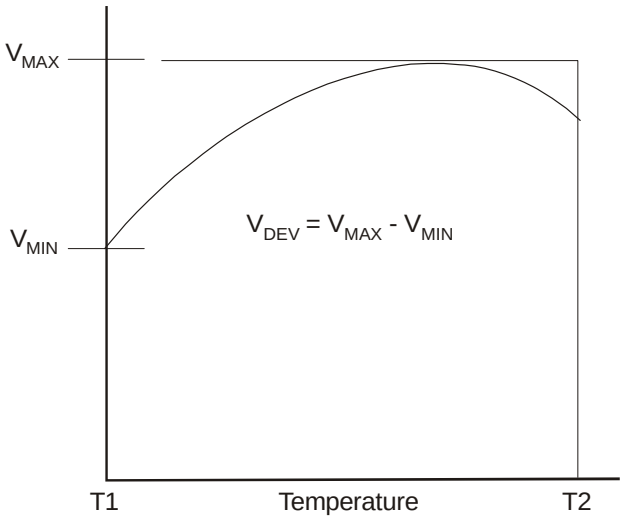


Fig.3 Test Circuit for Off State Current

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:



$$V_{ref}(ppm/^oC) = \frac{V_{dev} \times 1000000}{V_{ref}(T1 - T2)}$$

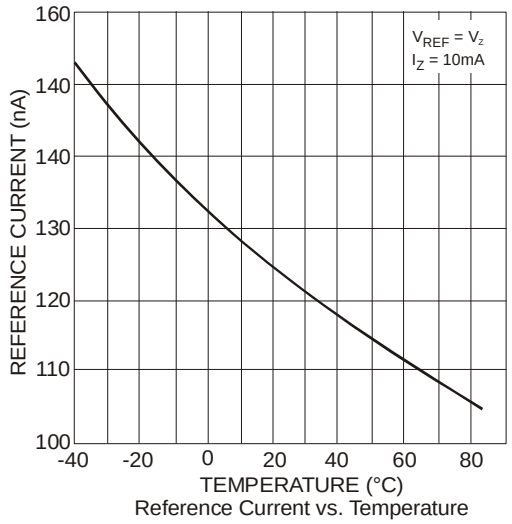
The dynamic output impedance, RZ is defined as:

$$R_z = \frac{\Delta V_z}{\Delta I_z}$$

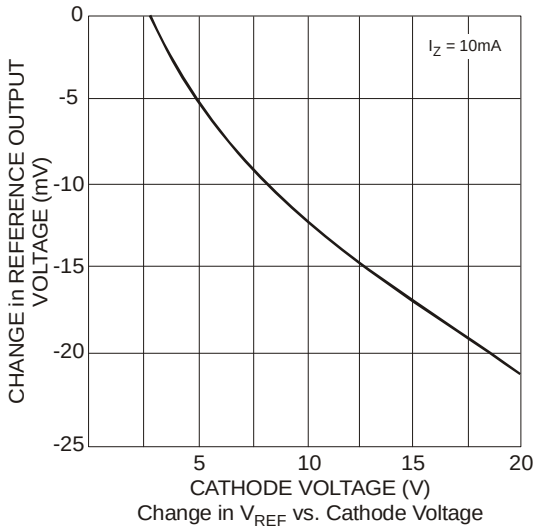
When the device is programmed with two external resistors, R1 and R2, (Fig 2), the dynamic output impedance of the overall circuit, R', is defined as:

$$R' = R_z(1 + \frac{R1}{R2})$$

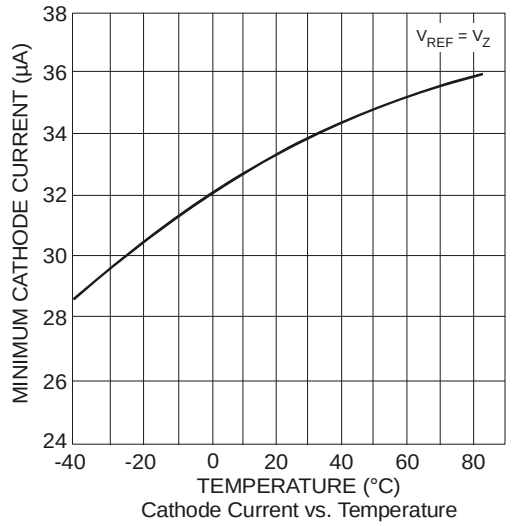
Typical Characteristics



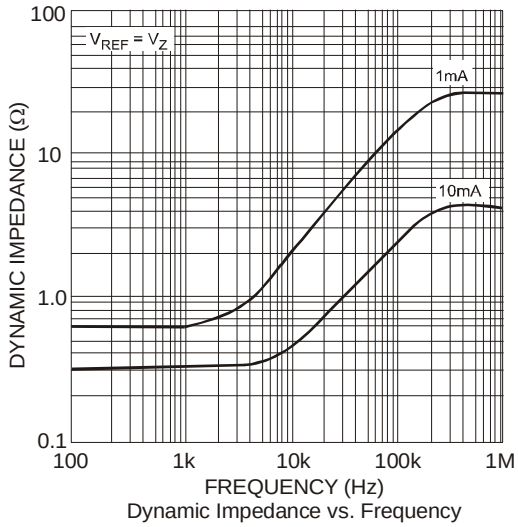
Reference Current vs. Temperature



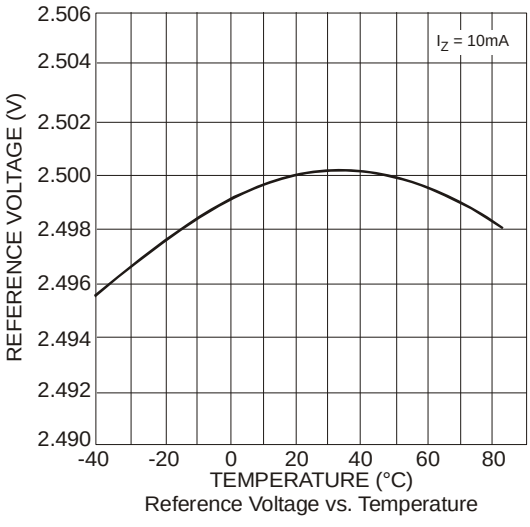
Change in V_{REF} vs. Cathode Voltage



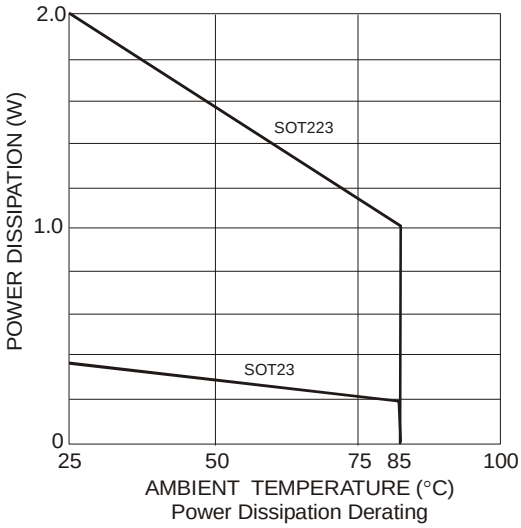
Cathode Current vs. Temperature



Dynamic Impedance vs. Frequency

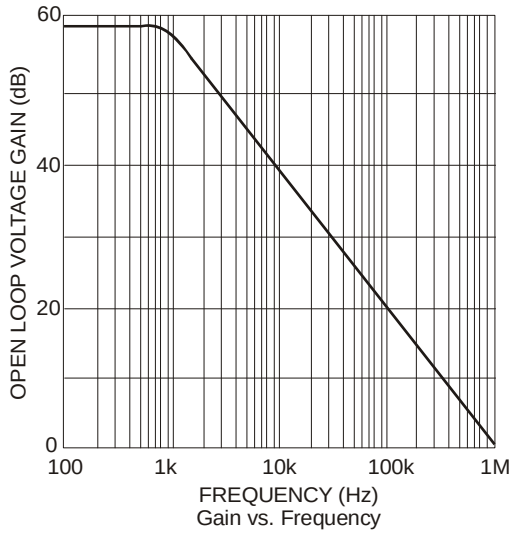


Reference Voltage vs. Temperature

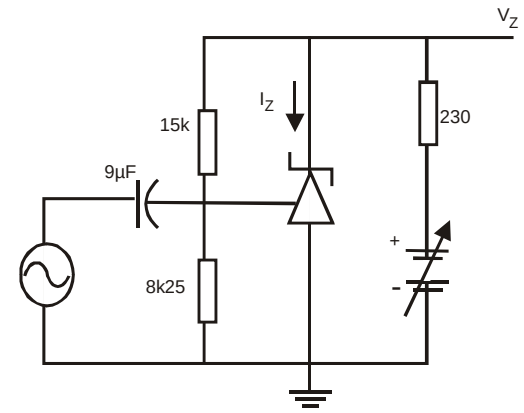


Power Dissipation Derating

Typical Characteristics (cont.)

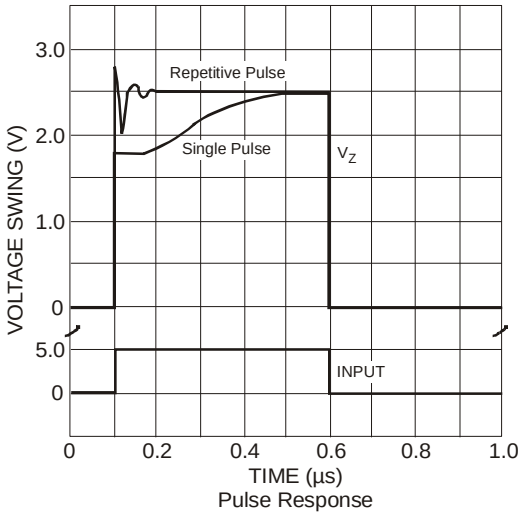


Gain vs. Frequency

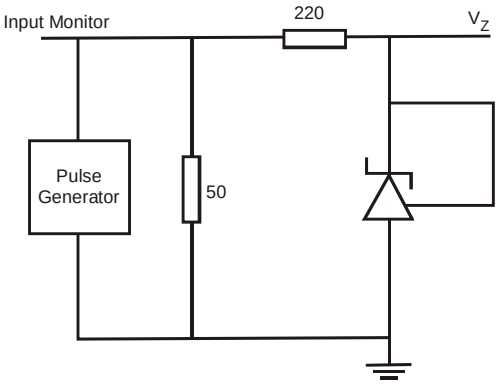


I_Z = 10mA, T_A = 25°C

Test Circuit for Open Loop Voltage Gain

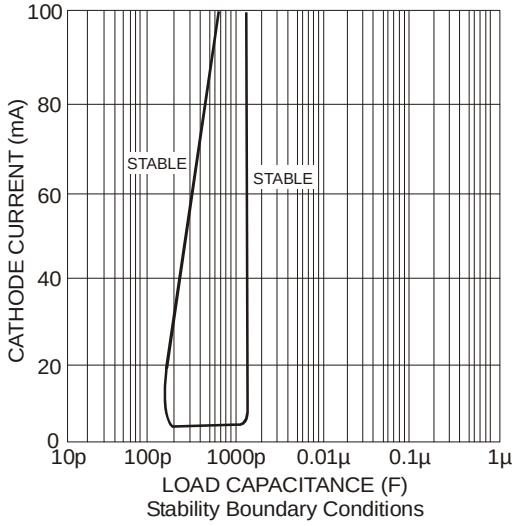


Pulse Response

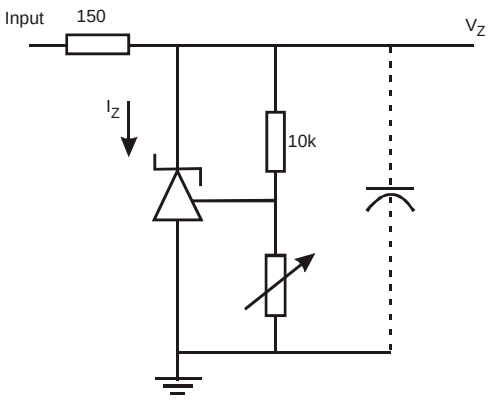


T_A = 25°C

Test Circuit for Pulse Response



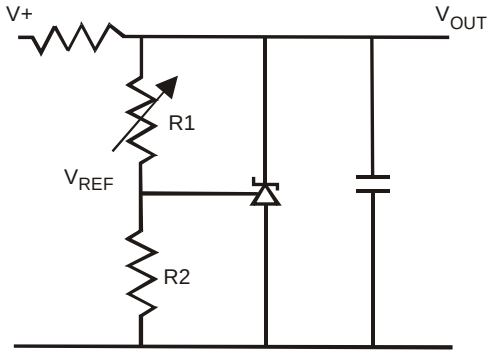
Stability Boundary Conditions



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

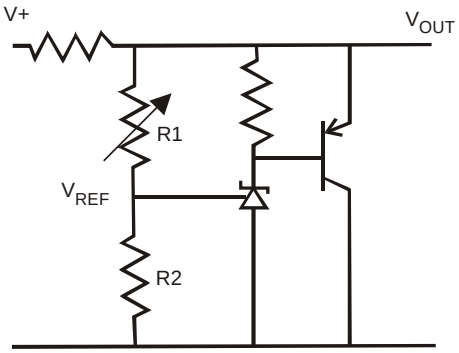
Test Circuit for Stability Boundary Conditions

Application Characteristics



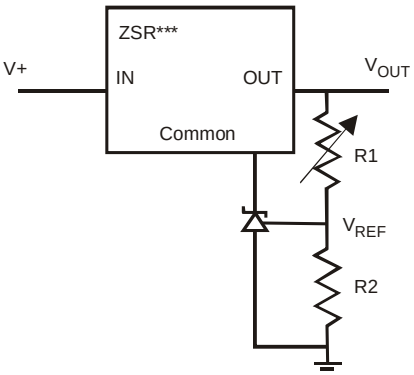
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

SHUNT REGULATOR



$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

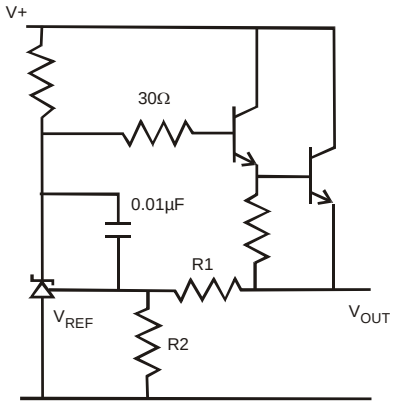
HIGHER CURRENT SHUNT REGULATOR



$$V_{OUT(MIN)} = V_{REF} + V_{REG}$$

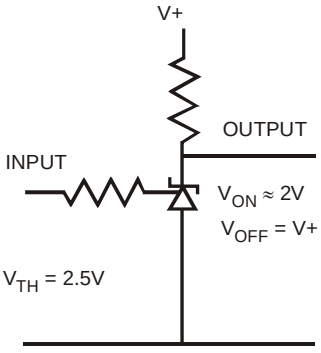
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

OUTPUT CONTROL OF A THREE TERMINAL FIXED REGULATOR

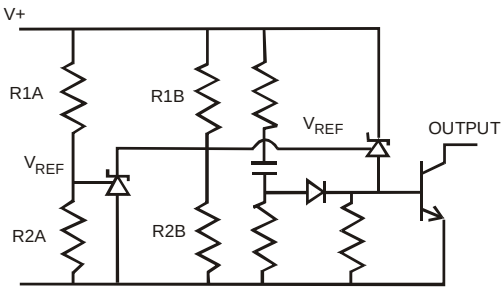


$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

SERIES REGULATOR



SINGLE SUPPLY COMPARATOR WITH TEMPERATURE COMPENSATED THRESHOLD

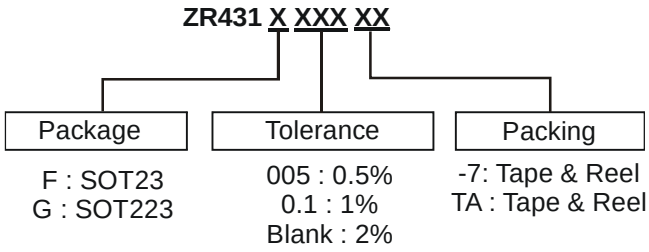


$$\text{Low limit} + \left(1 + \frac{R1B}{R2B}\right) V_{REF}$$

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

OVER VOLTAGE/UNDER VOLTAGE PROTECTION CIRCUIT

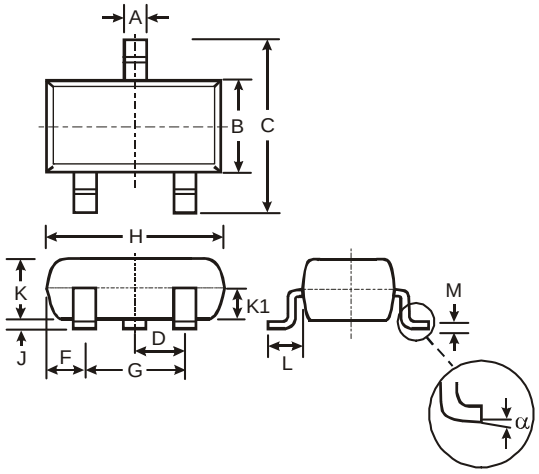
Ordering Information



Device		Tolerance	Package Code	Part Mark	Packaging	7" Tape and Reel	
						Quantity	Part Number Suffix
ZR431F005-7		0.5%	F	43R	SOT23	3000/Tape & Reel	-7
ZR431F005TA		0.5%	F	43R	SOT23	3000/Tape & Reel	TA
ZR431F01-7		1%	F	43B	SOT23	3000/Tape & Reel	-7
ZR431F01TA		1%	F	43B	SOT23	3000/Tape & Reel	TA
ZR431FTA		2%	F	43A	SOT23	3000/Tape & Reel	TA
ZR431GTA		2%	G	ZR431	SOT223	1000/Tape & Reel	TA

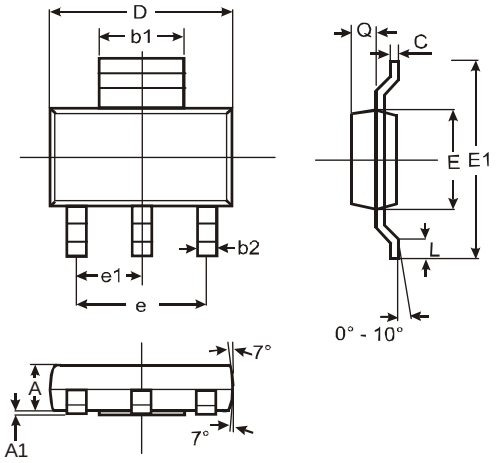
Package Outline Dimensions (All Dimensions in mm)

(1) Package Type: SOT23



SOT23			
Dim	Min	Max	Typ
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.903	1.10	1.00
K1	-	-	0.400
L	0.45	0.61	0.55
M	0.085	0.18	0.11
α	0°	8°	-
All Dimensions in mm			

(2) Package Type: SOT223



SOT223			
Dim	Min	Max	Typ
A	1.55	1.65	1.60
A1	0.010	0.15	0.05
b1	2.90	3.10	3.00
b2	0.60	0.80	0.70
C	0.20	0.30	0.25
D	6.45	6.55	6.50
E	3.45	3.55	3.50
E1	6.90	7.10	7.00
e	—	—	4.60
e1	—	—	2.30
L	0.85	1.05	0.95
Q	0.84	0.94	0.89
All Dimensions in mm			

IMPORTANT NOTICE

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

LIFE SUPPORT

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or

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.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

www.diodes.com