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

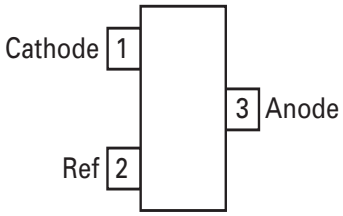
- Temperature range ..... -40 to 125°C
- Reference voltage tolerance at 25°C
  - 0.5% ..... B grade
  - 1% ..... A grade
- Low output noise
- 0.2 typical output impedance
- Sink current capability ..... 1mA to 100mA
- Adjustable output voltage..... V_{REF} to 20V

Applications

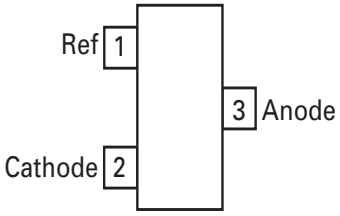
- Opto-coupler linearization
- Linear regulators
- Improved zener
- Variable reference

Pin connections

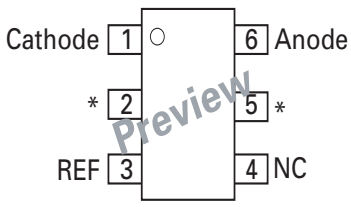
ZTL431_F SOT23
ZTL431_FF SOT23F
(top view)



ZTL432_F SOT23
ZTL432_FF SOT23F
(top view)



ZTL431_H6 SC70-6
(top view)



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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 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
SOT89	125°C/W	1000mW

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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

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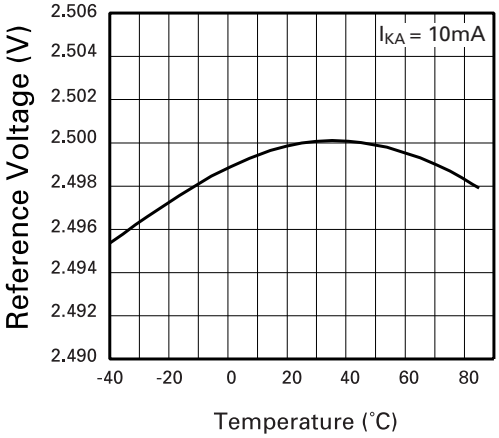
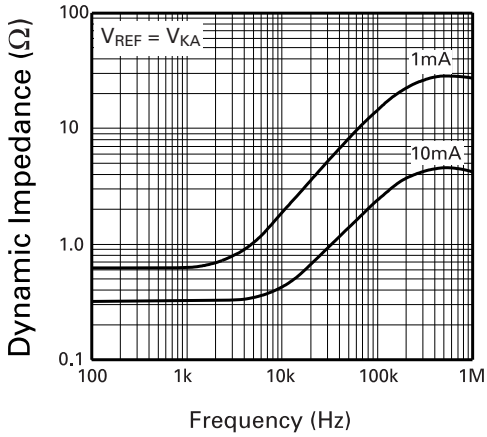
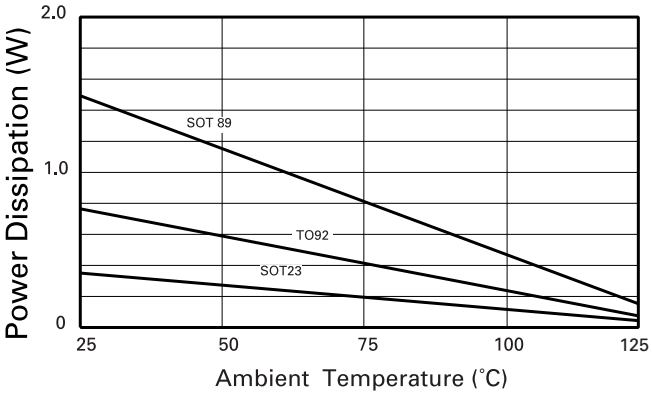
Typical characteristics



Reference Voltage v Temperature



Dynamic Impedance v Frequency



Power Dissipation Derating

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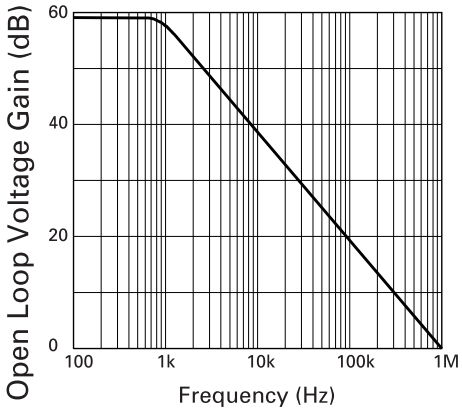
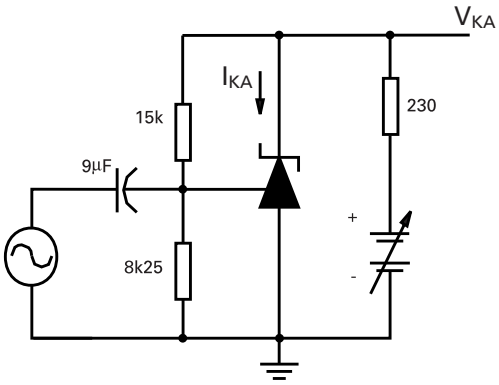
Typical characteristics

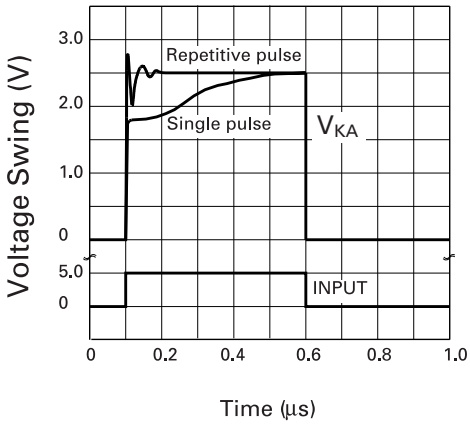


Gain v Frequency

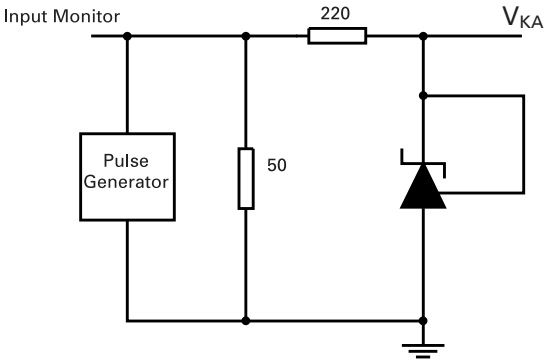


I_{KA} = 10mA, T_A = 25°C

Test Circuit for Open Loop Voltage Gain

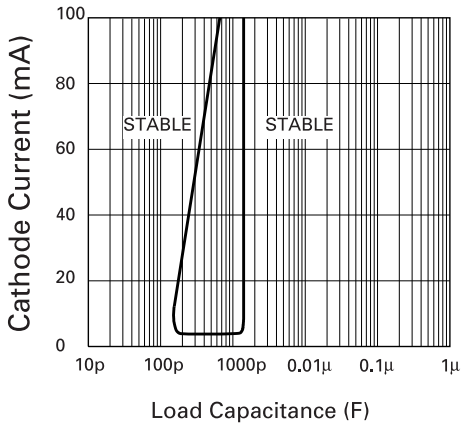


Pulse Response

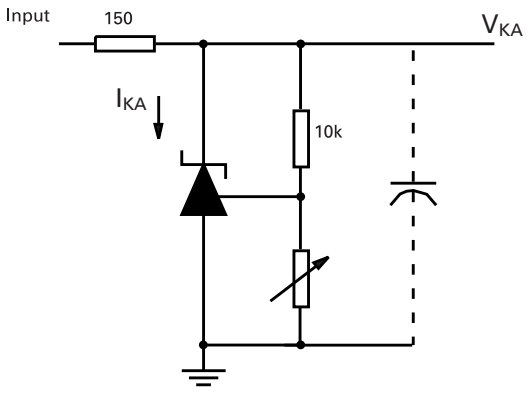


T_A = 25°C

Test Circuit for Pulse Response



Stability Boundary Conditions



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

Test Circuit for Stability Boundary Conditions

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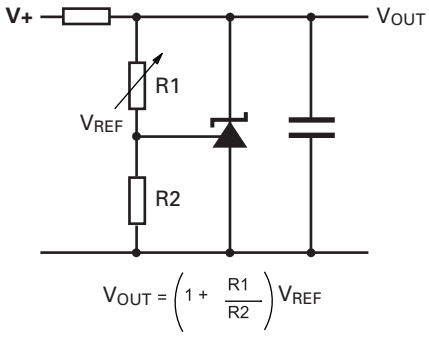
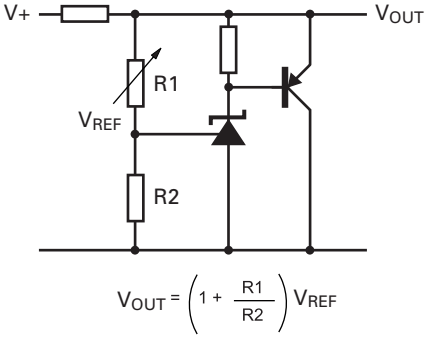
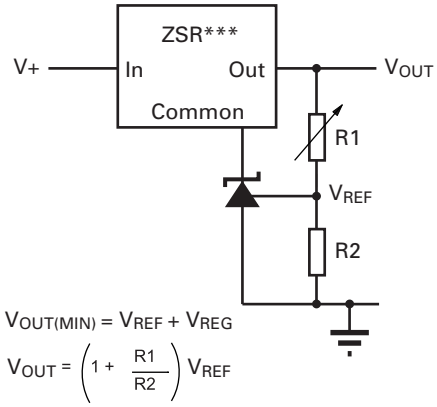
Application cicuits



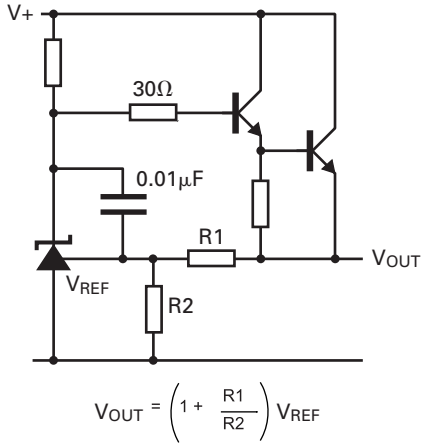
Shunt regulator



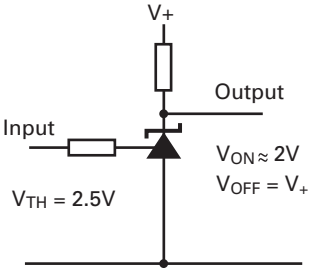
Higher current shunt regulator



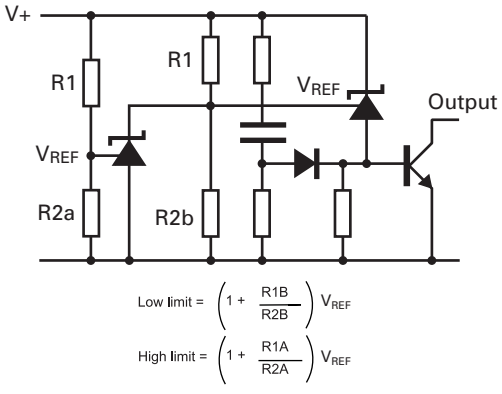
Output control of a three terminal fixed regulator



Series regulator



Single supply comparator with temperature compensated threshold



Over voltage / under voltage protection circuit

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DC test circuits

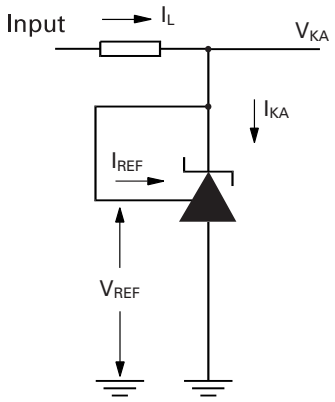


Figure 1 Test circuit for $V_{KA} = V_{REF}$

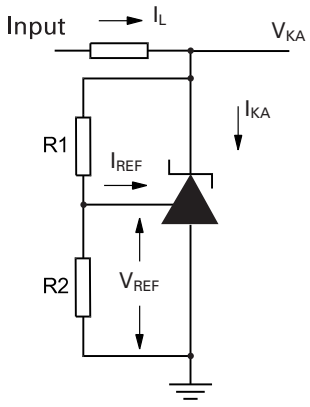


Figure 2 Test circuit for $V_{KA} > V_{REF}$

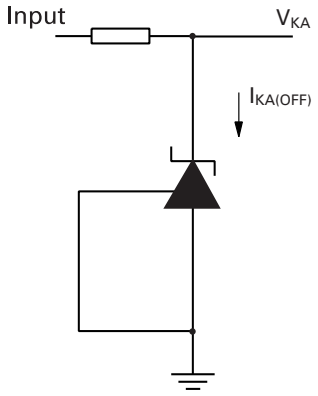


Figure 3 Test circuit for off state current

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:

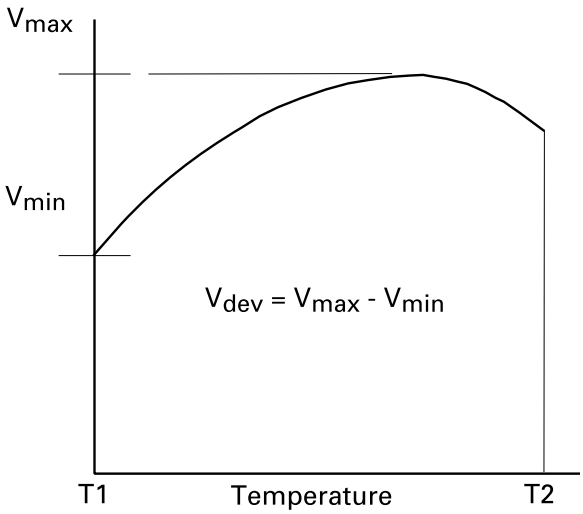
$$V_{REF}(ppm°C) = \frac{V_{DEV} \times 1,000,000}{V_{REF}(T1 - T2)}$$

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.

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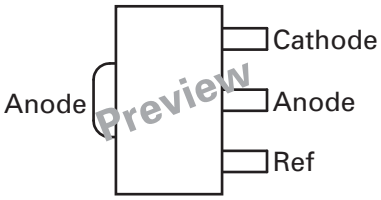
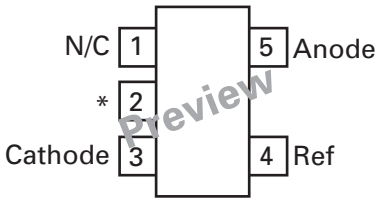
Pin connections - preview status devices

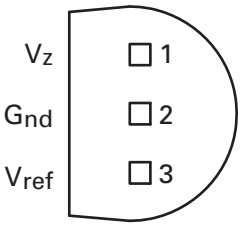
ZTL431_Z SOT89
(top view)



ZTL431_E5 SOT235
(top view)



ZTL431_C TO92
(underside view)



* Pin 2 should be left floating or connected to pin 5

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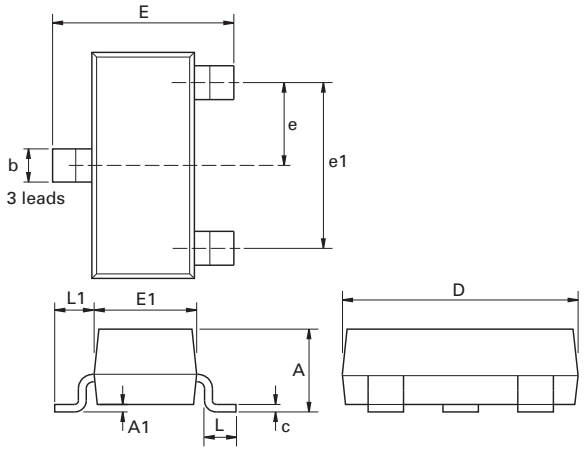
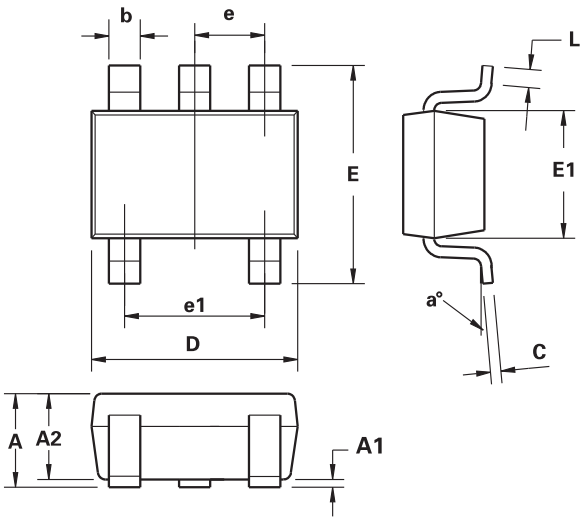
Packaging details - SOT23



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

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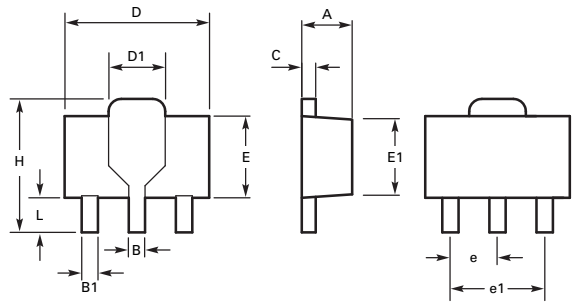
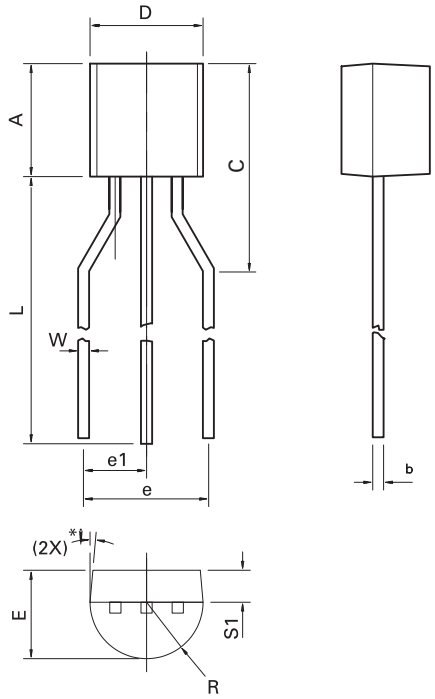
Package details - SOT89



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

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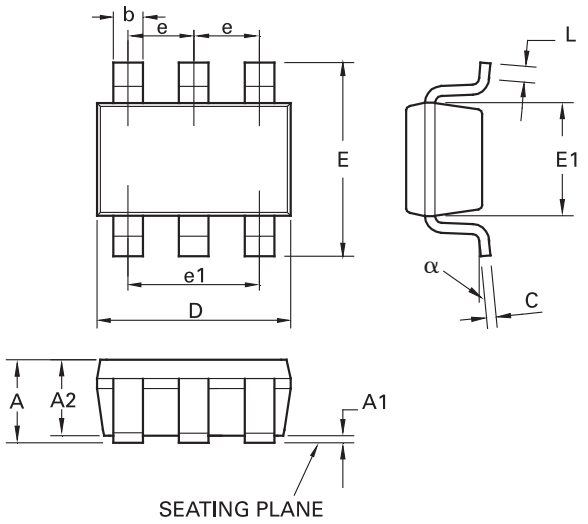
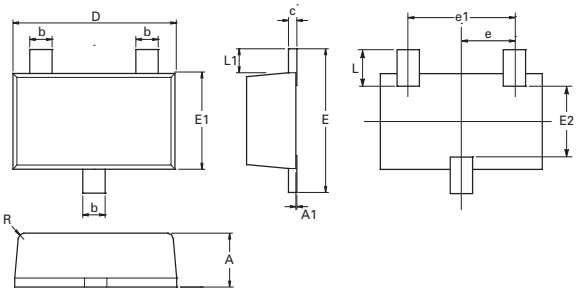
Package details - SC70-6



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

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"Obsolete"	Production has been discontinued

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