COST EFFECTIVE ADJUSTABLE PRECISION SHUNT REGULATOR

Description

The ZTL431 and ZTL432 are three terminal adjustable shunt regulators 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.

The ZTL432 has the same electrical specifications as the ZTL431 but has a different pin out in SOT23 (F-suffix) and SOT23F (FF-suffix).

Both variants are available in two grades with initial tolerances of 1% and 0.5% for the A and B grades, respectively.

These are functionally equivalent to the TL431/TL432 except for maximum operation voltage, and have an ambient temperature range of -40°C to +125°C as standard.

Features

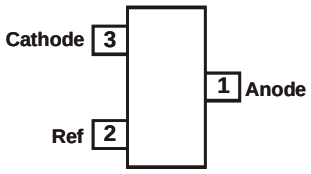
- Temperature Range ..... -40°C to +125°C
- Reference Voltage Tolerance at +25°C
  - 0.5%.....B grade
  - 1% .....A grade
- 0.2Ω Typical Output Impedance
- Sink Current Capability…….. 1mA to 100mA
- Adjustable Output Voltage……V_{REF} to 20V
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An Automotive-Compliant Part is Available Under Separate Datasheet (ZTL431AQ, ZTL431BQ, ZTL432AQ, ZTL432BQ)**

Applications

- Opto-Coupler Linearization
- Linear Regulators
- Improved Zener
- Variable Reference

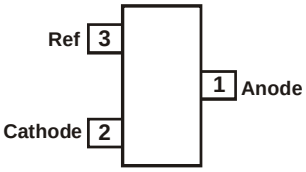
Pin Assignments

(Top View)



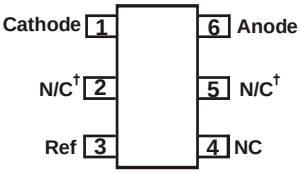
SOT23, SOT23F
(ZTL431)

(Top View)



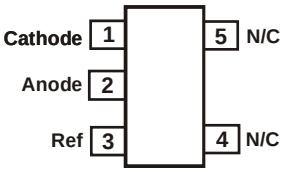
SOT23, SOT23F
(ZTL432)

(Top View)



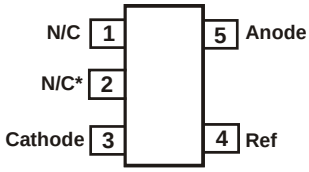
SOT363
†Connected internally to substrate;
should be left floating or connected to Anode

(Top View)



SOT25 (SE5 Package)

(Top View)



SOT25 (E5 Package)
*must be left floating or
connected to pin 5

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html 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.

Absolute Maximum Ratings (Voltages specified are relative to the Anode pin unless otherwise stated.)

Parameter	Rating	Unit
Cathode Voltage (V_{KA})	20	V
Continuous Cathode Current (I_{KA})	150	mA
Reference Input Current Range (I_{REF})	-50µA to +10mA	—
Operating Junction Temperature	-40 to +150	°C
Storage Temperature	-55 to +150	°C

Operation above the absolute maximum rating may cause device failure.
Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

Package Thermal Data

Package	θ_{JA}	P_{DIS} T_A = +25°C, T_J = +150°C
SOT23	380°C/W	330mW
SOT23F	138°C/W	900mW
SOT25	250°C/W	500mW
SOT363	380°C/W	330mW

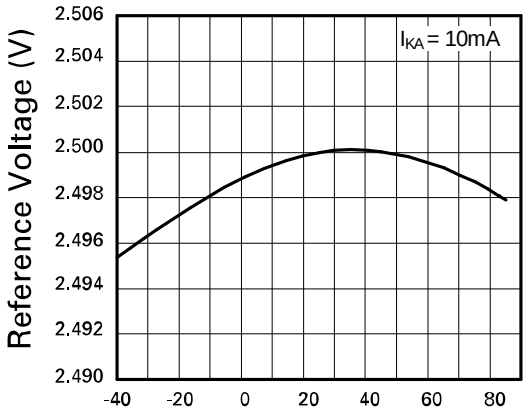
Recommended Operating Conditions (@T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Min	Max	Unit
V_{KA}	Cathode Voltage	V_{REF}	20	V
I_{KA}	Cathode Current	1	100	mA
T_A	Operating Ambient Temperature Range	-40	+125	°C

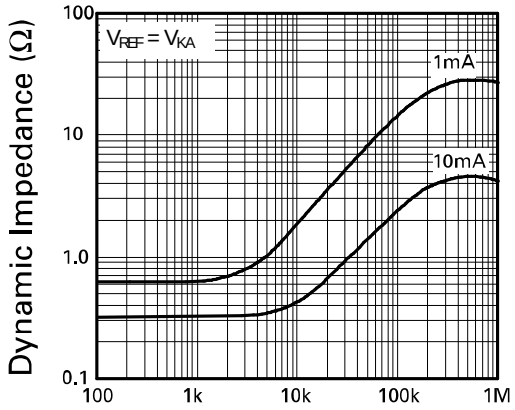
Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{REF}	Reference Voltage	V_{KA} = V_{REF} I_{KA} = 10mA	ZTL43_A	2.475	2.5	2.525	V
			ZTL43_B	2.487	2.5	2.513	
V_{DEV}	Deviation of Reference Voltage Over Full Temperature Range	V_{KA} = V_{REF} I_{KA} = 10mA	T_A = 0 to +70°C	—	6	16	mV
			T_A = -40 to +85°C	—	14	34	
			T_A = -40 to +125°C	—	14	34	
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Change In Reference Voltage To the Change In Cathode Voltage	I_{KA} = 10mA	V_{KA} = V_{REF} to 10V	—	-1.4	-2.7	mV/V
			V_{KA} = 10V to 20V	—	-1.0	-2.0	
I_{REF}	Reference Input Current	I_{KA} = 10mA, R1 = 10kΩ, R_2 = O/C (Open Circuit)		—	2	4	µA
ΔI_{REF}	I_{REF} Deviation Over Full Temperature Range	I_{KA} = 10mA R_1 = 10kΩ R_2 = O/C (Open Circuit)	T_A = 0 to +70°C	—	0.8	1.2	µA
			T_A = -40 to +85°C	—	0.8	2.5	
			T_A = -40 to +125°C	—	0.8	2.5	
$I_{KA(MIN)}$	Minimum Cathode Current for Regulation	V_{KA} = V_{REF}	—	—	0.4	0.6	mA
$I_{KA(OFF)}$	Off State Current	V_{KA} = 20V, V_{REF} = 0V	—	—	0.1	0.5	µA
R_Z	Dynamic Output Impedance	V_{KA} = V_{REF}, f = 0Hz	—	—	0.2	0.5	Ω

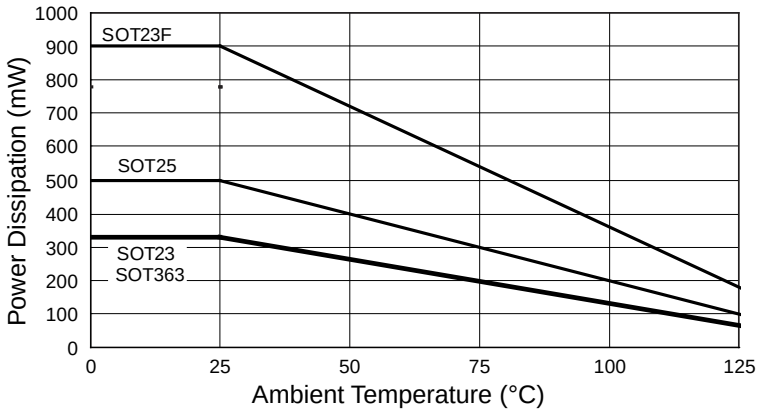
Typical Characteristics



Reference Voltage vs. Temperature

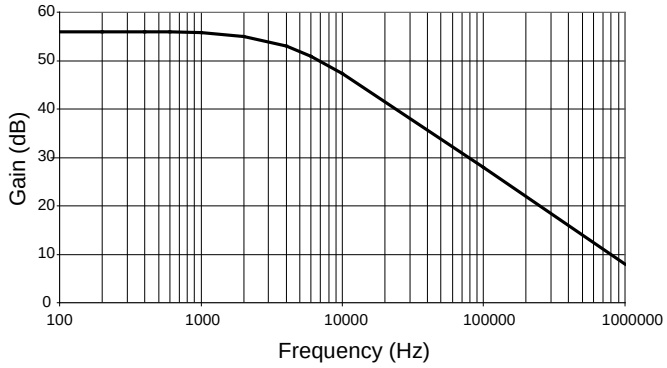


Dynamic Impedance vs. Frequency

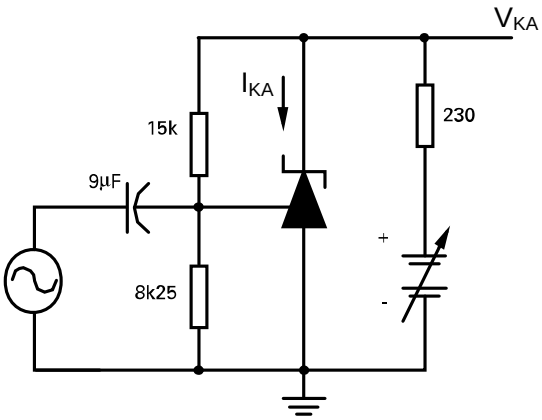


Power Dissipation Derating

Typical Characteristics (Cont.)

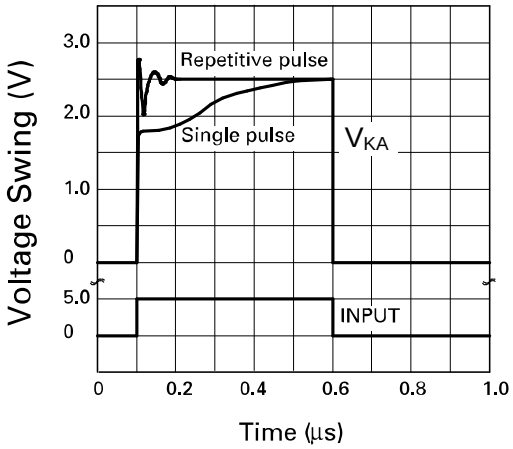


Gain vs. Frequency

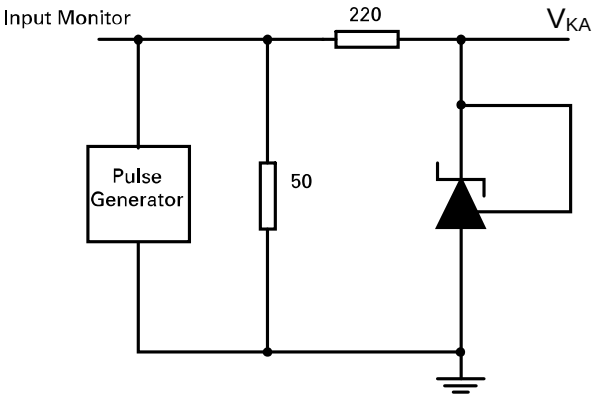


I_{KA} = 10mA, T_A = 25°C

Test Circuit for Open Loop Voltage Gain

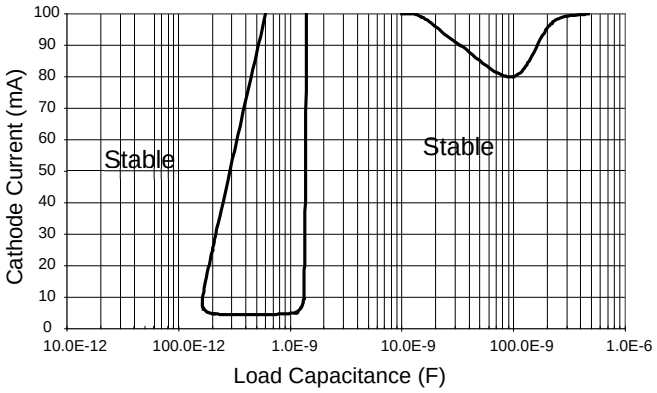


Pulse Response

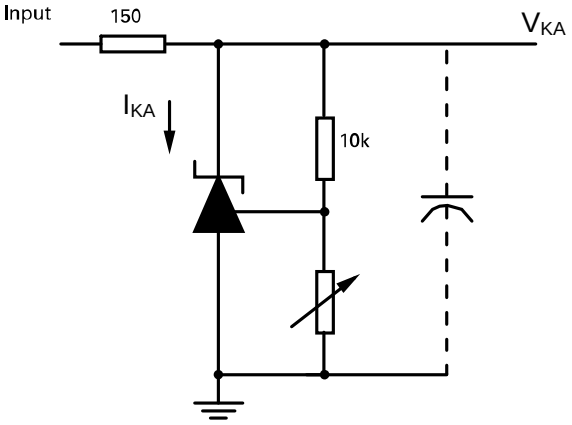


T_A = 25°C

Test Circuit for Pulse Response



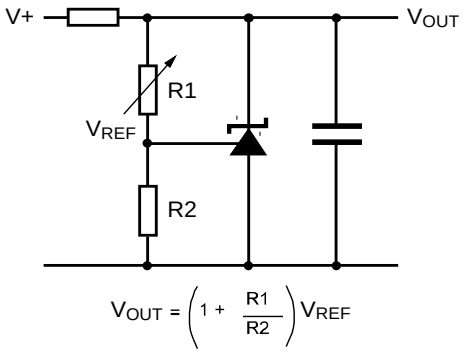
Stability Boundary Condition



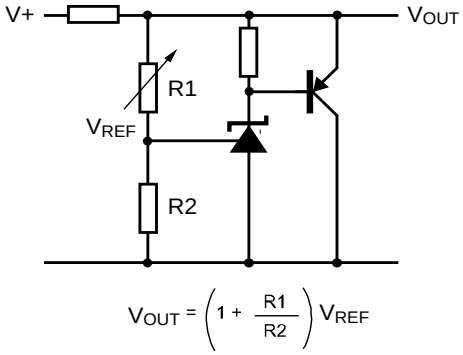
V_{REF} < V_{KA} < 20V, I_{KA} = 10mA, T_A = +25°C

Test Circuit for Stability Boundary Conditions

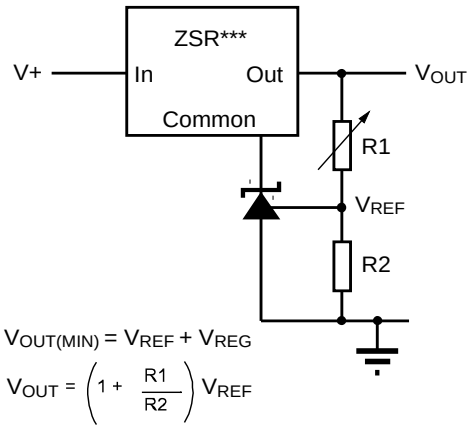
Application Circuits



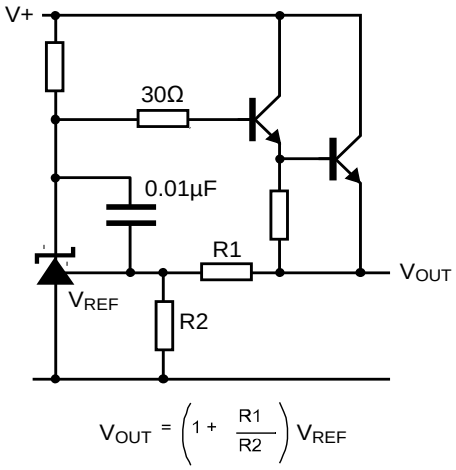
Shunt regulator



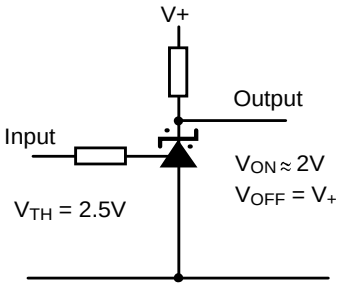
Higher current shunt regulator



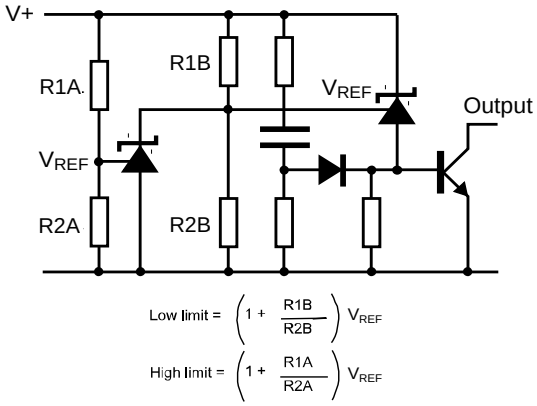
Output control of a three terminal fixed regulator



Series regulator



Single supply comparator with temperature compensated threshold



Over voltage / under voltage protection circuit

DC Test Circuits

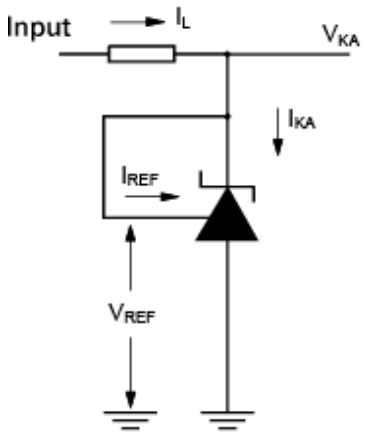


Figure 1. Test circuit for $V_{KA} = V_{REF}$

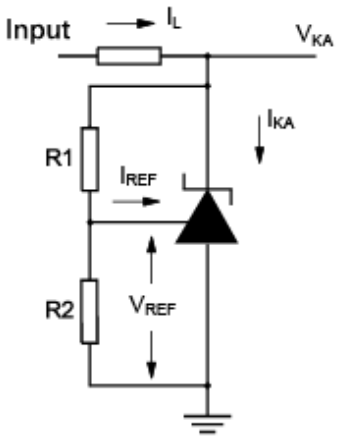


Figure 2. Test circuit for $V_{KA} > V_{REF}$

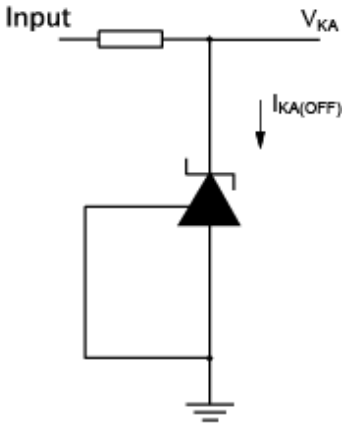


Figure 3. Test circuit for off state current

Notes

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:

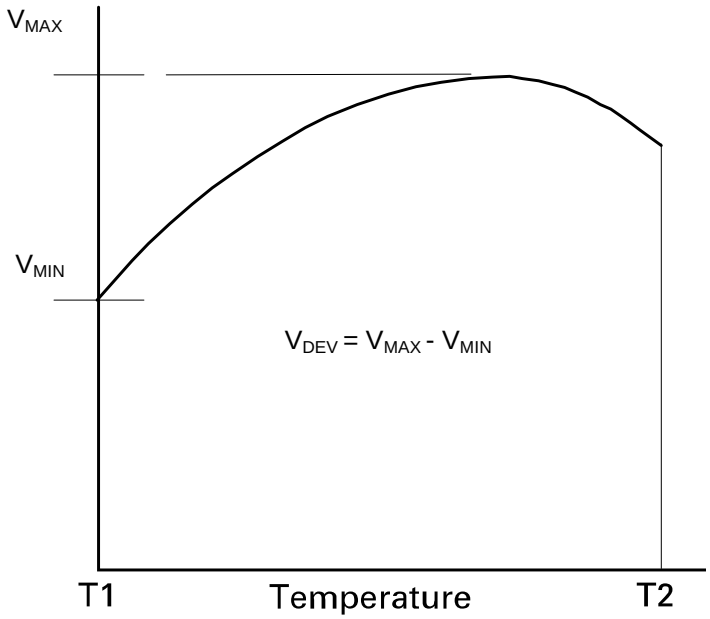
$$V_{REF}(ppm/°C) = \frac{V_{DEV} \times 1{,}000{,}000}{V_{REF}(T1-T2)}$$

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, (Figure 2), the dynamic output impedance of the overall circuit, R'_z, is defined as:

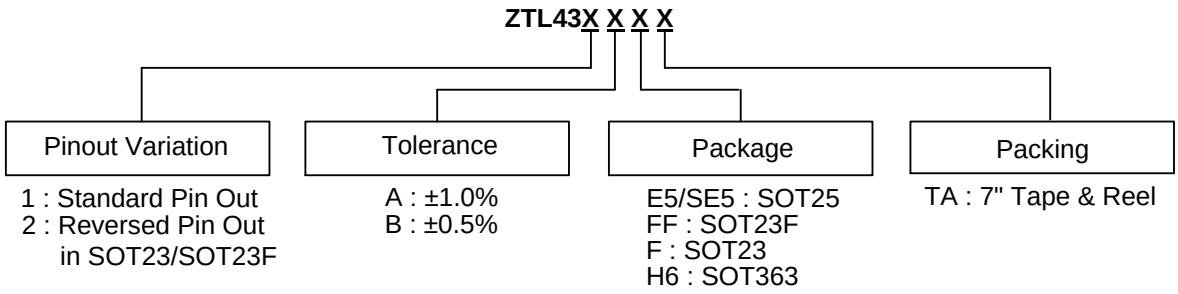
$$R'_Z = R_Z \left(1 + \frac{R1}{R2}\right)$$



Stability Boundary

The ZTL431 and ZTL432 are stable with a range of capacitive loads. A zone of instability exists as demonstrated in the typical characteristic graph on page 4. The graph shows typical conditions. To ensure reliable stability, a capacitor of 4.7nF or greater is recommended between anode and cathode.

Ordering Information

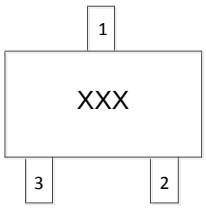


Tol.	Part Number	Package	Part Mark	Status	Reel Size	Tape Width (mm)	Quantity per Reel
1%	ZTL431AE5TA	SOT25	31A	Active	7", 180mm	8	3,000
	ZTL431AFFTA	SOT23F	31A	Active	7", 180mm	8	3,000
	ZTL431AFTA	SOT23	31A	Active	7", 180mm	8	3,000
	ZTL431AH6TA	SOT363	31A	Active	7", 180mm	8	3,000
	ZTL431ASE5TA	SOT25	S2A	Active	7", 180mm	8	3,000
	ZTL432AFFTA	SOT23F	32A	Active	7", 180mm	8	3,000
	ZTL432AFTA	SOT23	32A	Active	7", 180mm	8	3,000
0.5%	ZTL431BE5TA	SOT25	31B	Active	7", 180mm	8	3,000
	ZTL431BFFTA	SOT23F	31B	Active	7", 180mm	8	3,000
	ZTL431BFTA	SOT23	31B	Active	7", 180mm	8	3,000
	ZTL431BH6TA	SOT363	31B	Active	7", 180mm	8	3,000
	ZTL432BFFTA	SOT23F	32B	Active	7", 180mm	8	3,000
	ZTL432BFTA	SOT23	32B	Active	7", 180mm	8	3,000

Marking Information

(1) SOT23 and SOT23F

(Top View)

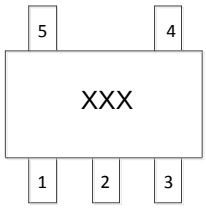


XXX : Identification Code

Part Number	Identification Code
ZTL431AFFTA	31A
ZTL431AFTA	31A
ZTL432AFFTA	32A
ZTL432AFTA	32A
ZTL431BFFTA	31B
ZTL431BFTA	31B
ZTL432BFFTA	32B
ZTL432BFTA	32B

(2) SOT25

(Top View)

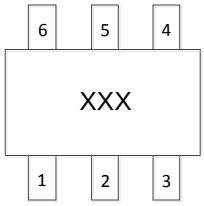


XXX : Identification Code

Part Number	Identification Code
ZTL431AE5TA	31A
ZTL431ASE5TA	S2A
ZTL431BE5TA	31B

(3) SOT363

(Top View)



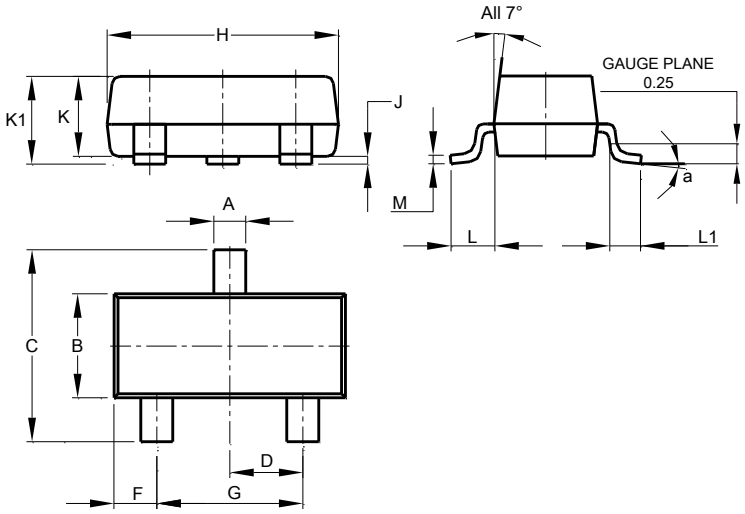
XXX : Identification Code

Part Number	Identification Code
ZTL431AH6TA	31A
ZTL431BH6TA	31B

Package Outline Dimensions

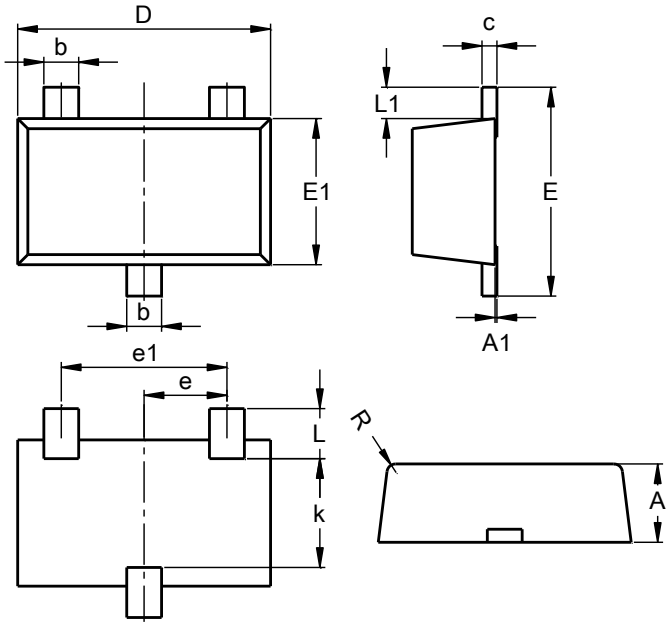
Please see http://www.diodes.com/package-outlines.html for the latest version.

(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: SOT23F

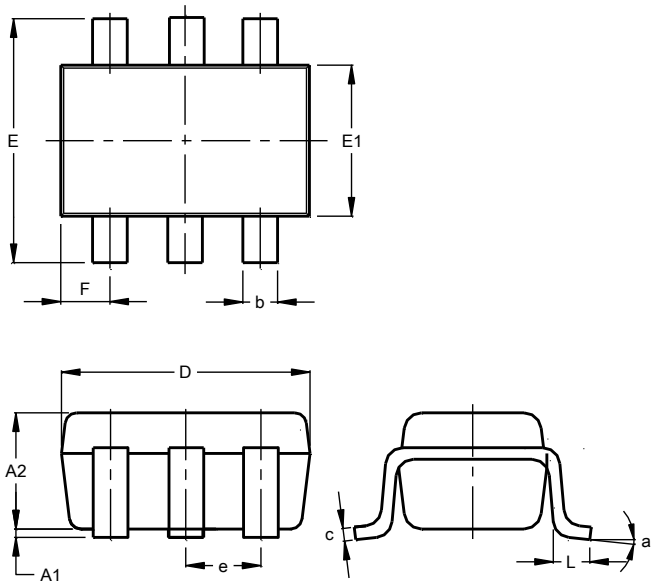


SOT23F			
Dim	**Min**	**Max**	**Typ**
A	0.80	1.00	0.90
A1	0.00	0.10	0.01
b	0.35	0.50	0.44
c	0.10	0.20	0.16
D	2.80	3.00	2.90
e	0.95 REF		
e1	1.90 REF		
E	2.30	2.50	2.40
E1	1.50	1.70	1.65
k	1.20	-	-
L	0.30	0.65	0.50
L1	0.30	0.50	0.40
R	0.05	0.15	-
All Dimensions in mm			

Package Outline Dimensions (Cont.)

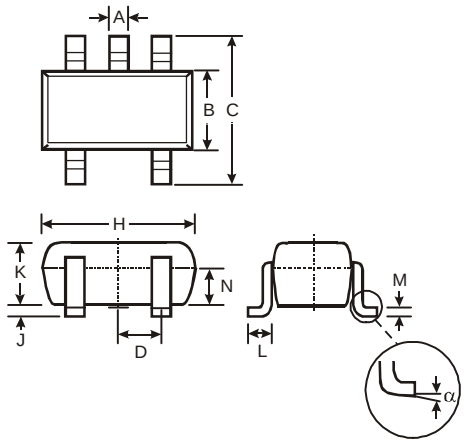
Please see http://www.diodes.com/package-outlines.html for the latest version.

(3) Package Type: SOT363



SOT363			
Dim	**Min**	**Max**	**Typ**
A1	0.00	0.10	0.05
A2	0.90	1.00	1.00
b	0.10	0.30	0.25
c	0.10	0.22	0.11
D	1.80	2.20	2.15
E	2.00	2.20	2.10
E1	1.15	1.35	1.30
e	0.650 BSC		
F	0.40	0.45	0.425
L	0.25	0.40	0.30
a	0°	8°	--
All Dimensions in mm			

(4) Package Type: SOT25

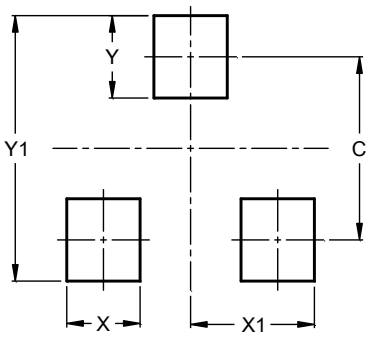


SOT25			
Dim	**Min**	**Max**	**Typ**
A	0.35	0.50	0.38
B	1.50	1.70	1.60
C	2.70	3.00	2.80
D	-	-	0.95
H	2.90	3.10	3.00
J	0.013	0.10	0.05
K	1.00	1.30	1.10
L	0.35	0.55	0.40
M	0.10	0.20	0.15
N	0.70	0.80	0.75
α	0°	8°	-
All Dimensions in mm			

Suggested Pad Layout

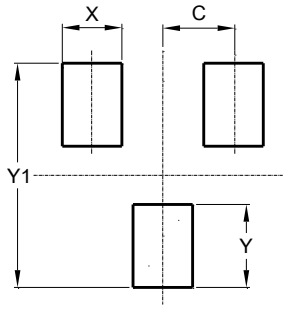
Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) Package Type: SOT23



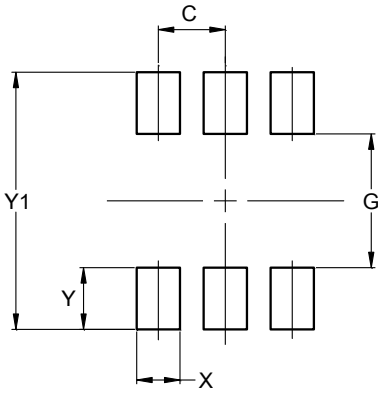
Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

(2) Package Type: SOT23F



Dimensions	Value (in mm)
C	0.95
X	0.80
Y	1.110
Y1	3.000

(3) Package Type: SOT363

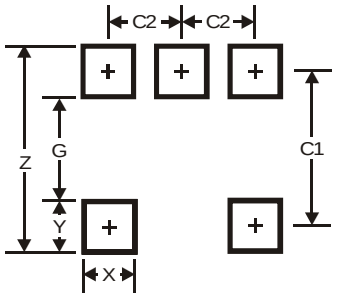


Dimensions	Value (in mm)
C	0.650
G	1.300
X	0.420
Y	0.600
Y1	2.500

Suggested Pad Layout (Cont.)

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

(4) Package Type: SOT25



Dimensions	Value
Z	3.20
G	1.60
X	0.55
Y	0.80
C1	2.40
C2	0.95