Description

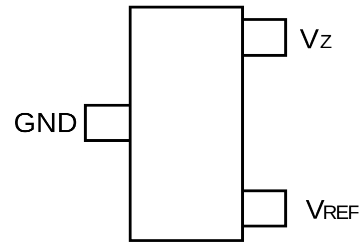
The ZHT431 is a three terminal adjustable shunt regulator offering excellent temperature stability and output current handling capability up to 100mA. The device offers extended operating temperature range working from -55 to +125°C.

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.

Pin Assignments

(Top View)



SOT23 (Type DN)

Features

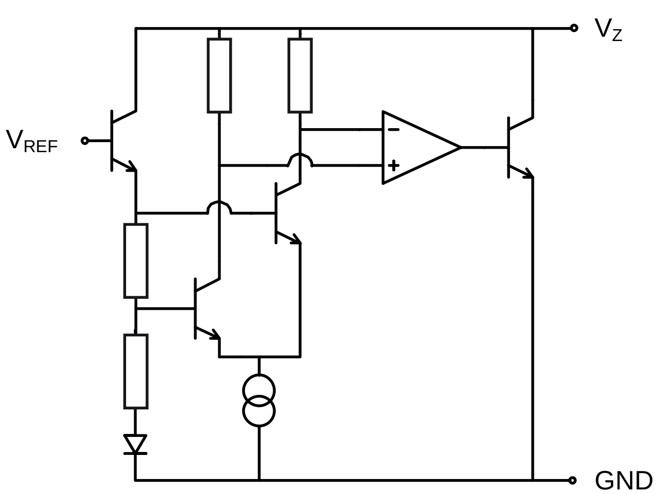
- Surface Mount SOT23 (Type DN) Package
- 0.5%, 1% and 2% Tolerance
- Maximum Temperature Coefficient 67ppm/°C
- Temperature Compensated for Operation Over the Full Temperature Range
- Programmable Output Voltage
- 50µA to 100mA Current Sink Capability
- Low Output Noise
- Wide Temperature Range -55 to +125°C
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Applications

- Series and Shunt Regulator
- Voltage Monitor
- Over Voltage / Under Voltage Protection
- 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, Antimony and Beryllium-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl), <1000ppm antimony compounds and <1000ppm Beryllium.

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_A = +25°C, T_{JMAX} = +150°C)	330	mW

Recommended Operating Conditions

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

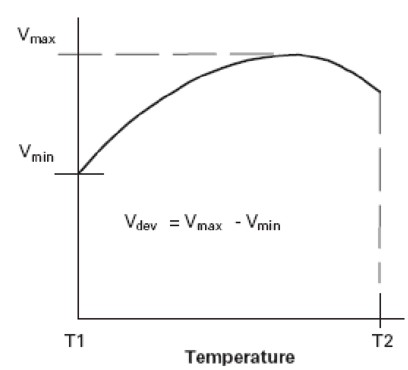
Electrical Characteristics (Test conditions unless otherwise specified: T_A = +25°C.)

Symbol	VParameter	Values			Unit	Conditions
		Min.	Typ.	Max.		
V_{REF}	Reference Voltage 2%	2.45	2.50	2.55	V	I_L = 10mA (Fig.1), $V_Z = V_{REF}$
	1%	2.475	2.50	2.525		
	0.5%	2.4875	2.50	2.5125		
V_{DEV}	Deviation of Reference Input Voltage Over Temperature	—	10	30	mV	I_L = 10mA, $V_Z = V_{REF}$ T_A = Full Range (Fig.1)
$\frac{\Delta V_{REF}}{\Delta V_Z}$	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	-2.0	mV/V	V_Z from 10V to 20V I_Z = 10mA (Fig.2)
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_A = 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:

$$V_{REF}\left(\frac{ppm}{°C}\right) = \frac{V_{DEV} \, x \, 1000000}{V_{REF}(T1 - T2)}$$



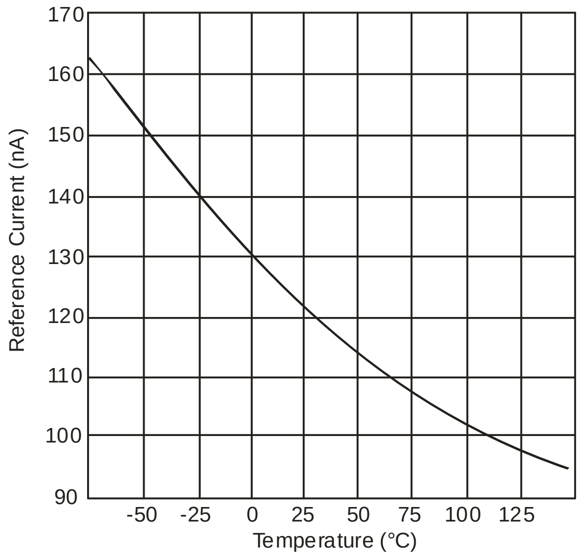
The dynamic output impedance, R_Z, is defined as:

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

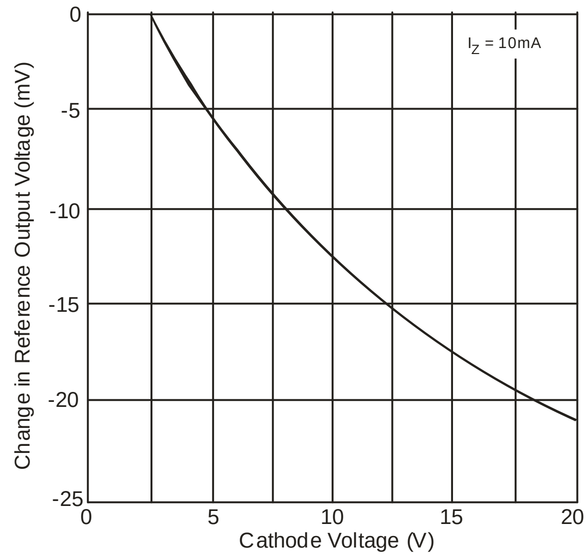
When the device is programmed with two external resistors, R1 and R2, (Fig. 2), the dynamic output impedance of the overall circuit, R', is defined as:

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

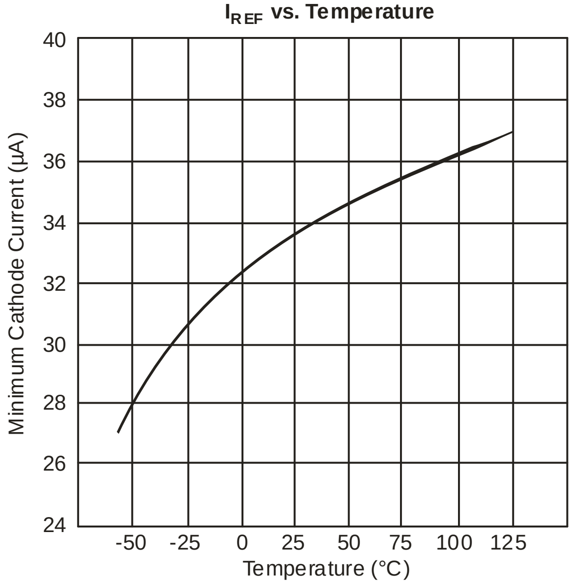
Typical Operating Conditions



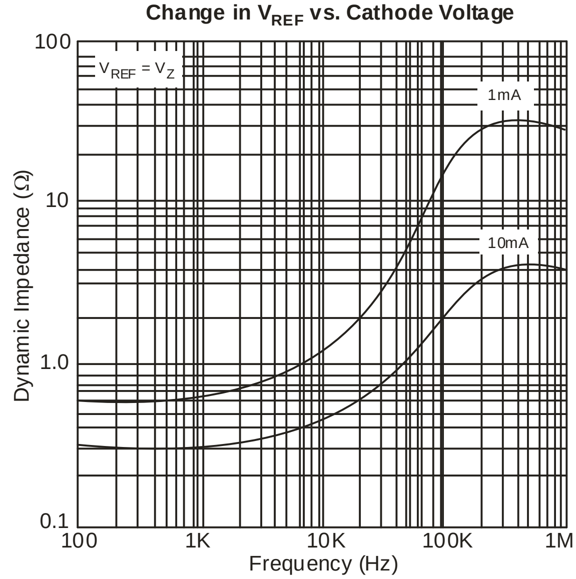
I_{REF} **vs. Temperature**



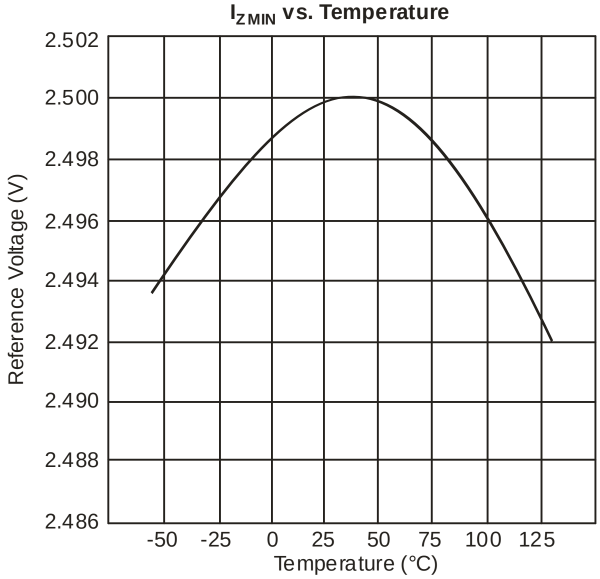
Change in V_{REF} vs. Cathode Voltage



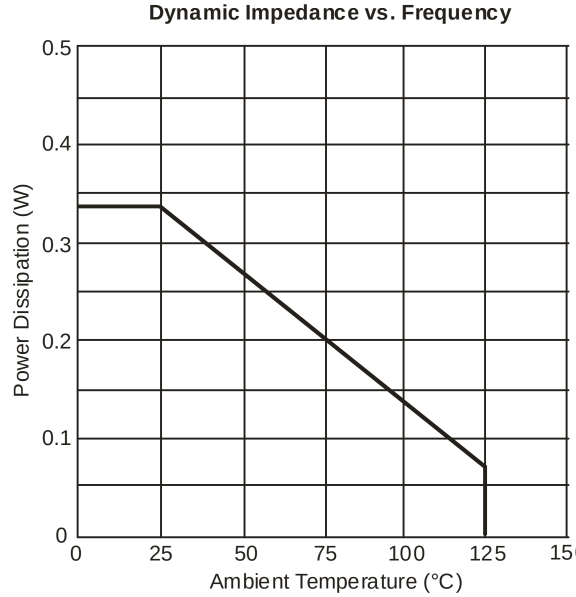
I_{ZMIN} **vs. Temperature**



Dynamic Impedance vs. Frequency

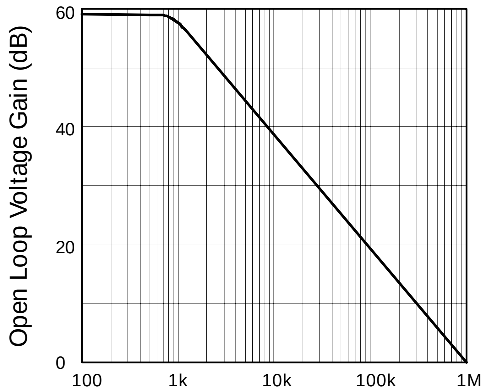


V_{REF} **vs. Temperature**

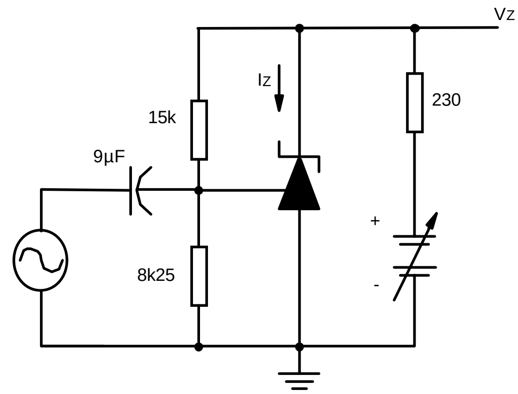


Power Dissipation Derating

Typical Operating Conditions (Cont.)

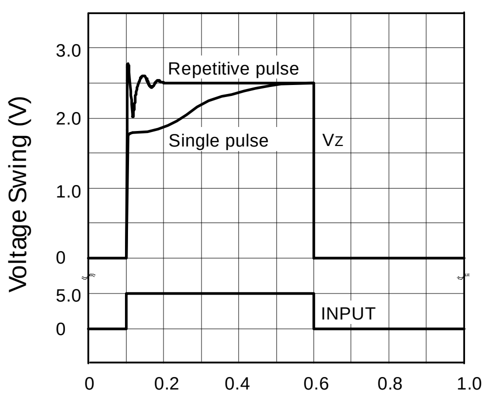


Gain v Frequency

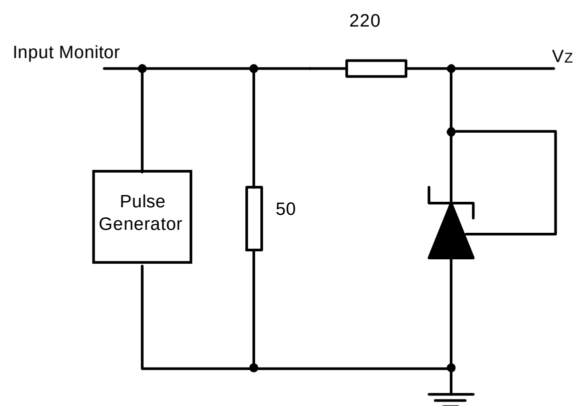


I_Z = 10mA, T_A = 25°C

Test Circuit for Open Loop Voltage Gain

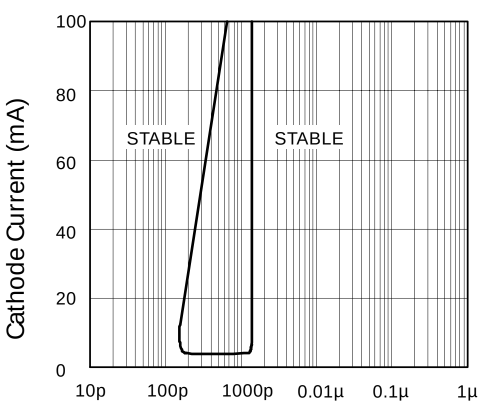


Pulse Response

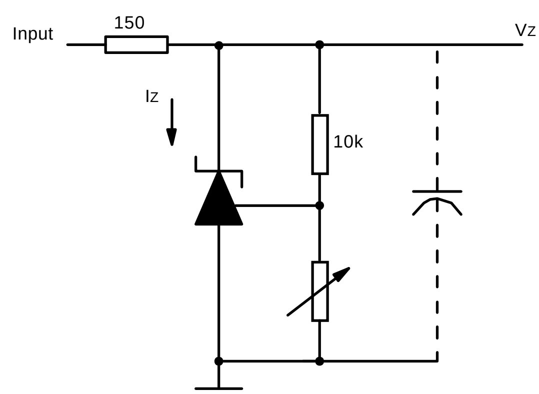


T_A = 25°C

Test Circuit for Pulse Response



Stability Boundary Conditions



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

Test Circuit for Stability Boundary Conditions

DC Test Circuits

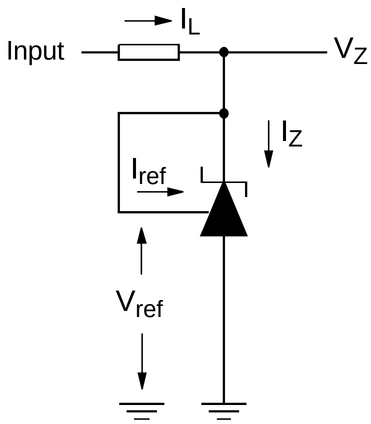


Fig 1 - Test circuit for $V_Z = V_{ref}$

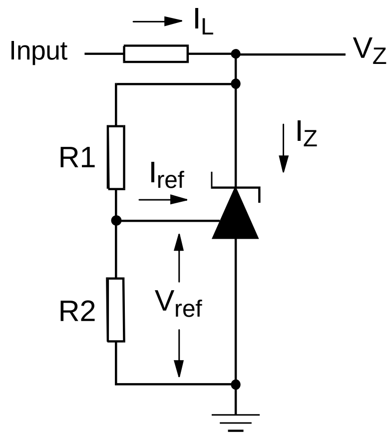


Fig 2 - Test circuit for $V_Z > V_{ref}$

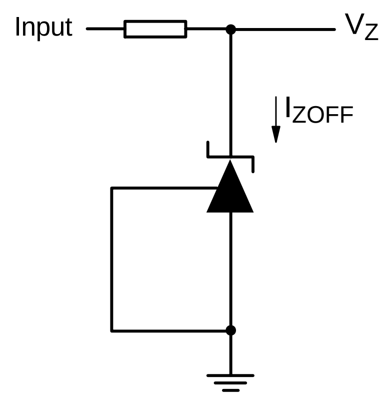
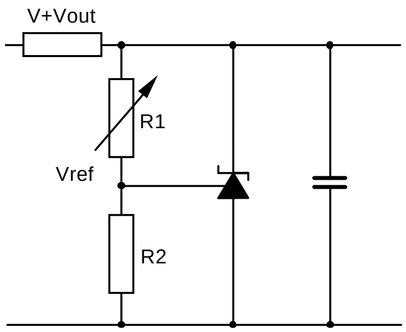


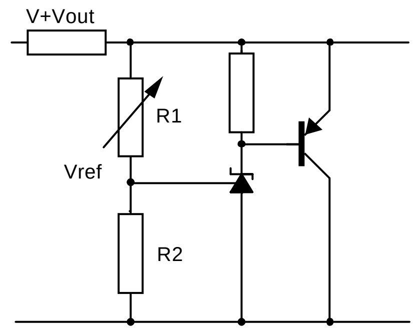
Fig 3 - Test circuit for Off state current†

Application Circuits



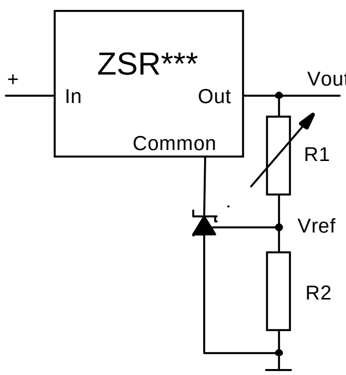
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

Shunt regulator



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

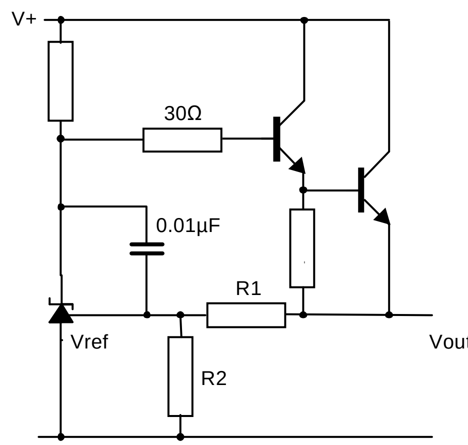
Higher current shunt regulator



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

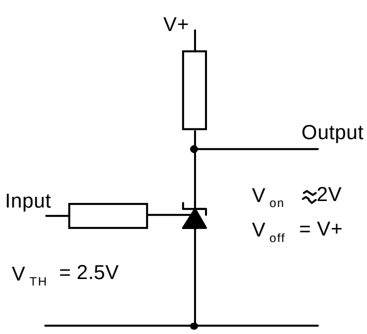
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

Output control of a
three terminal fixed regulator

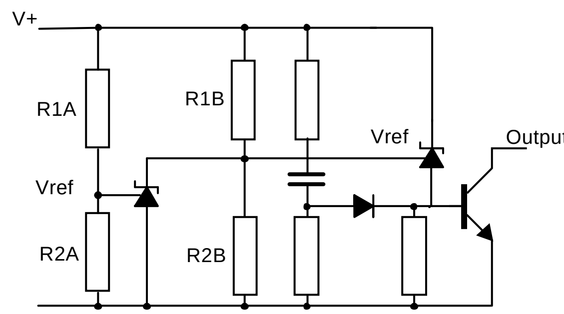


$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

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

ZHT431 X X X

Package — F : SOT23 (Type DN)

Tolerance — M : 0.5%, 01 : 1.0%, 02 : 2%

Packing — TA : 7" Tape & Reel

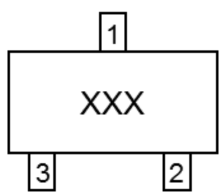
Part Number	Tolerance (%)	Package (Note 5)	Part Mark	Reel Size (inches)	Quantity per reel	Tape Width	Status (Note 4)
ZHT431F01TA	1	SOT23 (Type DN)	43C	7	3000	8mm	In Production
ZHT431F01-7	1	SOT23 (Type DN)	43C	7	3000	8mm	End of Life
ZHT431FMTA	0.5	SOT23 (Type DN)	43P	7	3000	8mm	In Production
ZHT431F02TA	2	SOT23 (Type DN)	43D	7	3000	8mm	In Production

Notes: 4. ZHT431F01-7 is End of Life without any alternative.
5. For packaging details, go to our website at: https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information

SOT23 (Type DN)

(Top View)

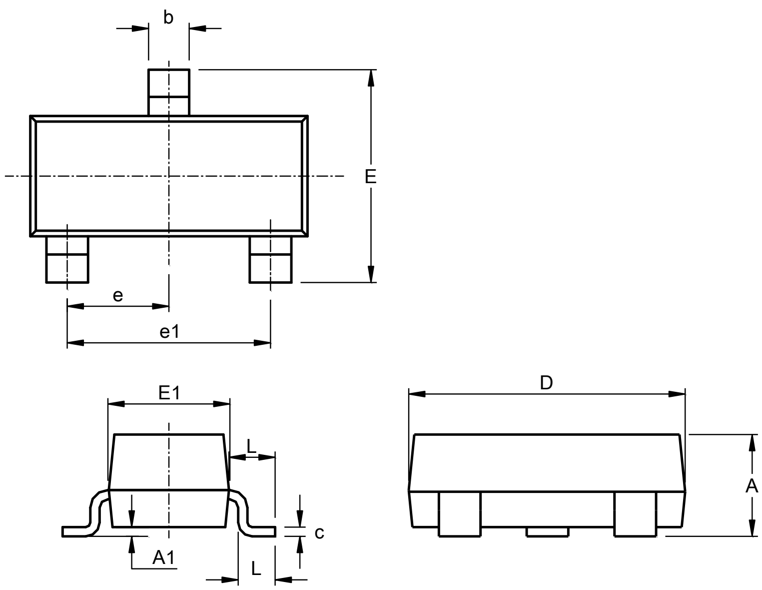


XXX : Part Mark

Package Outline Dimensions

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

(1) Package Type: SOT23 (Type DN)

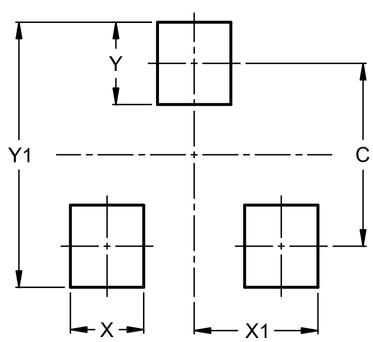


SOT23 (Type DN)			
Dim	**Min**	**Max**	**Typ**
A	0.89	1.12	1.00
A1	0.01	0.10	0.05
b	0.30	0.51	0.45
c	0.08	0.20	0.10
D	2.80	3.04	3.00
E	2.10	2.64	2.42
E1	1.20	1.40	1.37
e	0.95 REF		
e1	1.90 REF		
L	0.25	0.60	0.30
L1	0.45	0.62	0.54
All Dimensions in mm			

Suggested Pad Layout

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

(1) Package Type: SOT23 (Type DN)



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