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

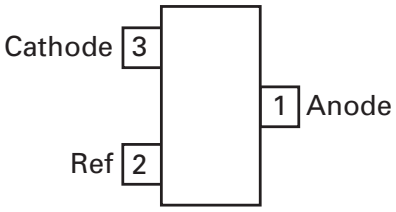
- Temperature range ..... -40 to 125°C
- Reference voltage tolerance at 25°C
  - 0.5% ..... B grade
  - 1% ..... A grade
- 0.2Ω typical output impedance
- Sink current capability ..... 1mA to 100mA
- Adjustable output voltage..... V_{REF} to 20V

Applications

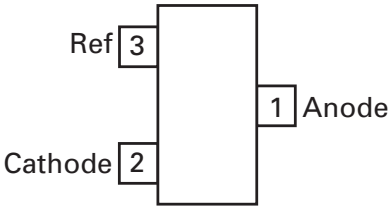
- Opto-coupler linearization
- Linear regulators
- Improved zener
- Variable reference

Pin connections

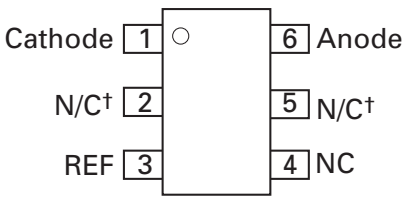
ZTL431_F SOT23
ZTL431_FF SOT23F
(top view)



ZTL432_F SOT23
ZTL432_FF SOT23F
(top view)

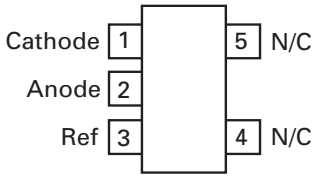


ZTL431_H6 SC70-6
(top view)

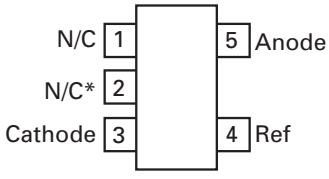


† Connected internally to substrate; should be left floating or connected to Anode

ZTL431ASE5 SOT235
(top view)



ZTL431_E5 SOT235
(top view)



* must be left floating or connected to pin 5

Ordering information

Tol.	Order code	Pack	Part mark	Status*	Reel Size	Tape width (mm)	Quantity per reel
1%	ZTL431ACSTZ	TO92	ZTL431A	Obsolete	Concertina	N/A	1500
	ZTL431AE5TA	SOT23-5	31A	Active	7", 180mm	8	3000
	ZTL431AFFTA	SOT23F	31A	Active	7", 180mm	8	3000
	ZTL431AFTA	SOT23	31A	Active	7", 180mm	8	3000
	ZTL431AH6TA	SC70-6	31A	Active	7", 180mm	8	3000
	ZTL431ASE5TA	SOT23-5	S2A	Active	7", 180mm	8	3000
	ZTL432AFFTA	SOT23F	32A	Active	7", 180mm	8	3000
	ZTL432AFTA	SOT23	32A	Active	7", 180mm	8	3000
0.5%	ZTL431BCSTZ	TO92	ZTL431B	Obsolete	Concertina	N/A	1500
	ZTL431BE5TA	SOT23-5	31B	Active	7", 180mm	8	3000
	ZTL431BFFTA	SOT23F	31B	Active	7", 180mm	8	3000
	ZTL431BFTA	SOT23	31B	Active	7", 180mm	8	3000
	ZTL431BH6TA	SC70-6	31B	Active	7", 180mm	8	3000
	ZTL432BFFTA	SOT23F	32B	Active	7", 180mm	8	3000
	ZTL432BFTA	SOT23	32B	Active	7", 180mm	8	3000

NOTES:
* For availability of preview 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 µA 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°C, T_J = 150°C
TO92	160°C/W	780mW
SOT23	380°C/W	330mW
SOT23F	138°C/W	900mW
SOT23-5	250°C/W	500mW
SOT70-6	380°C/W	330mW

Recommended operating conditions

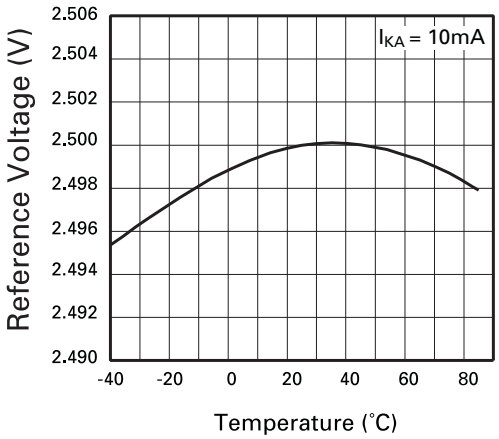
		Min	Max	Units
V_{KA}	Cathode voltage	V_{ref}	20	V
I_{KA}	Cathode current	1	100	mA
T_A	Operating ambient temperature range	-40	125	°C

Electrical characteristics

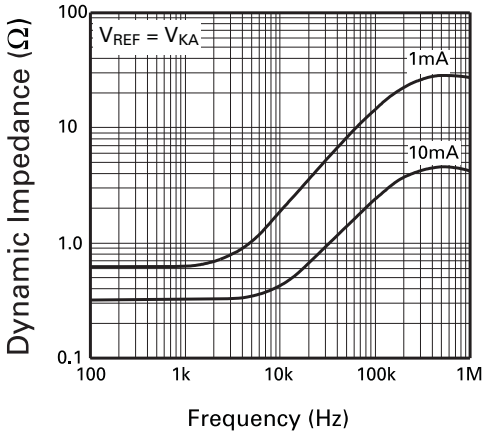
Electrical characteristics over recommended operating conditions, T_A = 25°C, unless otherwise stated.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Units
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} = 10 mA	T_A = 0 to 70°		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 10		-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 = OC			2	4	µA
ΔI_{REF}	I_{REF} deviation over full temperature range	I_{KA} = 10mA R_1 = 10kΩ R_2 = OC	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

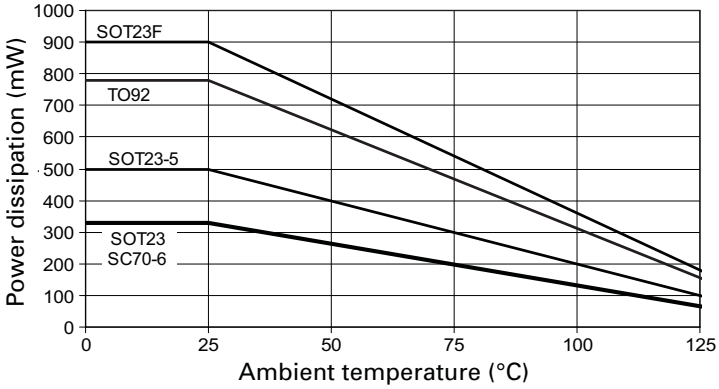
Typical characteristics



Reference Voltage v Temperature

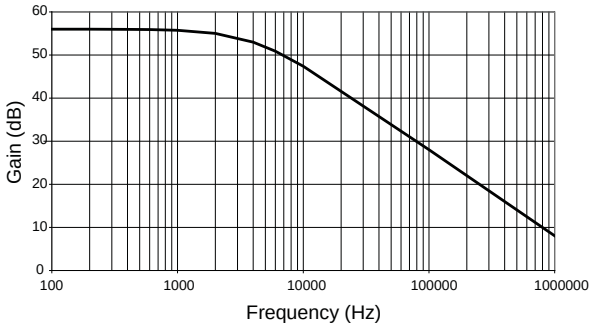


Dynamic Impedance v Frequency

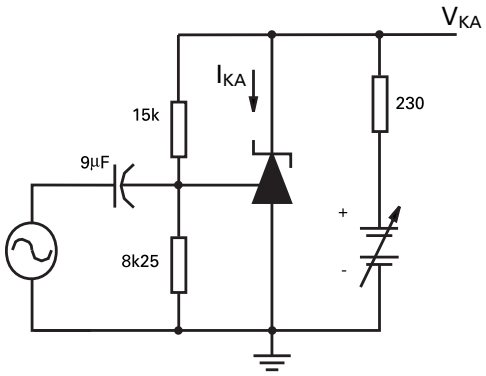


Power Dissipation Derating

Typical characteristics

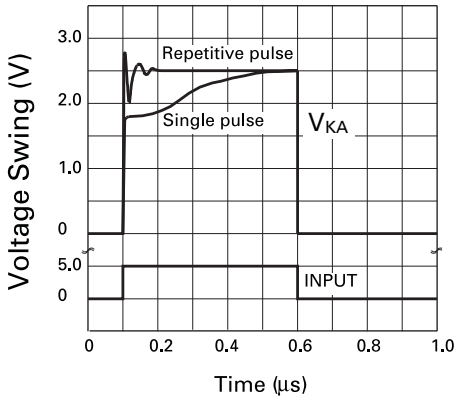


Gain vs Frequency

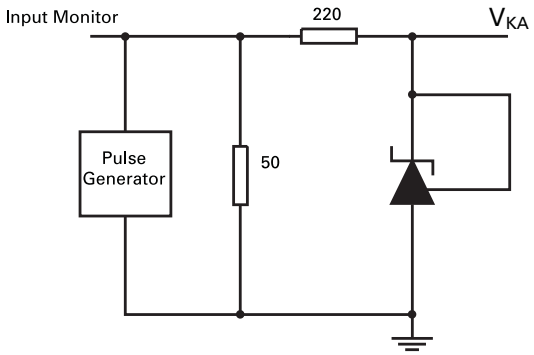


I_{KA} = 10mA, T_A = 25˚C

Test Circuit for Open Loop Voltage Gain

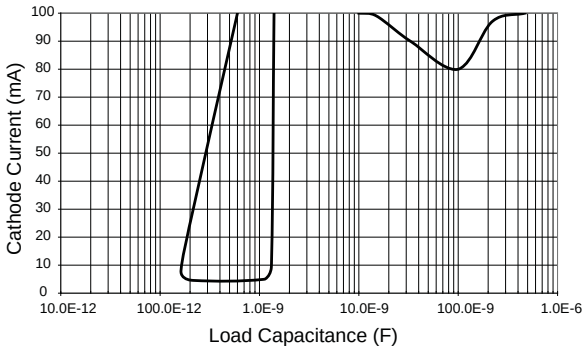


Pulse Response

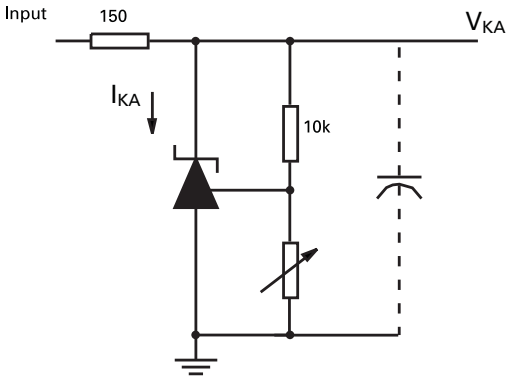


T_A = 25˚C

Test Circuit for Pulse Response



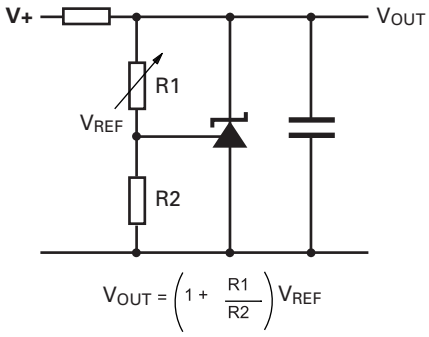
Stability Boundary Condition



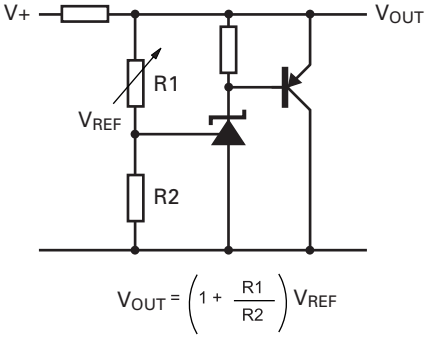
V_{REF} < V_{KA} < 20, I_{KA} = 10mA, T_A = 25°C

Test Circuit for Stability Boundary Conditions

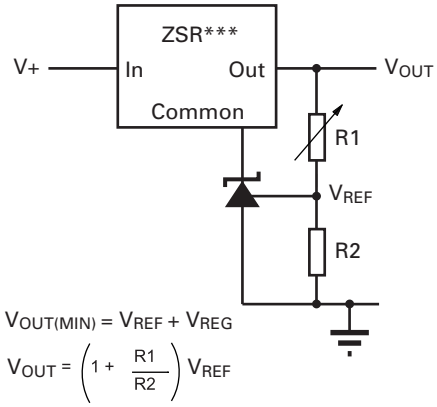
Application cicuits



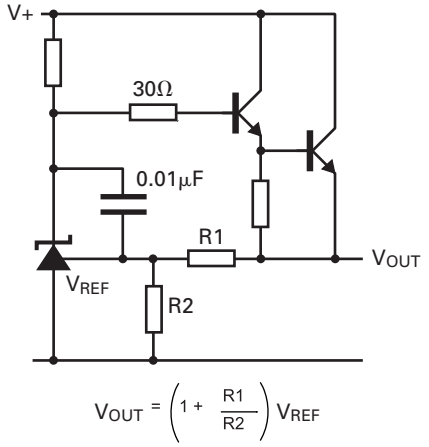
Shunt regulator



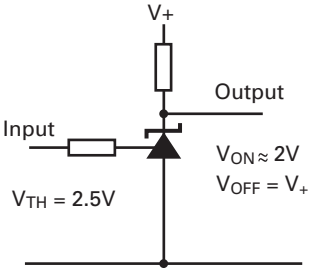
Higher current shunt regulator



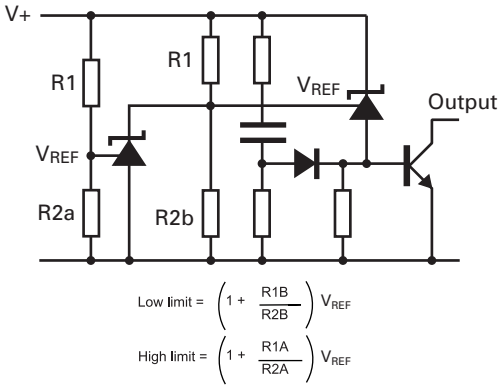
Output control of a three terminal fixed regulator



Series regulator



Single supply comparator with temperature compensated threshold



Over voltage / under voltage protection circuit

DC test circuits

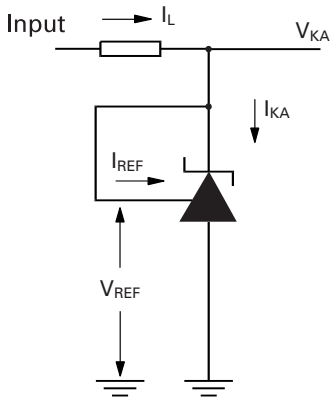


Figure 1 Test circuit for $V_{KA} = V_{REF}$

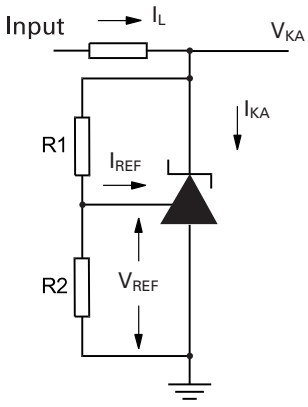


Figure 2 Test circuit for $V_{KA} > V_{REF}$

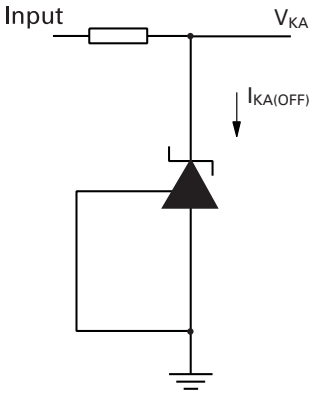


Figure 3 Test circuit for off state current

Notes

Deviation of reference input voltage, Vdev, 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:

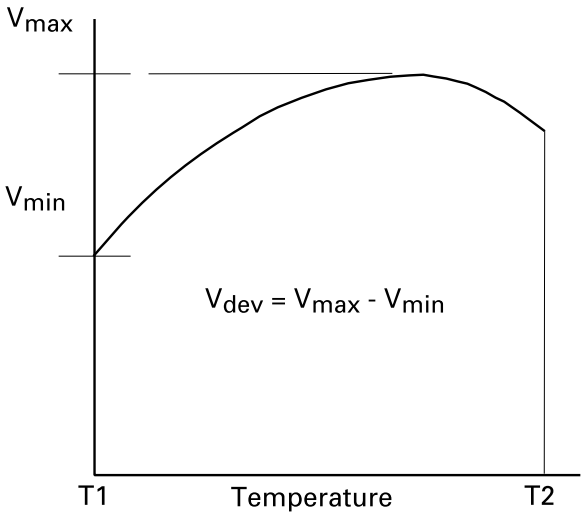
$$V_{REF}(ppm°C) = \frac{V_{DEV} \times 1,000,000}{V_{REF}(T1 - T2)}$$

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

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

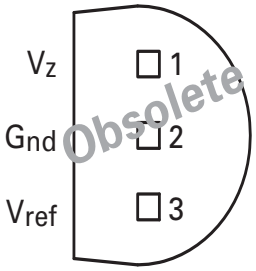


Stability boundary

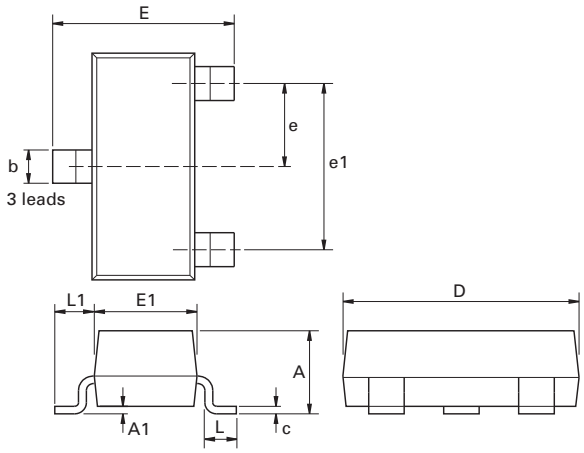
The ZTL431 and ZTL432 are stable with a range of capacitive loads. A zone of instability exists as demonstrated in the typical characteristic graph on page 5. The graph shows typical conditions. To ensure reliable stability a capacitor of 4.7nF or greater is recommended between anode and cathode.

Pin connections - obsolete devices

ZTL431_C TO92
(underside view)



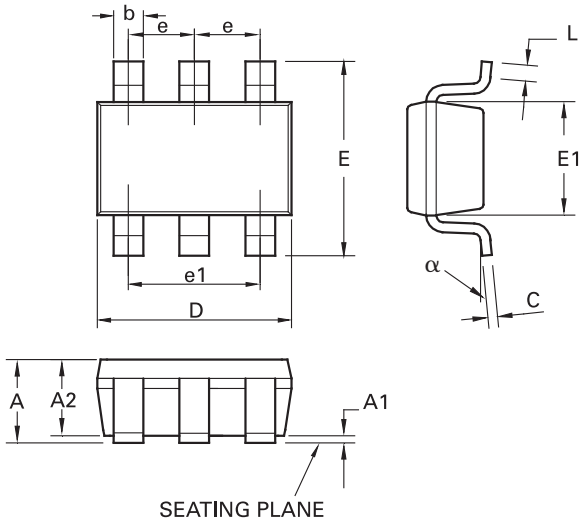
Packaging details - SOT23



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

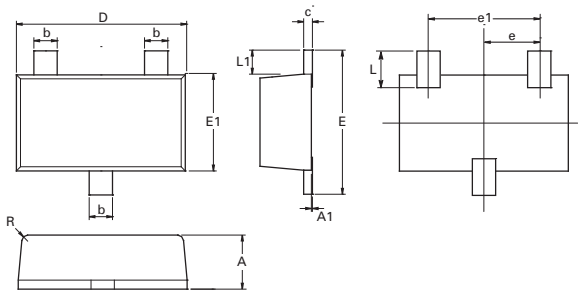
Package details - SC70-6



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

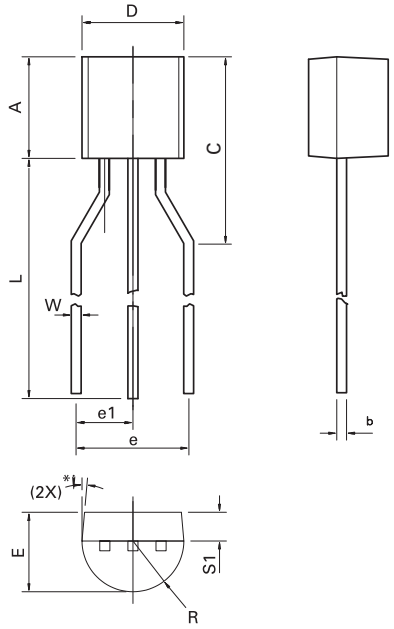
Package details SOT23F



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

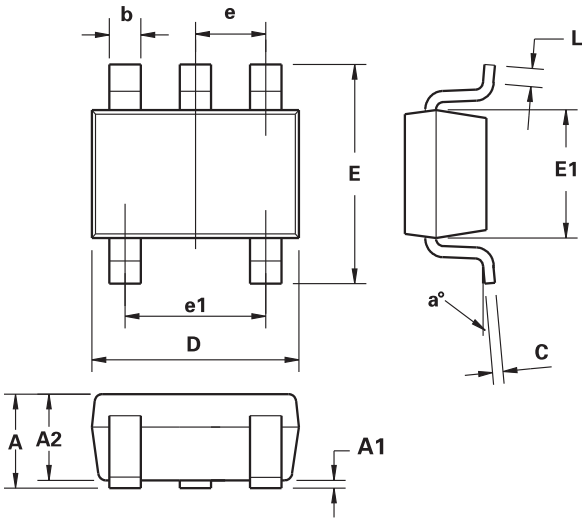
Package details - TO92



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

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

Definitions

Product change

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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.

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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**

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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.

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