

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.

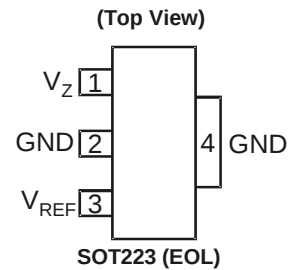
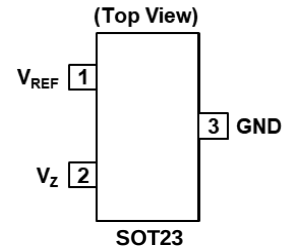
The devices can be used as a replacement for Zener diodes in many applications requiring an improvement in Zener performance.

Features

- Surface-Mount SOT223 and SOT23 Packages
- 2%, 1% and 0.5% Tolerance
- Max. Temperature Coefficient 72ppm/°C
- Temperature Compensated for Operation
- Over the Full Temperature Range
- Programmable Output Voltage
- 50µA to 100mA Current Sink Capability
- Low Output Noise
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](https://www.diodes.com/quality/product-definitions/) or your local Diodes representative.**

<https://www.diodes.com/quality/product-definitions/>

Pin Assignments



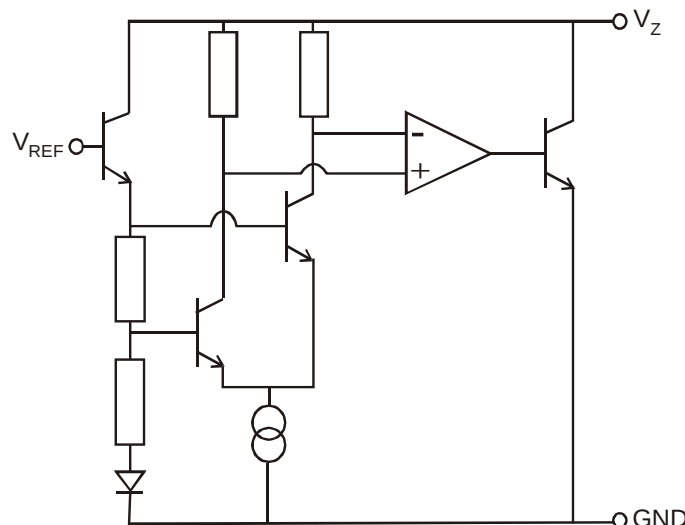
Pin 4 floating or connected to Pin 2.

Applications

- Shunt regulators
- Series regulators
- Voltage monitors
- Overvoltage/undervoltage protections
- Switch mode power supplies

- 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- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Typical Application Circuit



Absolute Maximum Ratings (Note 4)

Symbol	Parameter		Rating	Unit
V _Z	Cathode Voltage		20	V
I _Z	Cathode Current		150	mA
T _J	Junction Temperature Range		-40 to +150	°C
T _{ST}	Storage Temperature		-55 to +150	°C
P _D	Power Dissipation (Notes 5 & 6)	SOT23	330	mW
		SOT223	2	W

Notes:

- Stresses greater than those listed under *Absolute Maximum Ratings* can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to *Absolute Maximum Ratings* for extended periods can affect device reliability. Unless otherwise stated, voltages specified are relative to the GND pin.
- T_J, max = +150°C.
- 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
T _A	Operating Temperature	-40	+125	°C

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V _{REF}	Reference Voltage (Note 7)	I _L = 10mA (Figure 1) V _Z = V _{REF}	2%	2.45	2.50	V
			1%	2.475	2.50	
			0.5%	2.487	2.50	
V _{DEV}	Deviation of Reference Input Voltage over Temperature	I _L = 10mA, V _Z = V _{REF} T _A = Full Range (Figure 1)	—	10	30	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 (Figure 2)	—	-1.85	-2.7	mV/V
		V _Z from 10V to 20V, I _Z = 10mA (Figure 2)	—	-1.0	-2.0	
I _{REF}	Reference Input Current	R1 = 10k, R2 = O/C, I _L = 10mA (Figure 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 (Figure 2)	—	0.04	0.2	μA
I _{Z(MIN)}	Minimum Cathode Current for Regulation	V _Z = V _{REF} (Figure 1)	—	35	50	μA
I _{Z(OFF)}	Off-State Current	V _Z = 20V, V _{REF} = 0V (Figure 3)	—	—	0.1	μA
R _Z	Dynamic Output Impedance	V _Z = V _{REF} (Figure 1), f = 0Hz	—	—	0.75	Ω

Note: 7. 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

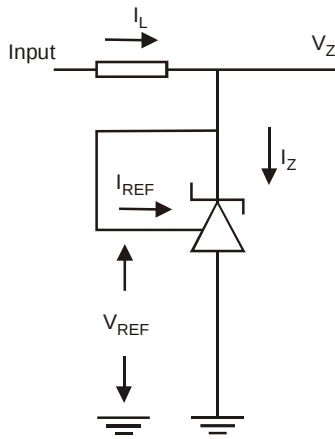


Figure 1. Test Circuit for $V_Z = V_{REF}$

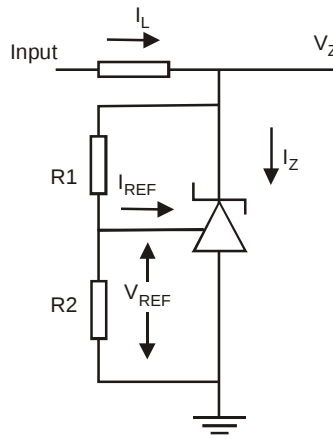


Figure 2. Test Circuit for $V_Z > V_{REF}$

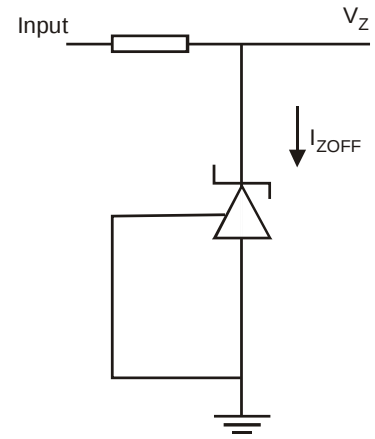
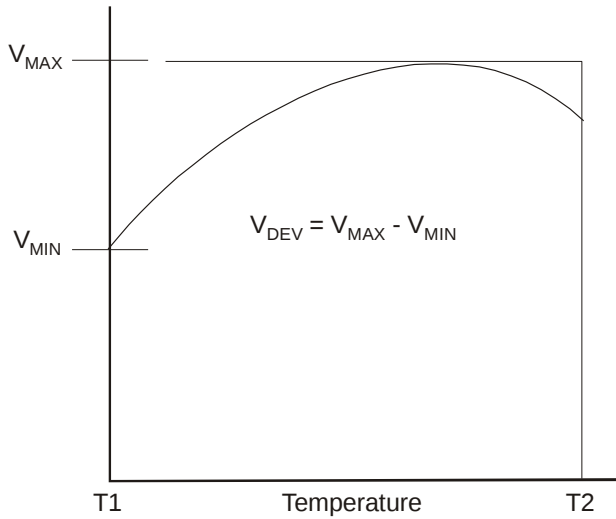


Figure 3. Test Circuit for Off State Current

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:



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

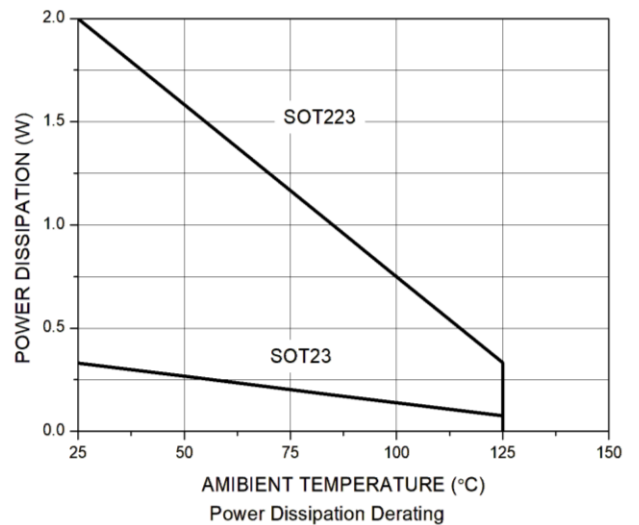
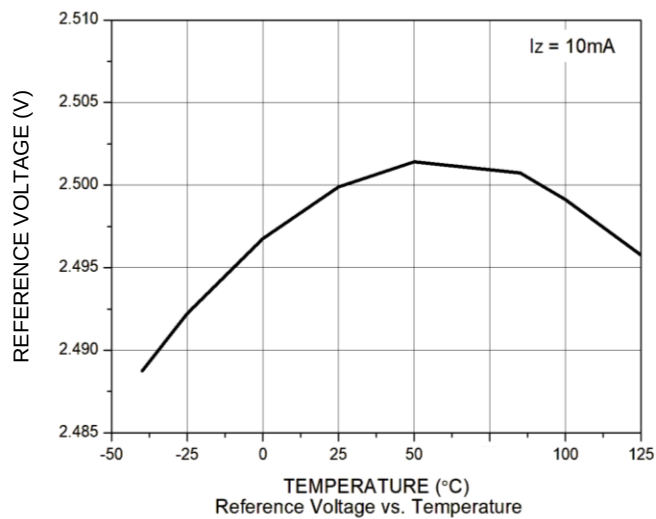
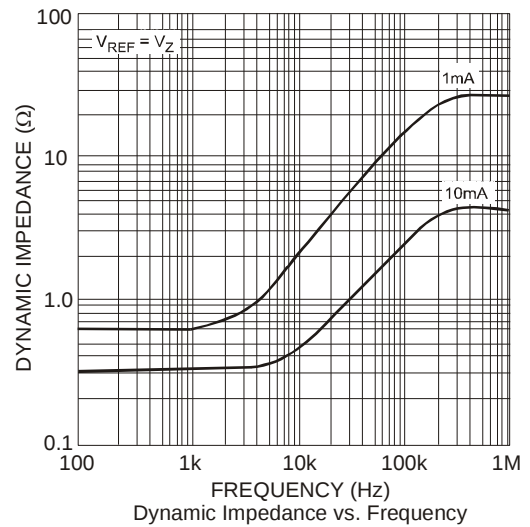
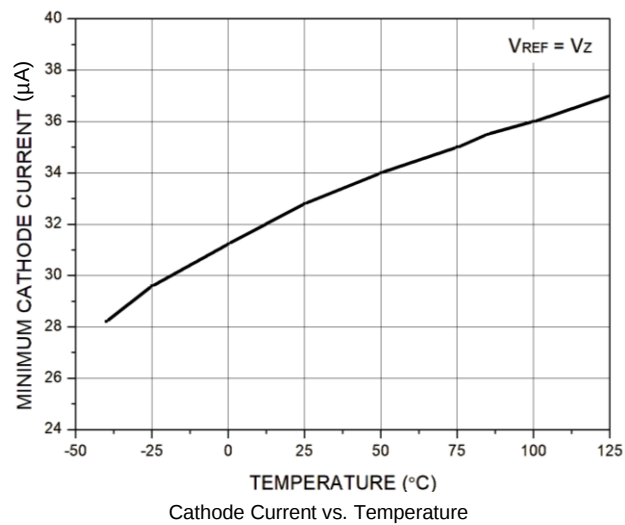
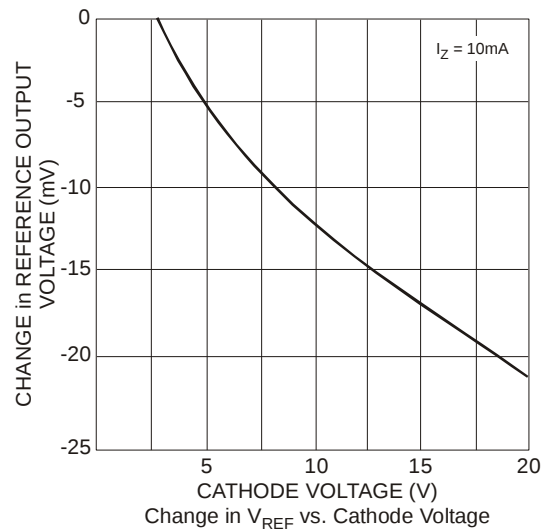
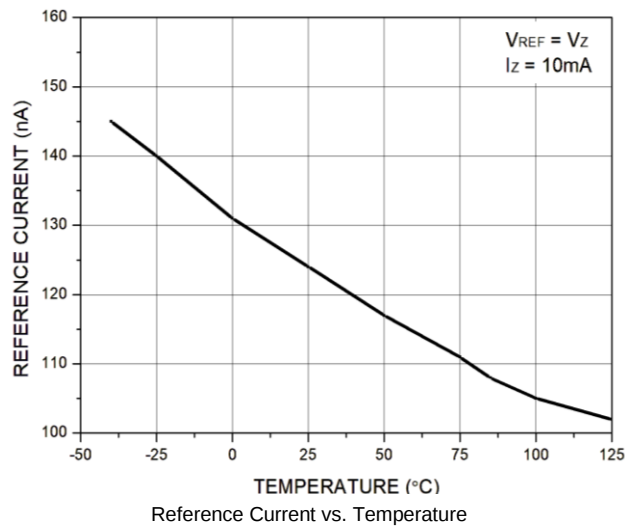
The dynamic output impedance, R_z is defined as:

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

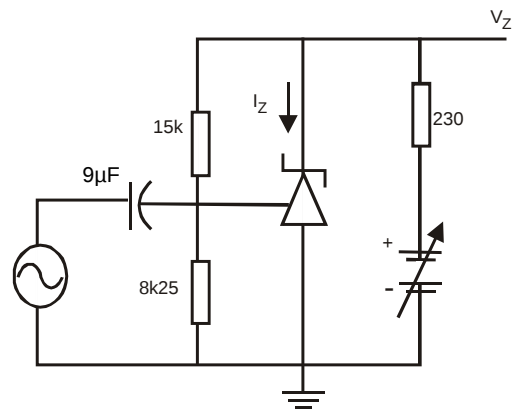
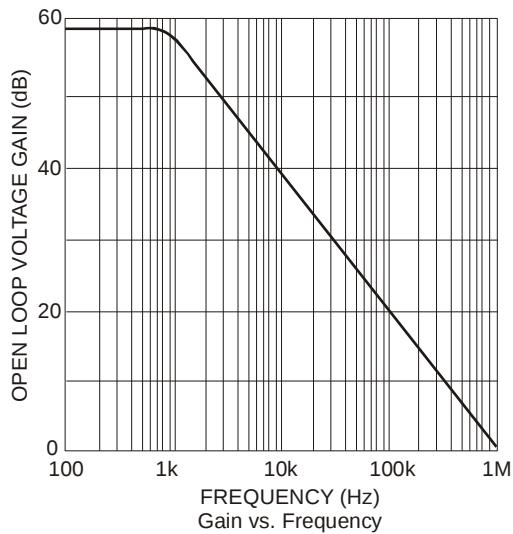
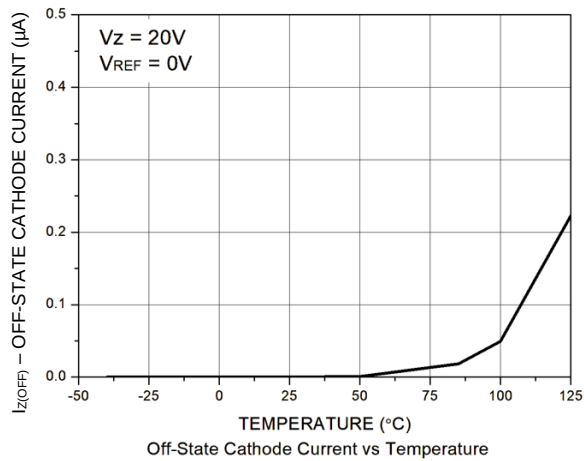
When the device is programmed with two external resistors, R_1 and R_2 , (Figure 2), the dynamic output impedance of the overall circuit, R' , is defined as:

$$R' = R_z \left(1 + \frac{R_1}{R_2}\right)$$

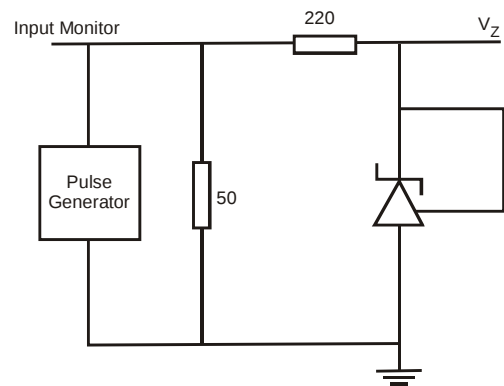
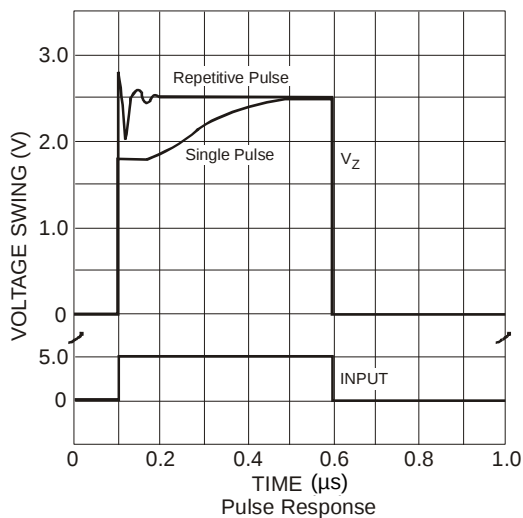
Typical Characteristics



Typical Characteristics (continued)

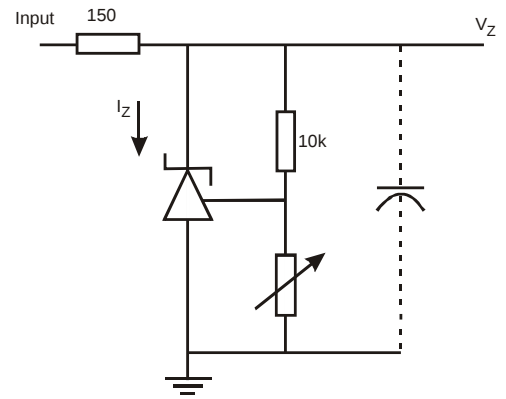
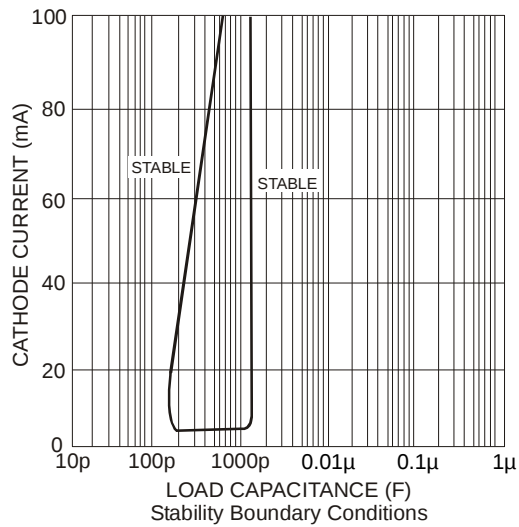


$I_Z = 10mA$, $T_A = +25^{\circ}C$
Test Circuit for Open-Loop Voltage Gain



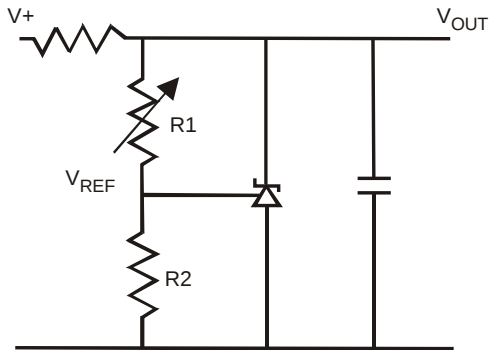
$T_A = +25^{\circ}C$
Test Circuit for Pulse Response

Typical Characteristics (continued)



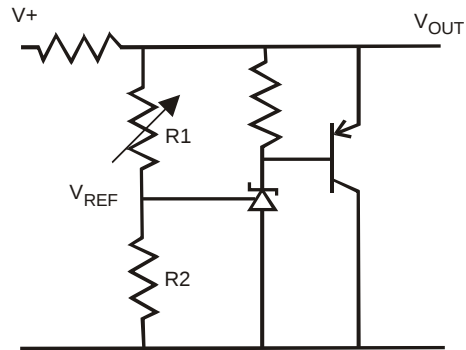
$V_{REF} < V_Z < 20V$, $I_Z = 10mA$, $T_A = +25^\circ C$
Test Circuit for Stability Boundary Conditions

Application Characteristics



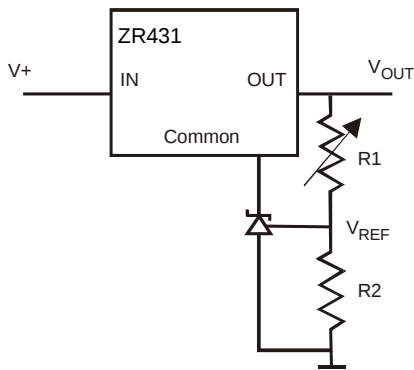
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

SHUNT REGULATOR



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

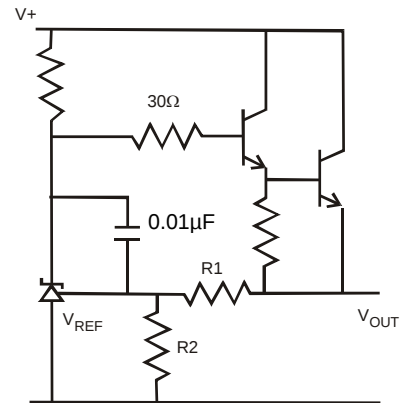
HIGHER CURRENT SHUNT REGULATOR



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

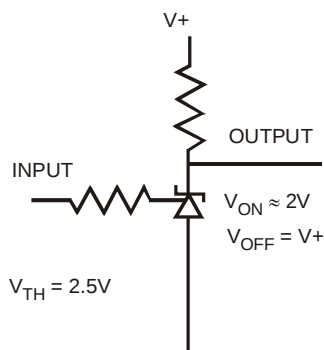
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

OUTPUT CONTROL OF A THREE TERMINAL FIXED REGULATOR

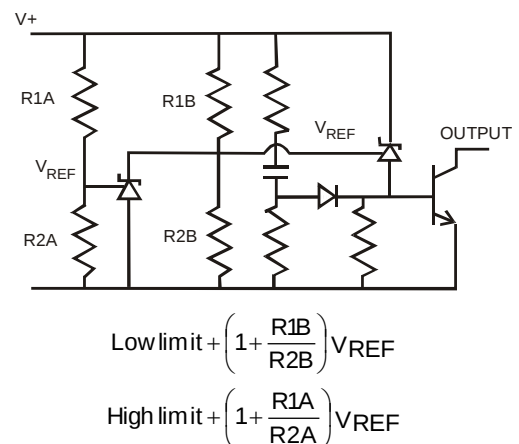


$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

SERIES REGULATOR



SINGLE SUPPLY COMPARATOR WITH TEMPERATURE COMPENSATED THRESHOLD

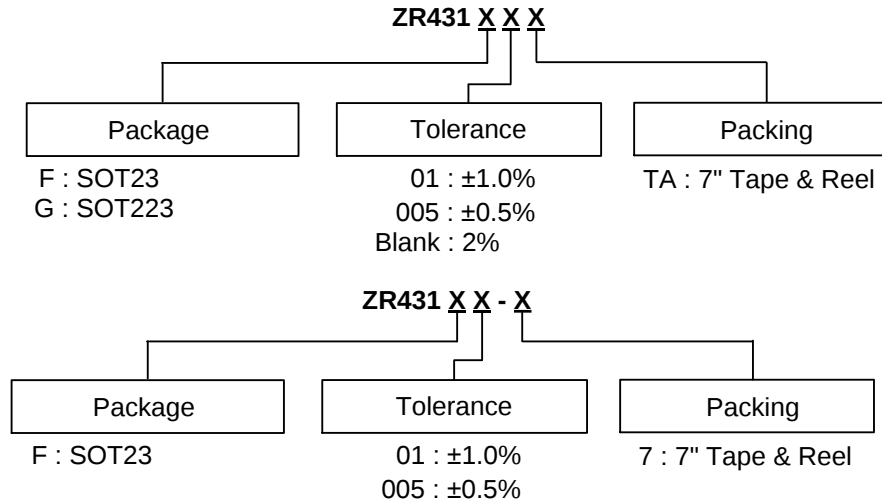


$$\text{Low limit} + \left(1 + \frac{R1B}{R2B}\right) V_{REF}$$

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

OVERVOLTAGE/UNDERVOLTAGE PROTECTION CIRCUIT

Ordering Information

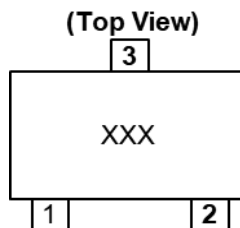


Part Number	Tolerance	Package Code	Identification Code	Package (Note 8)	Packing		Status (Note 9)
					Qty.	Carrier	
ZR431F005-7	0.5%	F	43R	SOT23	3000	7" Tape & Reel	EOL
ZR431F005TA	0.5%	F	43R	SOT23	3000	7" Tape & Reel	In Production
ZR431F01-7	1%	F	43B	SOT23	3000	7" Tape & Reel	EOL
ZR431F01TA	1%	F	43B	SOT23	3000	7" Tape & Reel	In Production
ZR431FTA	2%	F	43A	SOT23	3000	7" Tape & Reel	In Production
ZR431GTA	2%	G	ZR431	SOT223	1000	7" Tape & Reel	EOL

Notes: 8. For packaging details, go to our website at: <https://www.diodes.com/design/support/packaging/diodes-packaging/>.
9. ZR431F005-7, ZR431F01-7 and ZR431GTA are End of Life (EOL). Please [contact us](#).

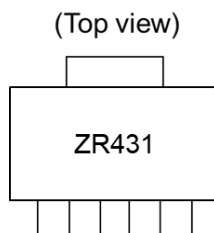
Marking Information

(1) SOT23



Part Number	Identification Code
ZR431F005-7	43R
ZR431F005TA	43R
ZR431F01-7	43B
ZR431F01TA	43B
ZR431FTA	43A

(2) SOT223

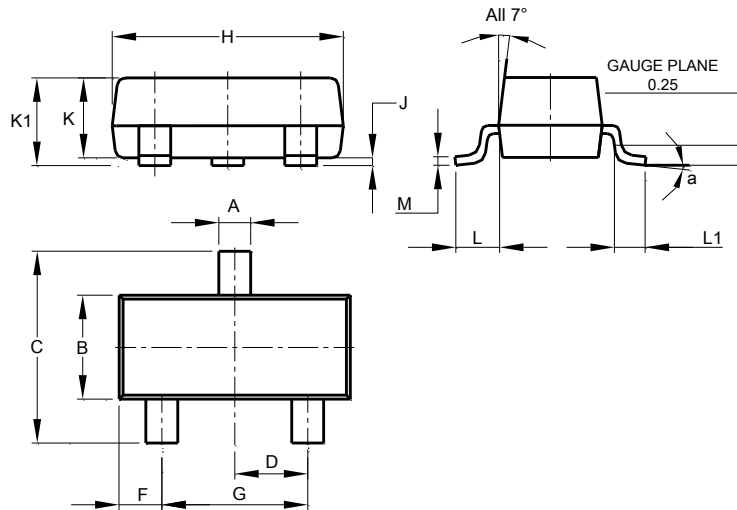


Part Number	Identification Code
ZR431GTA	ZR431

Package Outline Dimensions

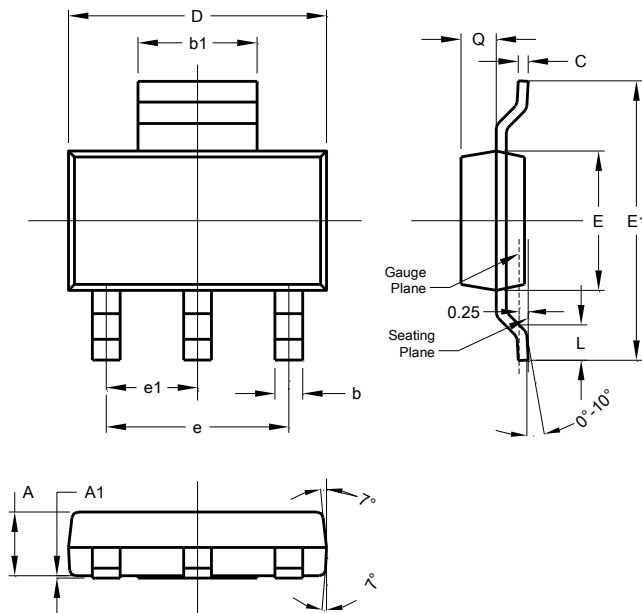
Please see <http://www.diodes.com/package-outlines.html> for latest version.

(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	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			

(2) Package Type: SOT223

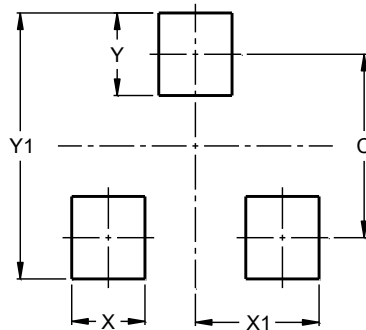


SOT223			
Dim	Min	Max	Typ
A	1.55	1.65	1.60
A1	0.010	0.15	0.05
b	0.60	0.80	0.70
b1	2.90	3.10	3.00
C	0.20	0.30	0.25
D	6.45	6.55	6.50
E	3.45	3.55	3.50
E1	6.90	7.10	7.00
e	-	-	4.60
e1	-	-	2.30
L	0.85	1.05	0.95
Q	0.84	0.94	0.89
All Dimensions in mm			

Suggested Pad Layout

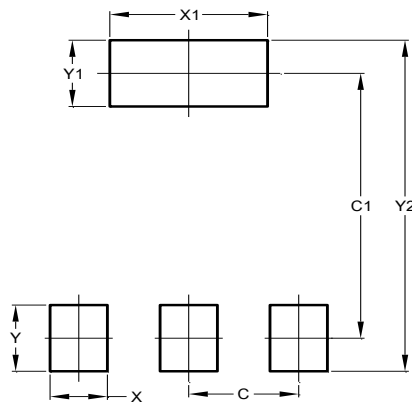
Please see <http://www.diodes.com/package-outlines.html> for latest version.

(1) Package Type: SOT23



Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

(2) Package Type: SOT223



Dimensions	Value (in mm)
C	2.30
C1	6.40
X	1.20
X1	3.30
Y	1.60
Y1	1.60
Y2	8.00

Mechanical Data

- Moisture Sensitivity:
 - SOT23: Level 1 per J-STD-020
 - SOT223: Level 3 per J-STD-020
- Terminals: Finish — Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 **Ⓔ**
- Weight:
 - SOT23: 0.009 grams (Approximate)
 - SOT223: 0.112 grams (Approximate)

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