

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.

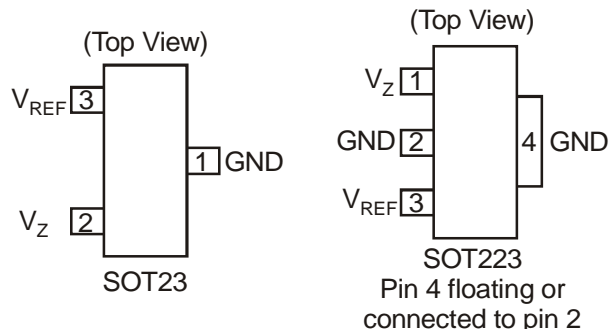
The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

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)

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.

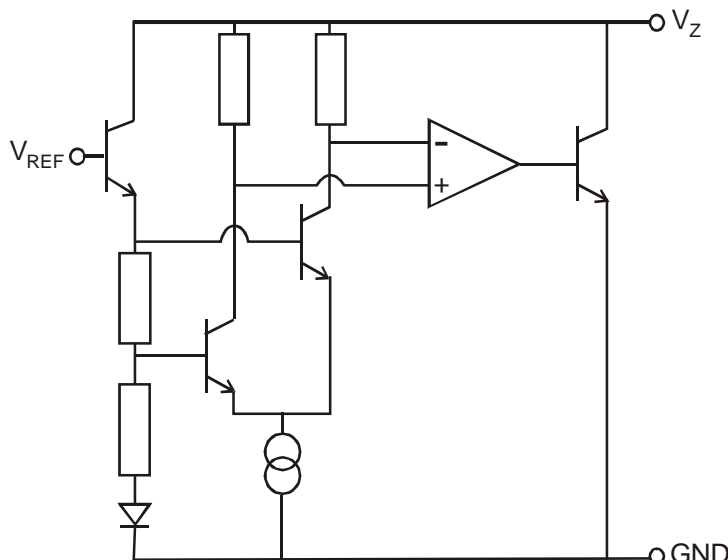
Pin Assignments



Applications

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

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

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

Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit	
V_{REF}	Reference voltage (Note 5)	$I_L = 10\text{mA}$ (Fig 1), $V_Z = V_{REF}$	2%	2.45	2.50	2.55	V
			1%	2.475	2.50	2.525	
			0.5%	2.487	2.50	2.513	
V_{DEV}	Deviation of reference input voltage over temperature	$I_L = 10\text{mA}$, $V_Z = V_{REF}$ $T_A = \text{Full range}$ (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 $I_Z = 10\text{mA}$ (Fig 2)		-1.85	-2.7	mV/V	
		V_Z from 10V to 20V $I_Z = 10\text{mA}$ (Fig 2)		-1.0	-2.0		
I_{REF}	Reference input current	$R1 = 10\text{k}$, $R2 = \text{O/C}$, $I_L = 10\text{mA}$ (Fig 2)		0.12	1.0	μA	
ΔI_{REF}	Deviation of reference input current over temperature	$R1 = 10\text{k}$, $R2 = \text{O/C}$, $I_L = 10\text{mA}$ $T_A = \text{Full range}$ (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	$V_Z = 20\text{V}$, $V_{REF} = 0\text{V}$ (Fig 3)			0.1	μA	
R_Z	Dynamic output impedance	$V_Z = V_{REF}$ (Fig 1), $f = 0\text{Hz}$			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

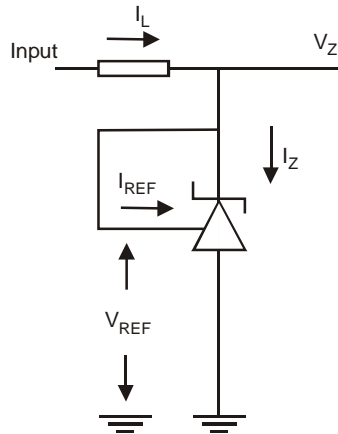


Fig. 1 Test Circuit for $V_Z = V_{REF}$

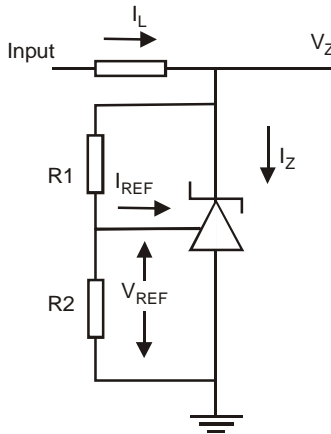


Fig. 2 Test Circuit for $V_Z > V_{REF}$

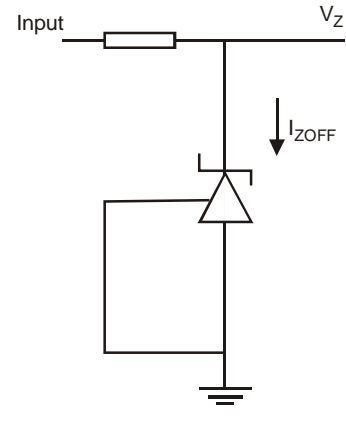
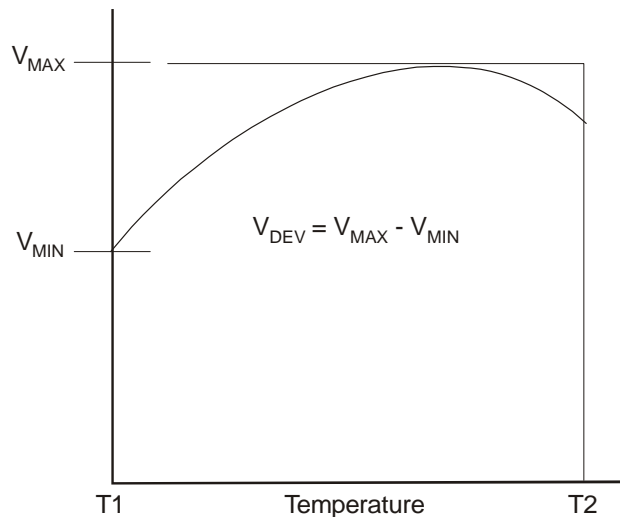


Fig.3 Test Circuit for Off State Current

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:



$$V_{ref} \text{ (ppm/}^\circ\text{C)} = \frac{V_{dev} \times 1000000}{V_{ref} (T_1 - T_2)}$$

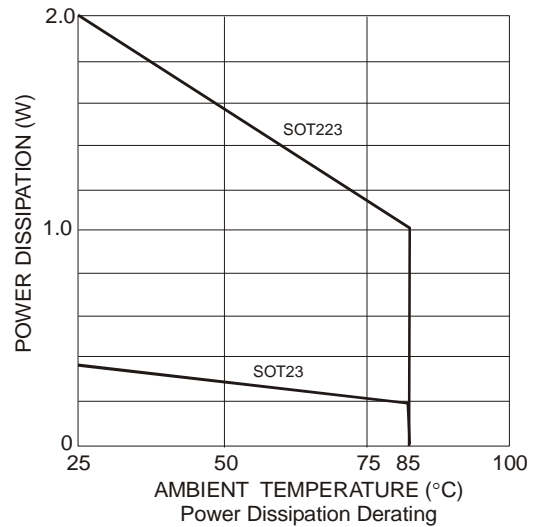
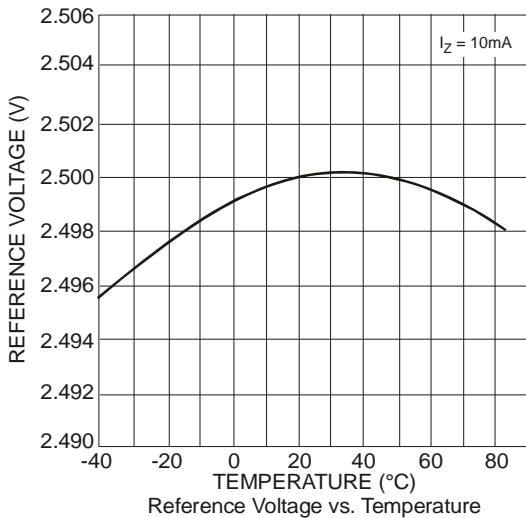
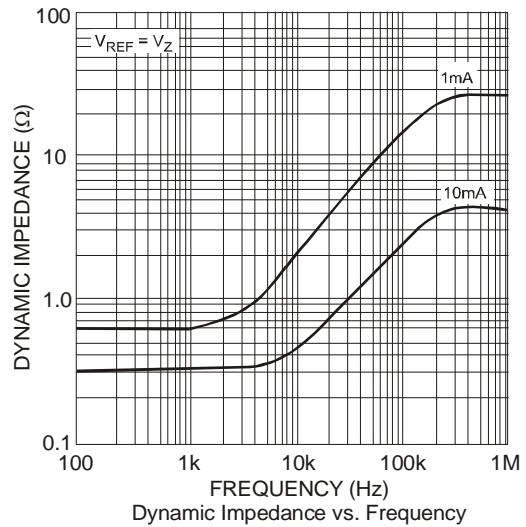
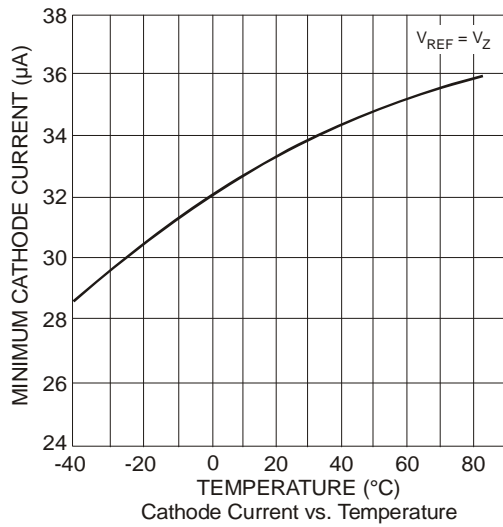
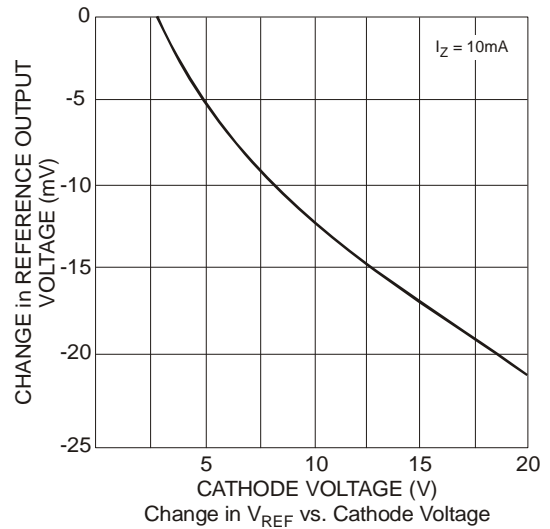
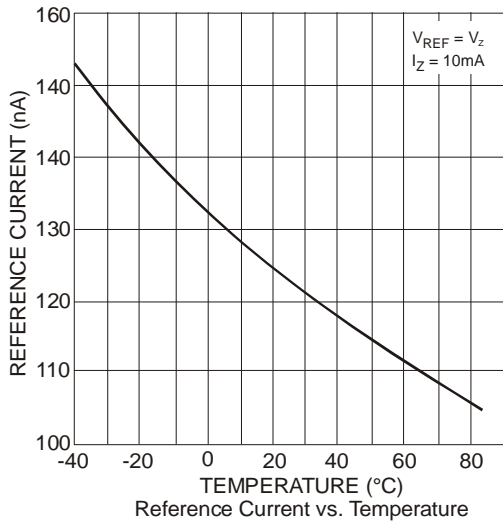
The dynamic output impedance, R_Z is defined as:

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

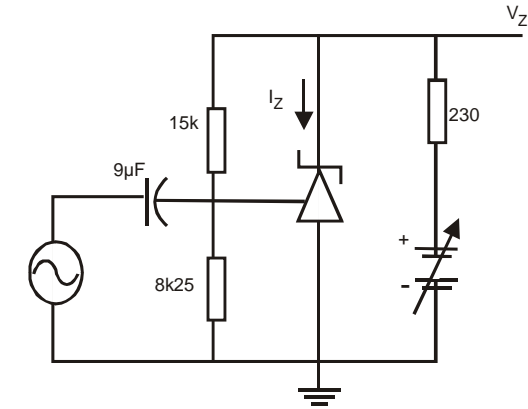
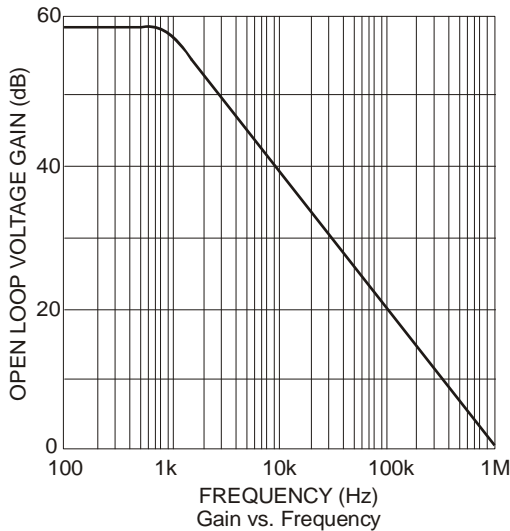
When the device is programmed with two external resistors, R_1 and R_2 , (Fig 2), the dynamic output impedance of the overall circuit, R' , is defined as:

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

Typical Characteristics

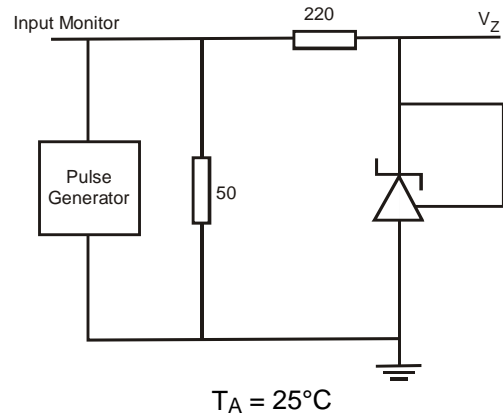
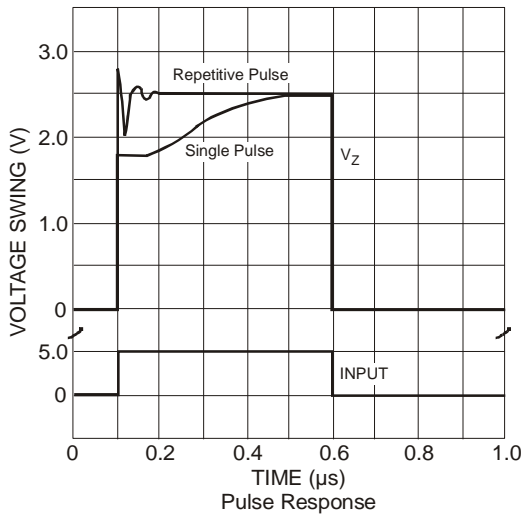


Typical Characteristics (cont.)



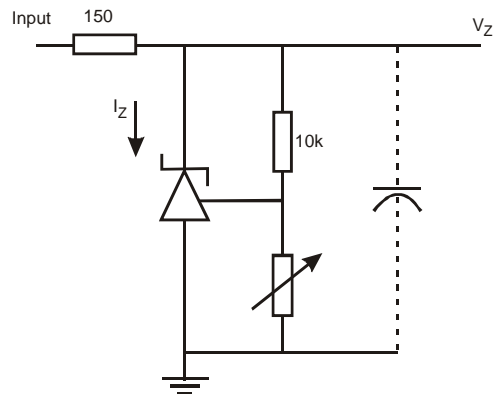
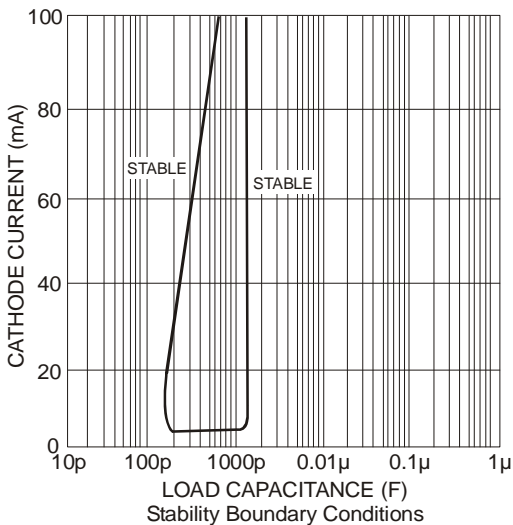
$I_Z = 10\text{mA}$, $T_A = 25^\circ\text{C}$

Test Circuit for Open Loop Voltage Gain



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

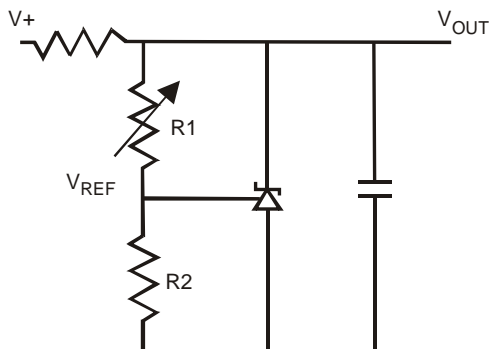
Test Circuit for Pulse Response



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

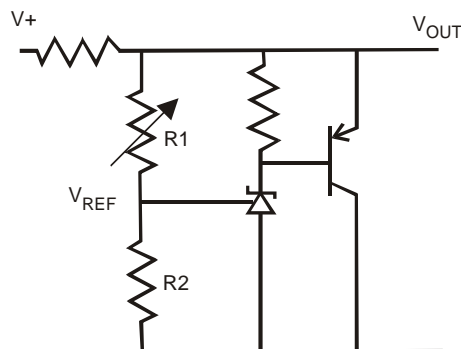
Test Circuit for Stability Boundary Conditions

Application Characteristics



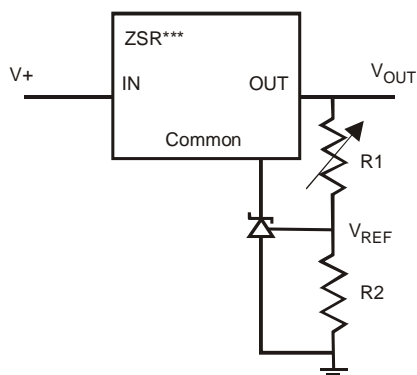
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

SHUNT REGULATOR



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

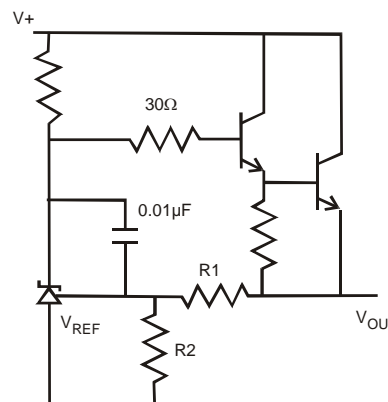
HIGHER CURRENT SHUNT REGULATOR



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

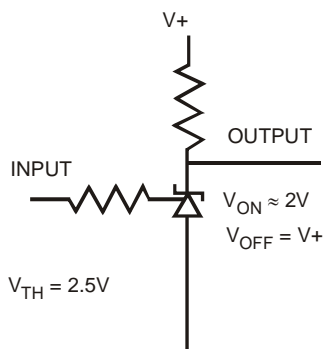
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

OUTPUT CONTROL OF A THREE TERMINAL FIXED REGULATOR

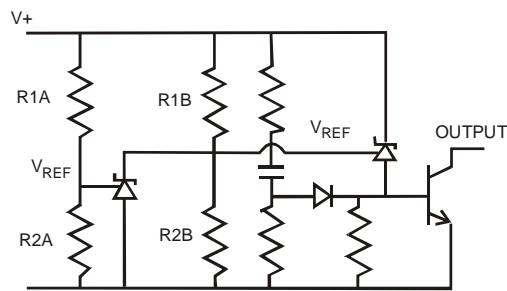


$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

SERIES REGULATOR



SINGLE SUPPLY COMPARATOR WITH TEMPERATURE COMPENSATED THRESHOLD

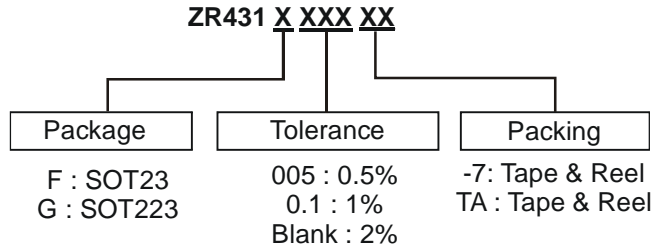








$$\text{Low limit} + \left(1 + \frac{R1B}{R2B}\right) V_{REF}$$

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

OVER VOLTAGE/UNDER VOLTAGE PROTECTION CIRCUIT

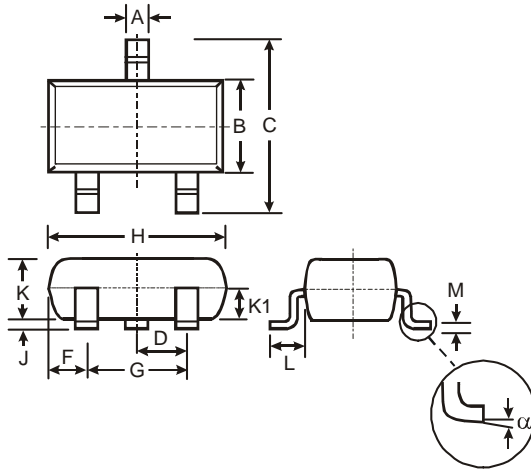
Ordering Information



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

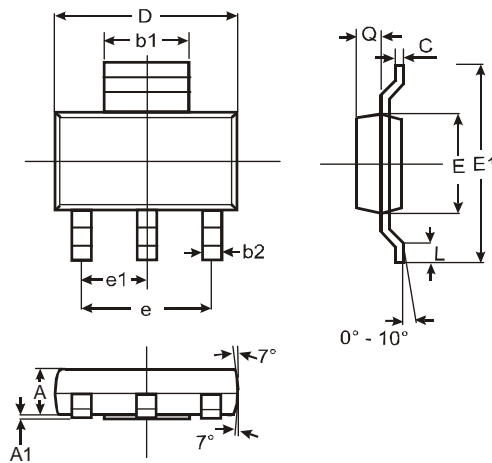
Package Outline Dimensions (All Dimensions in mm)

(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			

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