



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

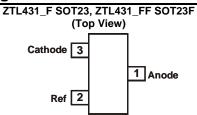
 0.2Ω typical output impedance

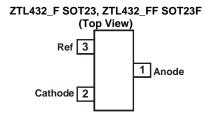
- o 0.5%.....B grade
- o 1%A grade
- Sink current capability....... 1mA to 100mA
- Adjustable output voltage.....V_{REF} to 20V

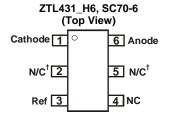
Applications

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

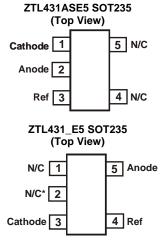
Pin Assignments







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



*must be left floating or connected to pin 5



ZTL431/ZTL432

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 (IREF)	-50µA to 10mA	
Operating Junction Temperature	-40 to 150	°C
Storage Temperature	-55 to 150	°C

Package Thermal Data

Package	θυΑ	P _{DIS} T _A = 25°C, T _J = 150°C
SOT23	380°C/W	330 mW
SOT23F	138°C/W	900 mW
SOT23-5	250°C/W	500 mW
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 (Test conditions unless otherwise specified: T_A = 25°C)

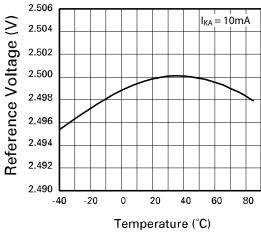
Symbol	Parameter	Con	ditions	Min.	Тур.	Max.	Units
\ /	Deference veltage	$V_{KA} = V_{REF}$	ZTL43_A	2.475	2.5	2.525	V
V_{REF}	Reference voltage	$I_{KA} = 10mA$	ZTL43_B	2.487	2.5	2.513	V
	Deviation of reference		$T_A = 0 \text{ to } 70^{\circ}$		6	16	
V_{DEV}	voltage over full	$V_{KA} = V_{REF}$ $I_{KA} = 10 \text{ mA}$	$T_A = -40 \text{ to } 85^{\circ}\text{C}$		14	34	mV
	temperature range	IKA – TO TIII ($T_A = -40 \text{ to } 125^{\circ}\text{C}$		14	34	111 V
	Ratio of change in		$V_{KA} = V_{REF}$ to 10		-1.4	-2.7	
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$		I _{KA} = 10mA	V _{KA} = 10V to 20V		-1.0	-2.0	mV/V
I _{REF}	Reference input current	I_{KA} = 10mA, R1 = 10k Ω R ₂ = OC			2	4	μA
		I _{KA} = 10mA	$T_A = 0$ to 70° C		0.8	1.2	
ΔI_{REF}		$R_1 = 10k\Omega$	$T_A = -40 \text{ to } 85^{\circ}\text{C}$		0.8	2.5	μA
ZIKEF	temperature range	$R_2 = OC$	$T_A = -40 \text{ to } 125^{\circ}\text{C}$		0.8	2.5	μπ
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	μΑ
R _z	Dynamic output impedance	$V_{KA} = V_{REF}, f = 0Hz$			0.2	0.5	Ω

Operation above the absolute maximum rating may cause device failure.

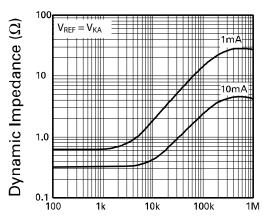
Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.



Typical Characteristics

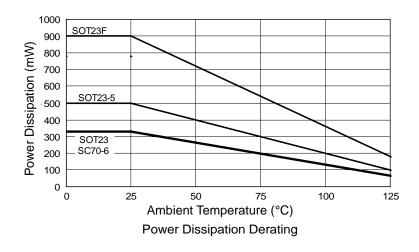


Reference Voltage vs. Temperature



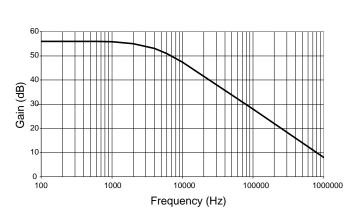
Frequency (Hz)

Dynamic Impedance vs. Frequency

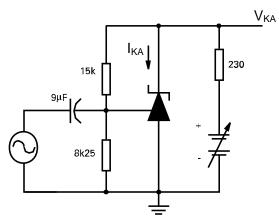




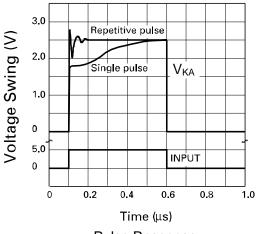
Typical Characteristics (Cont.)



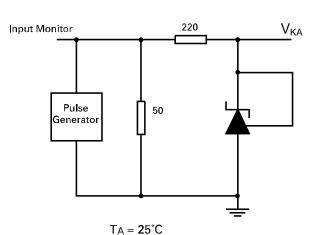
Gain vs. Frequency



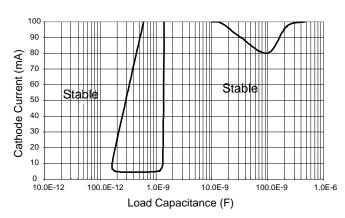
 I_{KA} = 10mA, T_A = 25°C Test Circuit for Open Loop Voltage Gain



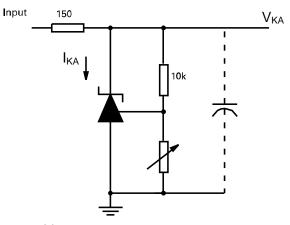
Pulse Response



Test Circuit for Pulse Response



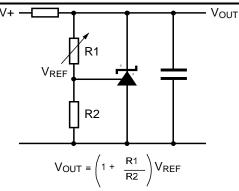
Stability Boundary Condition



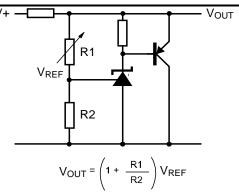
 $V_{REF} < V_{KA} < 20, \ I_{KA} = 10 mA, \ T_A = 25 ^{\circ} C$ Test Circuit for Stabilty Boundary Conditions



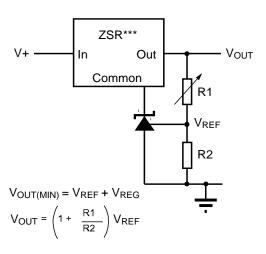
Application Circuits



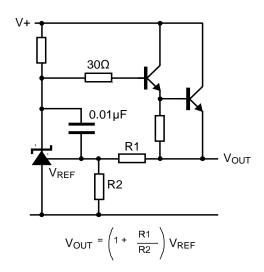
Shunt regulator



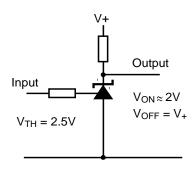
Higher current shunt regulator



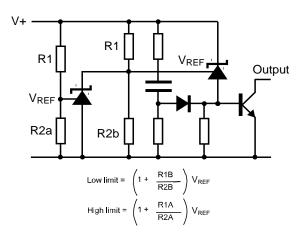
Output control of a three terminal fixed regulator



Series regulator



Single supply comparator with temperature compensated threshold



Over voltage / under voltage protection circuit



DC Test Circuits

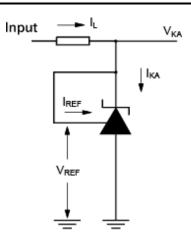


Figure 1. Test circuit for V_{KA} = V_{REF}

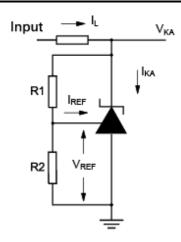


Figure 2. Test circuit for V_{KA} > V_{REF}

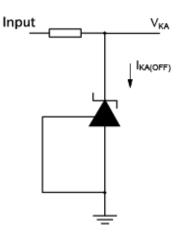


Figure 3. Test circuit for off state current

Notes

Deviation of reference input voltage, 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:

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

The dynamic output impedance, R_{z} , is defined as:

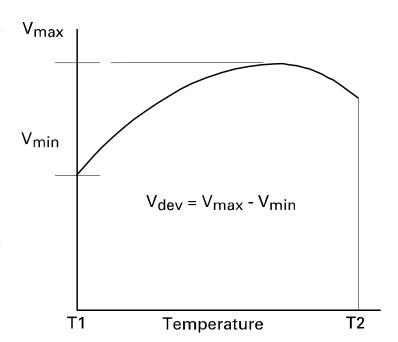
$$R_Z = \Delta V_Z \Delta I_Z$$

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



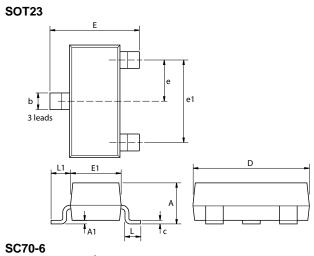


ZTL431/ZTL432

Ordering Information

Tol.	Ordering Code	Pack	Part Mark	Status*	Reel Size	Tape Width (mm)	Quantity per Reel
	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
1%	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
	ZTL431BE5TA	SOT23-5	31B	Active	7", 180mm	8	3000
	ZTL431BFFTA	SOT23F	31B	Active	7", 180mm	8	3000
0.5%	ZTL431BFTA	SOT23	31B	Active	7", 180mm	8	3000
0.5%	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

Package Outline Dimensions



70-6	b e e E E1
↑ ↑A A2↑ ↑	SEATING PLANE

Dim	Millimeters		Inch	es			eters	Inc	hes
Dim.	Min.	Max.	Min.	Max.	Dim.	Min.	Max.	Max.	Max.
Α	-	1.12	ı	0.044	e1	1.90 1	MON	0.075	NOM
A1	0.01	0.10	0.0004	0.004	Е	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
С	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
е	0.95	NOM	0.0375	MOV	-	-	-	-	-

Note: Controlling dimensions are in millimeters.

Approximate dimensions are provided in inches

D:	Millimeters		Inc	hes			neters	Inc	hes
Dim.	Min.	Max.	Min.	Max.	Dim.	Min.	Max.	Max.	Max.
Α	0.80	1.10	0.0315	0.0433	Е	2.10	BSC	0.082	BSC
A1	-	0.10	-	0.0039	E1	1.25	1.35	0.0492	0.0531
A2	0.80	1.00	0.0315	0.0394	е	0.65	BSC	0.025	5 BSC
b	0.15	0.30	0.006	0.0118	e1	1.30	BSC	0.051	1 BSC
С	0.08	0.25	0.0031	0.0098	L	0.26	0.46	0.0102	0.0181
D	2.00	BSC	0.078	7 BSC	а	0°	8°	0°	8°

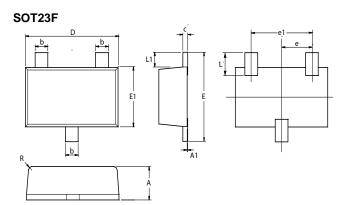
Note: Controlling dimensions are in millimeters.

Approximate dimensions are provided in inches



ZTL431/ZTL432

Package Outline Dimensions (continued)



D:	Millim	eters	Inc	hes	D:	Millin	neters	Inc	hes
Dim.	Min.	Max.	Min.	Max.	Dim.	Min.	Max.	Max.	Max.
Α	0.80	1.00	0.031	0.0394	Е	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
С	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
е	0.95	ref	0.0374 ref		0	0°	12°	0°	12°
e1	1.90) ref	0.748	30 ref	-	-	-	-	-

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

TO92	- D	
	4	
		7
		b
	R R	

Dim	Millim	neters	Inches		
Dim.	Min.	Max.	Min.	Max.	
Α	4.32	4.95	0.170	0.195	
b	0.36	0.51	0.014	0.020	
С	2.50	3.50	0.099	0.138	
Е	3.30	3.94	0.130	0.155	
е	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	
*0	4°	6°	4°	6°	

Note: Controlling dimensions are in millimeters.

Approximate dimensions are provided in inches

SOT23-5	e1 D	E1 C
A A2	A1	

Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.
А	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
С	0.09	0.26	0.0035	0.0102
D	2.70	3.10	0.1062	0.1220
Е	2.20	3.20	0.0866	0.1181
E1	1.30	1.80	0.0511	0.0708
е	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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