

ZTL431, ZTL432

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 2 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 to 125°C as standard.

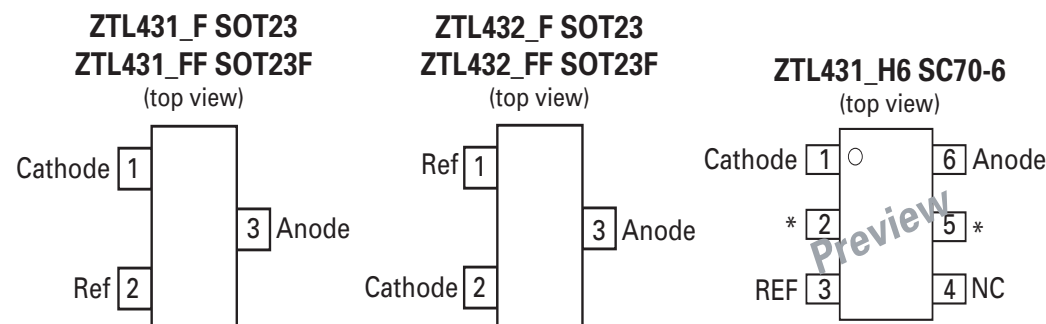
Features

- Temperature range -40 to 125°C
- Reference voltage tolerance at 25°C
 - 0.5% B grade
 - 1% A grade
- Low output noise
- 0.2 typical output impedance
- Sink current capability 1mA to 100mA
- Adjustable output voltage V_{REF} to 20V

Applications

- Opto-coupler linearization
- Linear regulators
- Improved zener
- Variable reference

Pin connections



ZTL431, ZTL432

Ordering information

Tol.	Order code	Pack	Part mark	Status*	Reel Size	Tape width (mm)	Quantity per reel
1%	ZTL431ACSTZ	TO92	ZTL431A	Active	Concertina	N/A	1500
	ZTL431AE5TA	SOT23-5	31A	Preview*	7", 180mm	8	3000
	ZTL431AFFTA	SOT23F	31A	Active	7", 180mm	8	3000
	ZTL431AFTA	SOT23	31A	Active	7", 180mm	8	3000
	ZTL431AH6TA	SC70-6	31A	Preview*	7", 180mm	8	3000
	ZTL431AZTA	SOT89	31A	Preview*	7", 180mm	12	1000
	ZTL432AFFTA	SOT23F	32A	Active	7", 180mm	8	3000
	ZTL432AFTA	SOT23	32A	Active	7", 180mm	8	3000
0.5%	ZTL431BCSTZ	TO92	ZTL431B	Preview*	Concertina	N/A	1500
	ZTL431BE5TA	SOT23-5	31B	Preview*	7", 180mm	8	3000
	ZTL431BFFTA	SOT23F	31B	Preview*	7", 180mm	8	3000
	ZTL431BFTA	SOT23	31B	Active	7", 180mm	8	3000
	ZTL431BH6TA	SC70-6	31B	Preview*	7", 180mm	8	3000
	ZTL431BZTA	SOT89	31B	Preview*	7", 180mm	12	1000
	ZTL432BFFTA	SOT23F	32B	Active	7", 180mm	8	3000
	ZTL432BFTA	SOT23	32B	Active	7", 180mm	8	3000

NOTES:

* For availability of pre-production status devices contact your local Zetex representative

Absolute maximum ratings

Cathode voltage (V_{KA}) 20V

Continuous cathode current (I_{KA}) 150mA

Reference input current range (I_{REF})..... -50 μ A 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.

Unless otherwise stated voltages specified are relative to the ANODE pin.

Package thermal data

Package	Θ_{JA}	P_{DIS} $T_A = 25^\circ\text{C}, T_J = 150^\circ\text{C}$
TO92	160°C/W	780mW
SOT23	380°C/W	330mW
SOT23F	138°C/W	900mW
SOT23-5	250°C/W	500mW
SOT89	125°C/W	1000mW

ZTL431, ZTL432

Recommended operating conditions

		Min	Max	Units
V_{KA}	Cathode voltage	V_{ref}	20	V
I_{KA}	Cathode current	1	100	mA
T_A	Operating ambient temperature range	-40	125	°C

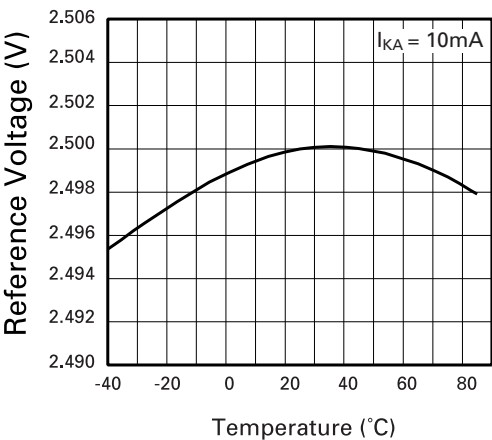
Electrical characteristics

Electrical characteristics over recommended operating conditions, $T_A = 25^\circ\text{C}$, unless otherwise stated.

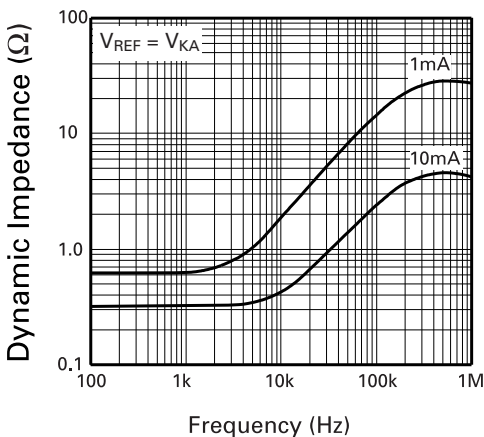
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{REF}	Reference voltage	$V_{KA} = V_{REF}$ $I_{KA} = 10\text{mA}$	ZTL43_A 2.475	2.5	2.525	V
			ZTL43_B 2.487	2.5	2.513	
V_{DEV}	Deviation of reference voltage over full temperature range	$V_{KA} = V_{REF}$ $I_{KA} = 10\text{mA}$	$T_A = 0\text{ to }70^\circ$ $T_A = -40\text{ to }85^\circ\text{C}$ $T_A = -40\text{ to }125^\circ\text{C}$	6 14 14	16 34 34	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of change in reference voltage to the change in cathode voltage	$I_{KA} = 10\text{mA}$	$V_{KA} = V_{REF}\text{ to }10$ $V_{KA} = 10\text{V to }20\text{V}$	-1.4 -1.0	-2.7 -2.0	mV/V
I_{REF}	Reference input current	$I_{KA} = 10\text{mA}$, $R_1 = 10\text{k}\Omega$ $R_2 = \text{OC}$		2	4	μA
ΔI_{REF}	I_{REF} deviation over full temperature range	$I_{KA} = 10\text{mA}$ $R_1 = 10\text{k}\Omega$ $R_2 = \text{OC}$	$T_A = 0\text{ to }70^\circ\text{C}$ $T_A = -40\text{ to }85^\circ\text{C}$ $T_A = -40\text{ to }125^\circ\text{C}$	0.8 0.8 0.8	1.2 2.5 2.5	μA
$I_{KA(MIN)}$	Minimum cathode current for regulation	$V_{KA} = V_{REF}$		0.4	0.6	mA
$I_{KA(OFF)}$	Off state current	$V_{KA} = 20\text{V}$, $V_{REF} = 0\text{V}$		0.1	0.5	μA
R_Z	Dynamic output impedance	$V_{KA} = V_{REF}$, $f = 0\text{Hz}$		0.2	0.5	Ω

ZTL431, ZTL432

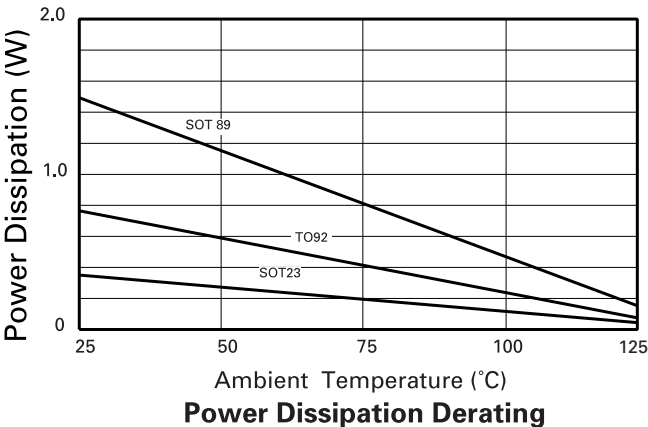
Typical characteristics



Reference Voltage v Temperature



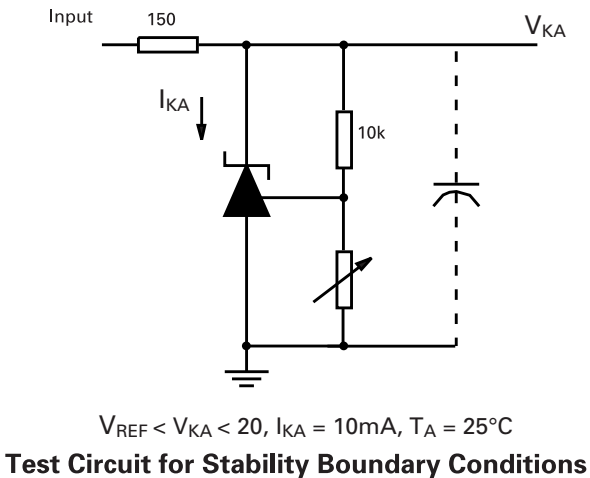
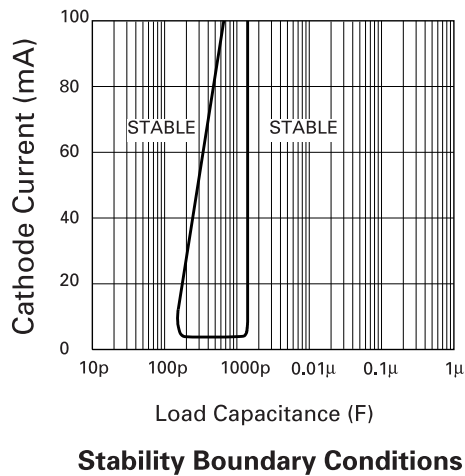
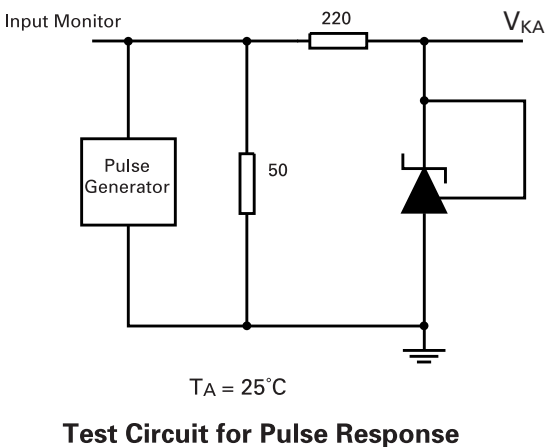
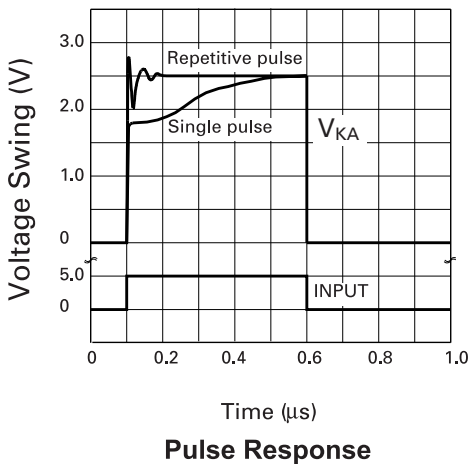
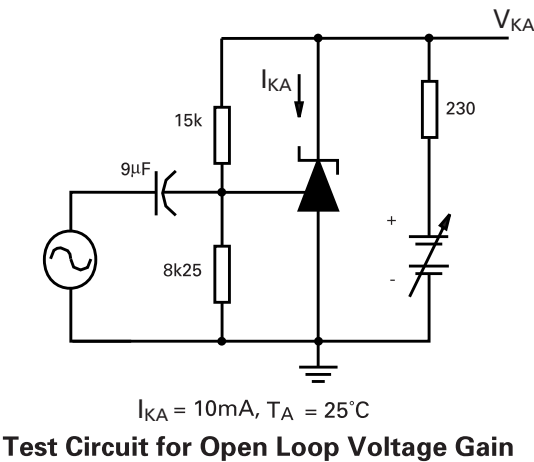
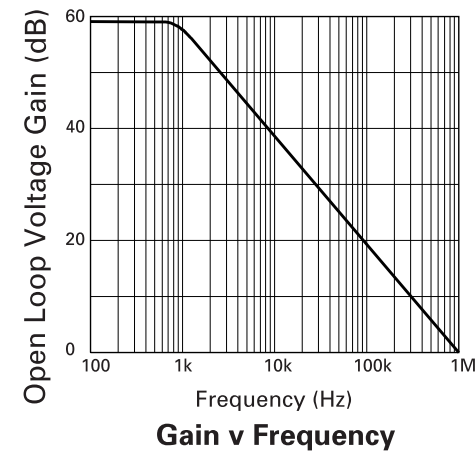
Dynamic Impedance v Frequency



Power Dissipation Derating

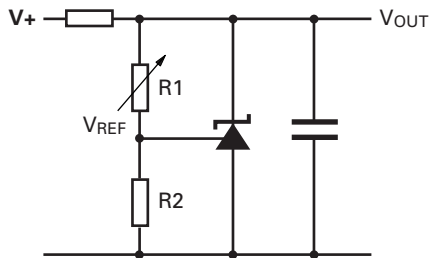
ZTL431, ZTL432

Typical characteristics



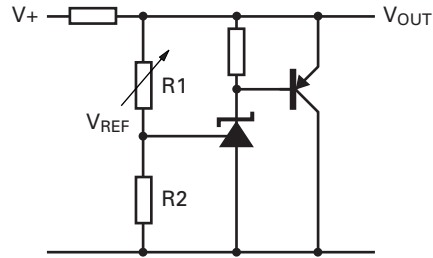
ZTL431, ZTL432

Application circuits



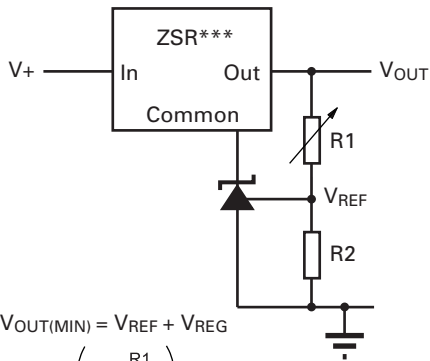
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Shunt regulator



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

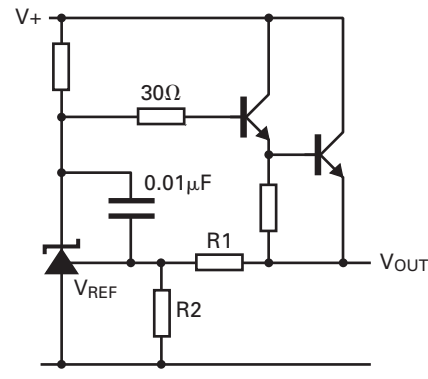
Higher current shunt regulator



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

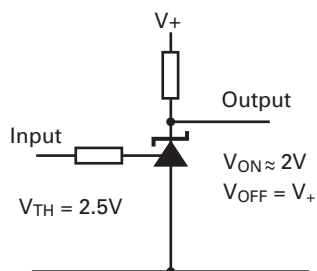
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Output control of a three terminal fixed regulator

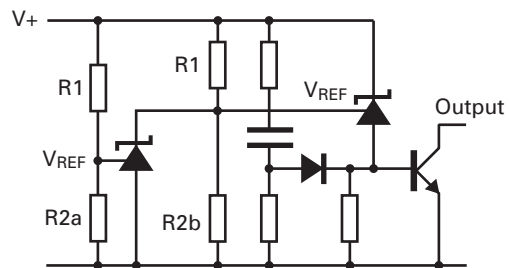


$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

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

DC test circuits

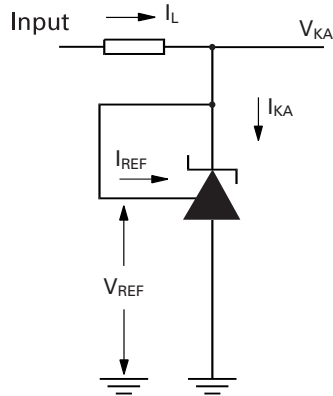


Figure 1 Test circuit for $V_{KA} = V_{REF}$

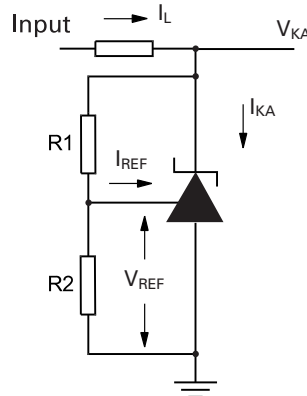


Figure 2 Test circuit for $V_{KA} > V_{REF}$

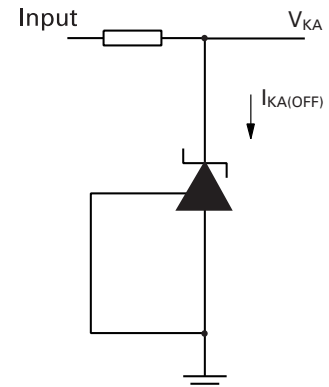


Figure 3 Test circuit for off state current

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:

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

The dynamic output impedance, R_z , is defined as:

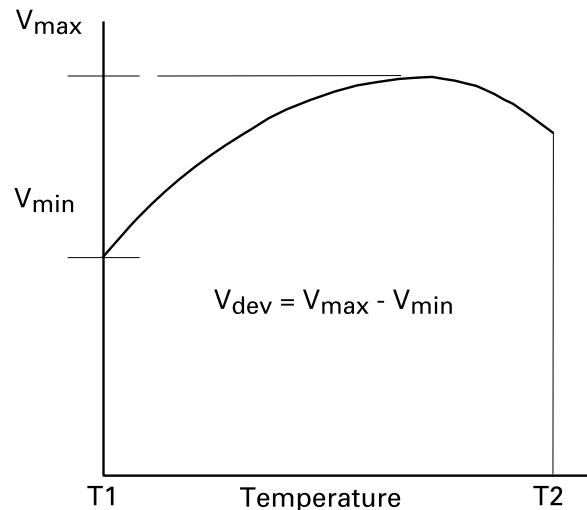
$$R_z = \frac{\Delta V_z}{\Delta I_z}$$

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

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

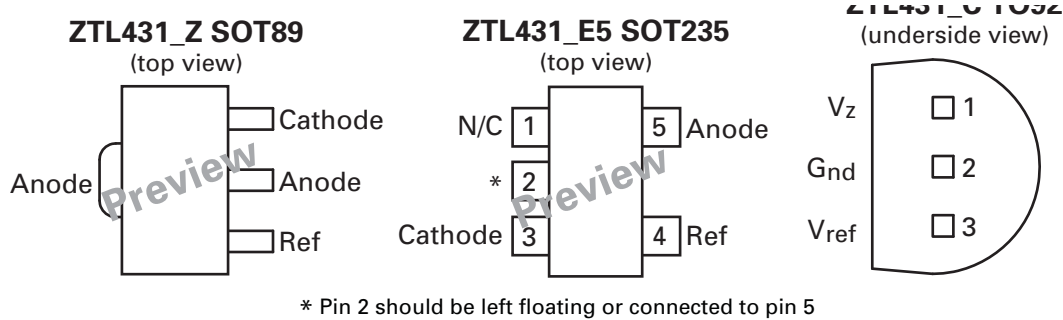
Stability boundary

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 5. The graph shows typical conditions. To ensure reliable stability a capacitor of 4.7nF or greater is recommended between anode and cathode.



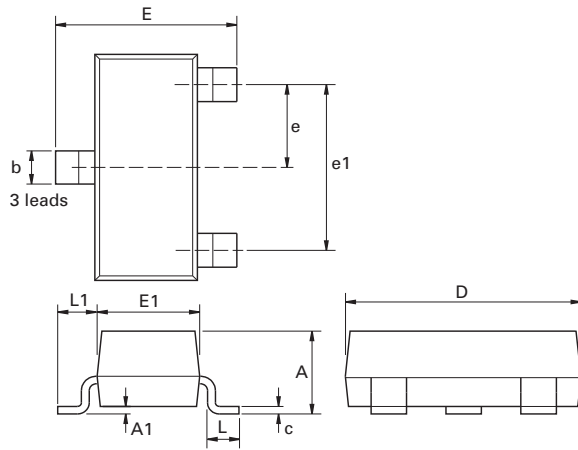
ZTL431, ZTL432

Pin connections - preview status devices



ZTL431, ZTL432

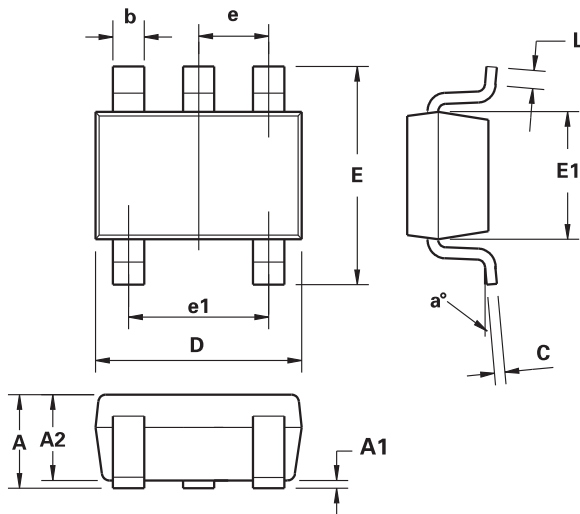
Packaging details - SOT23



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Max.	Max.
A	-	1.12	-	0.044	e1	1.90 NOM		0.075 NOM	
A1	0.01	0.10	0.0004	0.004	E	2.10	2.64	0.083	0.104
b	0.30	0.50	0.012	0.020	E1	1.20	1.40	0.047	0.055
C	0.085	0.120	0.003	0.008	L	0.25	0.62	0.018	0.024
D	2.80	3.04	0.110	0.120	L1	0.45	0.62	0.018	0.024
e	0.95 NOM		0.0375 NOM		-	-	-	-	-

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

Packaging details - SOT23-5

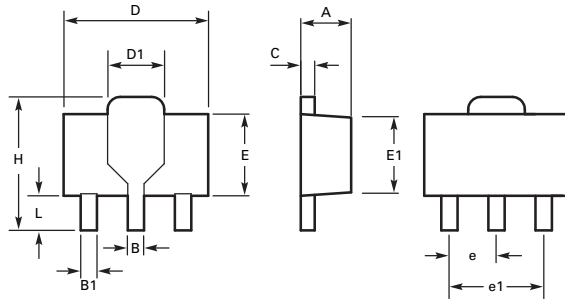


Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.90	1.45	0.0354	0.0570
A1	0.00	0.15	0.00	0.0059
A2	0.90	1.30	0.0354	0.0511
b	0.20	0.50	0.0078	0.0196
C	0.09	0.26	0.0035	0.0102
D	2.70	3.10	0.1062	0.1220
E	2.20	3.20	0.0866	0.1181
E1	1.30	1.80	0.0511	0.0708
e	0.95 REF		0.0374 REF	
e1	1.90 REF		0.0748 REF	
L	0.10	0.60	0.0039	0.0236
a°	0°	30°	0°	30°

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

ZTL431, ZTL432

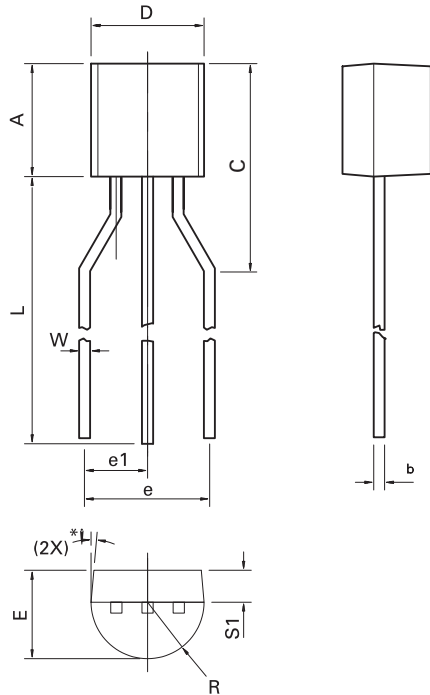
Package details - SOT89



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	1.40	1.60	0.550	0.630	E1	2.13	2.29	0.084	0.090
B	0.44	0.56	0.017	0.022	e	1.50 BSC		0.059 BSC	
B1	0.36	0.48	0.014	0.019	e1	3.00 BSC		0.118 BSC	
C	0.35	0.44	0.014	0.019	H	3.94	4.25	0.155	0.167
D	4.40	4.60	0.173	0.181	L	0.89	1.20	0.155	0.167
E	2.29	2.60	0.090	0.102		-	-	-	-

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

Package details - TO92

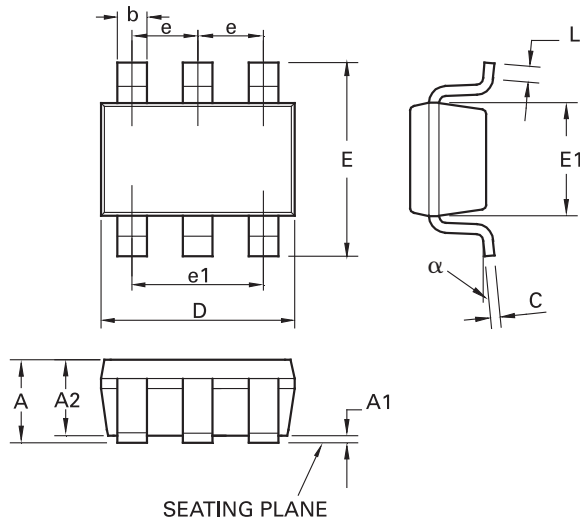


Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.32	4.95	0.170	0.195
b	0.36	0.51	0.014	0.020
C	2.50	3.50	0.099	0.138
E	3.30	3.94	0.130	0.155
e	4.88	5.88	0.192	0.232
e1	2.44	2.94	0.096	0.116
L	12.70	15.49	0.500	0.610
R	2.16	2.41	0.085	0.095
S1	1.14	1.52	0.045	0.060
W	0.41	0.56	0.016	0.022
D	4.45	4.95	0.175	0.195
*°	4°	6°	4°	6°

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

ZTL431, ZTL432

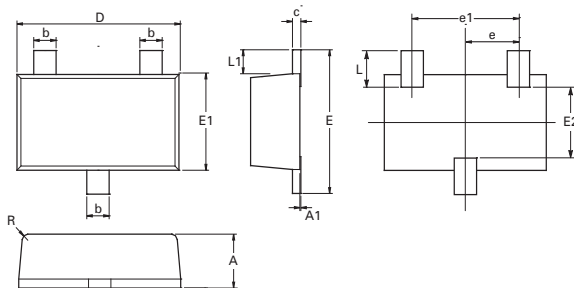
Package details - SC70-6



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Max.	Max.
A	0.80	1.10	0.0315	0.0433	E	2.10 BSC		0.0826 BSC	
A1	-	0.10	-	0.0039	E1	1.25	1.35	0.0492	0.0531
A2	0.80	1.00	0.0315	0.0394	e	0.65 BSC		0.0255 BSC	
b	0.15	0.30	0.006	0.0118	e1	1.30 BSC		0.0511 BSC	
C	0.08	0.25	0.0031	0.0098	L	0.26	0.46	0.0102	0.0181
D	2.00 BSC		0.0787 BSC		α	0°	8°	0°	8°

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

Package details SOT23F



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Max.	Max.
A	0.80	1.00	0.031	0.0394	E	2.30	2.50	0.0906	0.0984
A1	-	0.10	0.00	0.0043	E1	1.50	1.70	0.0590	0.0669
A2	0.06	0.16	0.0024	0.0006	E2	1.10	1.26	0.0433	0.0496
b	0.39	0.41	0.0153	0.0161	L	0.48	0.68	0.0189	0.0268
c	0.11	0.20	0.0043	0.0079	L1	0.39	0.41	0.0153	0.0161
D	2.80	3.00	0.1102	0.1181	R	0.05	0.15	0.0019	0.0059
e	0.95 ref		0.0374 ref		O	0°	12°	0°	12°
e1	1.90 ref		0.7480 ref			-	-	-	-

Note: Controlling dimensions are in millimeters.
Approximate dimensions are provided in inches

Definitions

Product change

Zetex Semiconductors reserves the right to alter, without notice, specifications, design, price or conditions of supply of any product or service. Customers are solely responsible for obtaining the latest relevant information before placing orders.

Applications disclaimer

The circuits in this design/application note are offered as design ideas. It is the responsibility of the user to ensure that the circuit is fit for the user's application and meets with the user's requirements. No representation or warranty is given and no liability whatsoever is assumed by Zetex with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Zetex does not assume any legal responsibility or will not be held legally liable (whether in contract, tort (including negligence), breach of statutory duty, restriction or otherwise) for any damages, loss of profit, business, contract, opportunity or consequential loss in the use of these circuit applications, under any circumstances.

Life support

Zetex 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 Zetex Semiconductors plc. 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 labelling 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.

Reproduction

The product specifications contained in this publication are issued to provide outline information only which (unless agreed by the company in writing) may not be used, applied or reproduced for any purpose or form part of any order or contract or be regarded as a representation relating to the products or services concerned.

Terms and Conditions

All products are sold subjects to Zetex' terms and conditions of sale, and this disclaimer (save in the event of a conflict between the two when the terms of the contract shall prevail) according to region, supplied at the time of order acknowledgement.

For the latest information on technology, delivery terms and conditions and prices, please contact your nearest Zetex sales office.

Quality of product

Zetex is an ISO 9001 and TS16949 certified semiconductor manufacturer.

To ensure quality of service and products we strongly advise the purchase of parts directly from Zetex Semiconductors or one of our regionally authorized distributors. For a complete listing of authorized distributors please visit: www.zetex.com/salesnetwork

Zetex Semiconductors does not warrant or accept any liability whatsoever in respect of any parts purchased through unauthorized sales channels.

ESD (Electrostatic discharge)

Semiconductor devices are susceptible to damage by ESD. Suitable precautions should be taken when handling and transporting devices. The possible damage to devices depends on the circumstances of the handling and transporting, and the nature of the device. The extent of damage can vary from immediate functional or parametric malfunction to degradation of function or performance in use over time. Devices suspected of being affected should be replaced.

Green compliance

Zetex Semiconductors is committed to environmental excellence in all aspects of its operations which includes meeting or exceeding regulatory requirements with respect to the use of hazardous substances. Numerous successful programs have been implemented to reduce the use of hazardous substances and/or emissions.

All Zetex components are compliant with the RoHS directive, and through this it is supporting its customers in their compliance with WEEE and ELV directives.

Product status key:

"Preview"	Future device intended for production at some point. Samples may be available
"Active"	Product status recommended for new designs
"Last time buy (LTB)"	Device will be discontinued and last time buy period and delivery is in effect
"Not recommended for new designs"	Device is still in production to support existing designs and production
"Obsolete"	Production has been discontinued

Datasheet status key:

"Draft version"	This term denotes a very early datasheet version and contains highly provisional information, which may change in any manner without notice.
"Provisional version"	This term denotes a pre-release datasheet. It provides a clear indication of anticipated performance. However, changes to the test conditions and specifications may occur, at any time and without notice.
"Issue"	This term denotes an issued datasheet containing finalized specifications. However, changes to specifications may occur, at any time and without notice.

Zetex sales offices

Europe	Americas	Asia Pacific	Corporate Headquarters
Zetex GmbH Kustermann-park Balanstraße 59 D-81541 München Germany Telefon: (49) 89 45 49 49 0 Fax: (49) 89 45 49 49 49 europe.sales@zetex.com	Zetex Inc 700 Veterans Memorial Highway Hauppauge, NY 11788 USA Telephone: (1) 631 360 2222 Fax: (1) 631 360 8222 usa.sales@zetex.com	Zetex (Asia Ltd) 3701-04 Metroplaza Tower 1 Hing Fong Road, Kwai Fong Hong Kong Telephone: (852) 26100 611 Fax: (852) 24250 494 asia.sales@zetex.com	Zetex Semiconductors plc Zetex Technology Park, Chadderton Oldham, OL9 9LL United Kingdom Telephone: (44) 161 622 4444 Fax: (44) 161 622 4446 hq@zetex.com

© 2007 Published by Zetex Semiconductors plc