

# Low Voltage(1.24V) Adjustable Precision Shunt Regulator TL432/A/C

## FEATURES

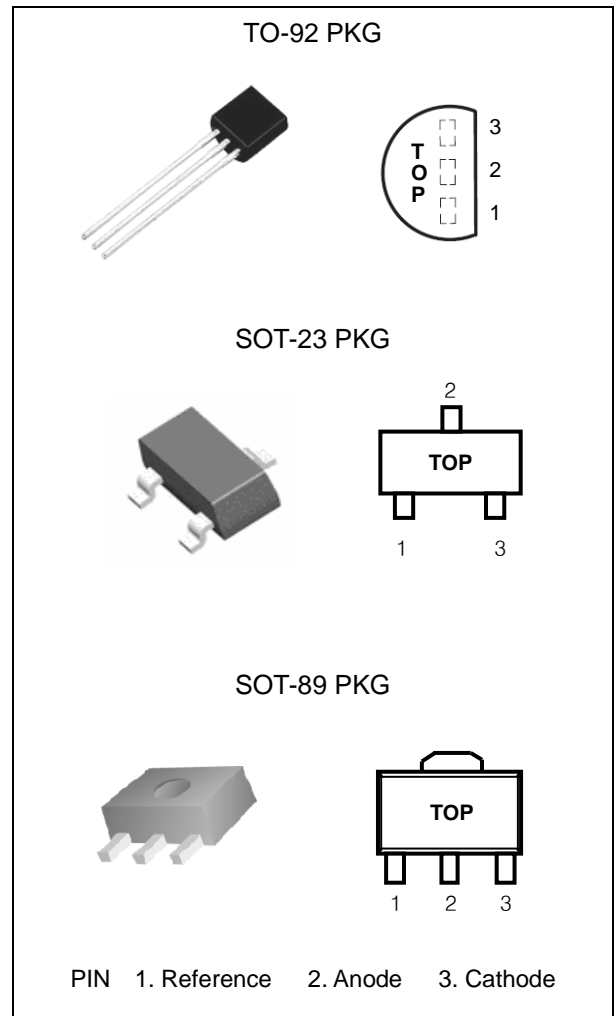
- Low Voltage Operation : 1.24 V
- Programmable Out Voltage to 18V
- Sink Current Capability of 1mA to 100mA
- Equivalent full range Temperature Coefficient of 50ppm/°C
- Temperature Compensated for operation over full rated operating Temperature Range
- Low Output Noise Voltage
- Moisture Sensitivity Level 3

## APPLICATION

- Shunt Regulator
- Voltage Monitoring
- Current Source and Sink Circuits
- Analog & Digital Circuits Requiring Precision References
- Low Out Voltage (3.0V to 3.3V) Switching Power Supply Error Amplifier

## DESCRIPTION

The TL432 is a three-terminal Shunt Voltage Reference providing a highly accuracy 1.24V band-gap reference with 0.5% and 1.0% tolerance. The TL432 thermal stability and wide operating current(100mA) makes it suitable for all variety of applications that are looking for a low cost solution with high performance. The TL432 is an ideal voltage reference in an isolated feed circuit for 3.0V to 3.3V switching mode power supplies.



## ORDERING INFORMATION

Device	Package
TL432TA	TO-92(Taping)
TL432SF	SOT-23 3L
TL432F	SOT-89 3L

\* Refer to the page 2 for detailed ordering Information,

## Absolute Maximum Ratings

(Full operating ambient temperature range applies unless otherwise noted.)

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Cathode Voltage	$V_{KA}$	-	20	V
Cathode Current Range(Continuous)	$I_K$	-	100	mA
Reference Input Current Range	$I_{REF}$	-	3	mA
Junction Temperature Range	$T_J$	-40	150	°C
Operating Temperature Range	$T_{OPR}$	-40	125	°C
Storage Temperature Range	$T_{STG}$	-65	150	°C
Total Power Dissipation	$P_D$	770		mW

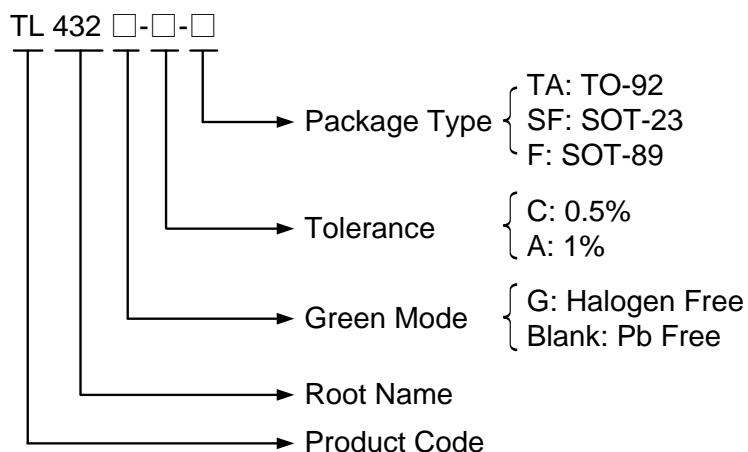
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## RECOMMENDED OPERATING CONDITIONS

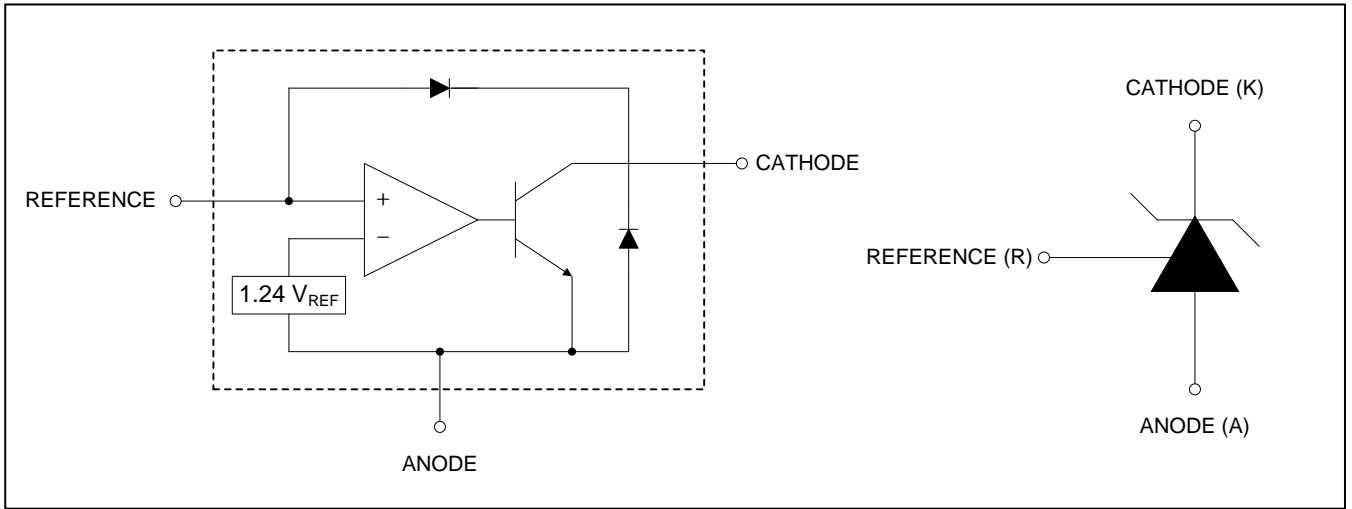
CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Cathode Voltage	$V_{KA}$	$V_{REF}$	18	V
Cathode Current	$I_K$	0.1	100	mA

## Ordering Information

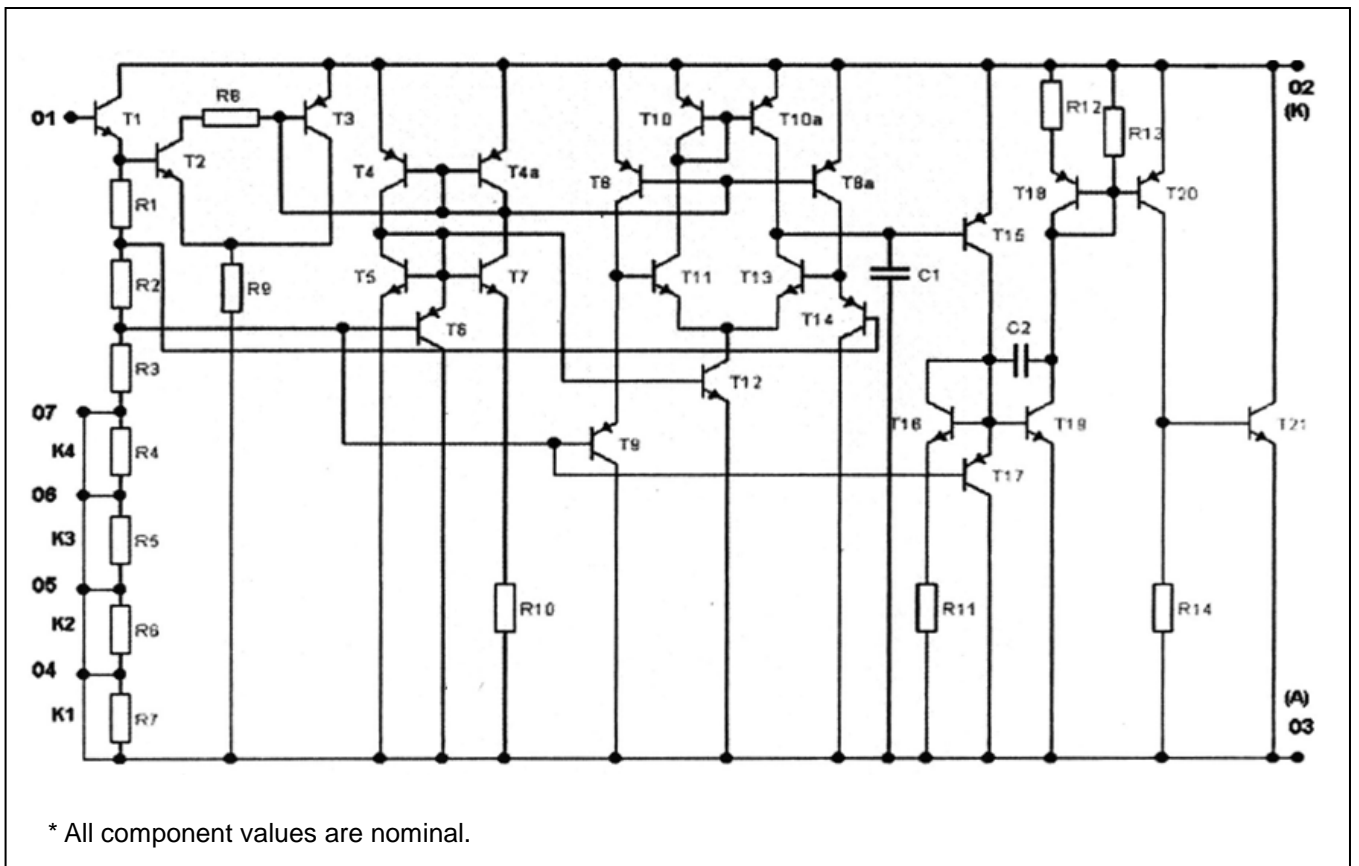
$V_{REF}$	Package	Tolerance	Order No.	Marking	Supplied As	Status
1.24V	TO-92	0.5%	TL432CTA	TL432-C	Tape	Active
			TL432GCTA	TL432GC	Tape	Contact us
		1%	TL432ATA	TL432-A	Tape	Active
			TL432GATA	TL432GA	Tape	Contact us
	SOT-23	0.5%	TL432CSF	432	Reel	Active
			TL432GCSF	432	Reel	Active
		1%	TL432ASF	432	Reel	Active
			TL432GASF	432	Reel	Active
	SOT-89	0.5%	TL432CF	432	Reel	Active
			TL432GCF	432	Reel	Active
		1%	TL432AF	432	Reel	Active
			TL432GAF	432	Reel	Active



FUNCTION BLOCK DIAGRAM

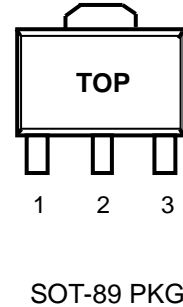
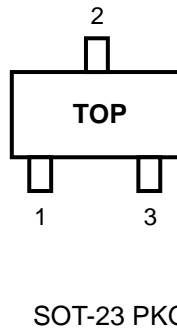
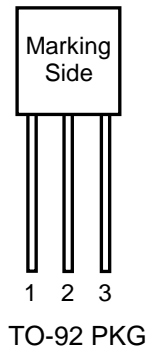


EQUIVALENT SCHEMATIC



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## PIN CONFIGURATION



## PIN DESCRIPTION

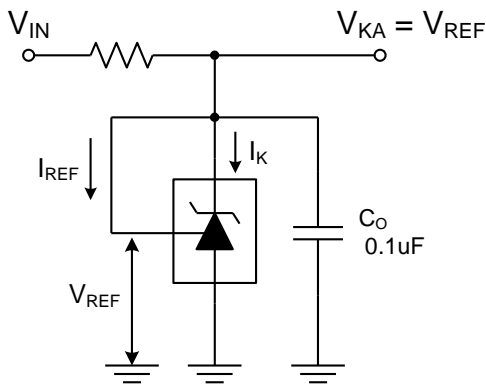
Pin No.	TO-92 / SOT-23 / SOT-89	
	Name	Function
1	Reference	Reference Voltage
2	Anode	Ground
3	Cathode	Input Supply Voltage

## ELECTRICAL CHARACTERISTICS

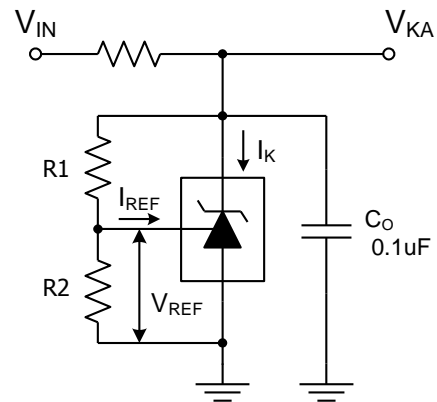
( $T_A=25^\circ\text{C}$ , unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Reference Input Voltage	$V_{REF}$	$V_{KA}=V_{REF}$ , $I_K=10\text{mA}$	TL432C	1.234	1.240	1.246	V
			TL432A	1.228	1.240	1.252	
Deviation of Reference Input Voltage	$\Delta V_{REF}/\Delta T$	$V_{KA} = V_{REF}$ , $I_K = 10\text{mA}$ $T_A = \text{Full Range}$		15	25	mV	
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	$V_{KA} = 1.25\text{V to } 14.5\text{V}$		1.0	2.7	mV/V	
Reference Input Current	$I_{REF}$	$R1=10\text{k}\Omega$ , $R2=\infty$		0.25	0.5	$\mu\text{A}$	
Deviation of Reference Input Current	$\Delta I_{REF}/\Delta T$	$R1=10\text{k}\Omega$ , $R2=\infty$ , $T_A = \text{Full Range}$		0.05	0.3	$\mu\text{A}$	
Minimum Cathode Current for Regulation	$I_{K(MIN)}$	$V_{KA} = V_{REF}$		60	80	$\mu\text{A}$	
Off-State Cathode Current	$I_{K(OFF)}$	$V_{KA} = 16\text{V}$ , $V_{REF} = 0$		0.04	0.5	$\mu\text{A}$	
Dynamic Impedance	$Z_{KA}$	$V_{KA} = V_{REF}$ , $I_K = 0.1\text{mA} \sim 100\text{mA}$ $f \leq 1\text{kHz}$		0.2	0.4	$\Omega$	

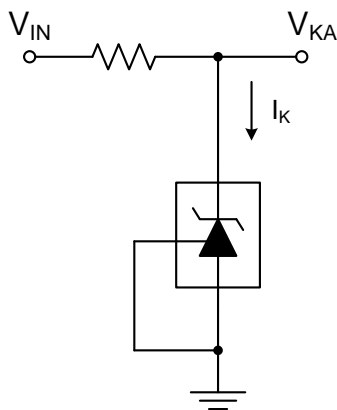
## TEST CIRCUITS



< Fig 1. Test circuit for  $V_{KA} = V_{REF}$  >



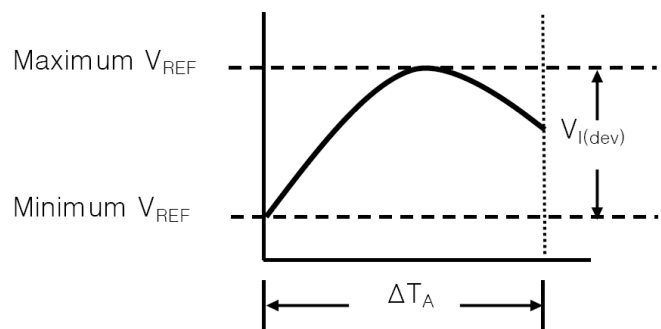
< Fig 2. Test circuit for  $V_{KA} \geq V_{REF}$  >



< Fig 3. Test circuit for  $I_{KA(OFF)}$  >

The deviation parameters  $\Delta V_{REF}/\Delta T$  and  $\Delta I_{REF}/\Delta T$  are defined as the differences between the maximum and minimum values obtained over the recommended temperature range. The average full-range temperature coefficient of the reference voltage,  $\alpha V_{REF}$ , is defined as :

$$|\alpha V_{REF}|(\text{ppm}/^\circ\text{C}) = \frac{\left(\frac{V_{I(\text{dev})}}{V_{REF} \text{ at } 25^\circ\text{C}}\right) \times 10^6}{\Delta T_A}$$



Where :

$\Delta T_A$  is the recommended operating free-air temperature range of the device.

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$\alpha V_{REF}$  can be positive or negative, depending on whether minimum  $V_{REF}$  or maximum  $V_{REF}$ , respectively, occurs at the lower temperature.

Example: Maximum  $V_{REF}=1190\text{mV}$  at  $30^\circ\text{C}$ , maximum  $V_{REF}=1262\text{mV}$  at  $0^\circ\text{C}$ ,  $V_{REF}=1241\text{mV}$  at  $25^\circ\text{C}$ ,  
 $\Delta T_A=125^\circ\text{C}$  for TL432C.

$$|\alpha V_{REF}| = \frac{\left(\frac{72\text{mV}}{1241\text{mV}}\right) \times 10^6}{125^\circ\text{C}} \approx 464.14\text{ppm}/^\circ\text{C}$$

Because minimum  $V_{REF}$  occurs at the lower temperature, the coefficient is positive.

### Calculating Dynamic Impedance

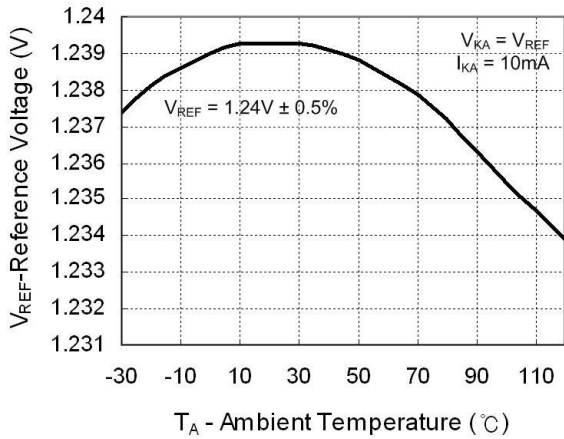
The dynamic impedance is defined as :  $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$

When the device is operating with two external resistors, the total dynamic impedance of the circuit is given by:

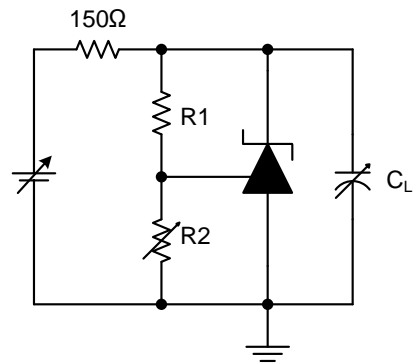
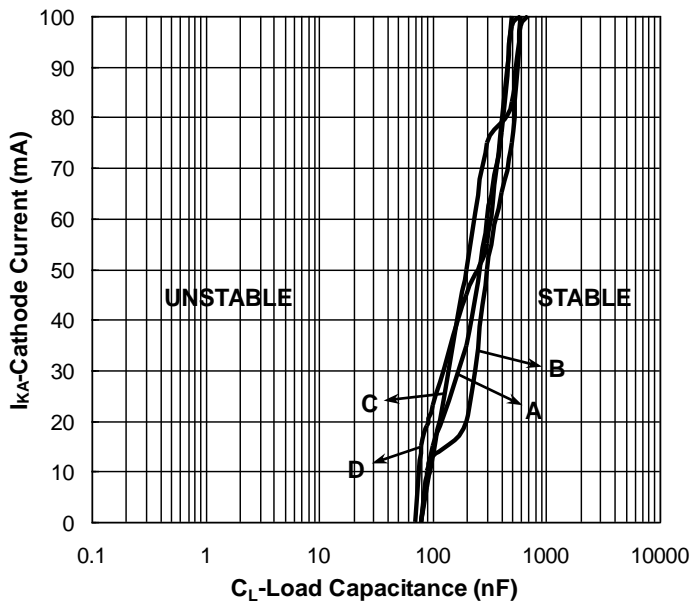
$$|Z'| = \frac{\Delta V}{\Delta I} \approx |Z_{KA}| (1 + R1/R2)$$

TYPICAL OPERATING CHARACTERISTICS

Reference Voltage vs. Junction Temperature



Stability Boundary Conditions



< Fig 4. Test Circuit >

- A  $V_{KA}=V_{REF}$   $R1= 0\Omega$ ,  $R2 = \infty$
- B  $V_{KA}=5.0V$ ,  $R1=10k\Omega$ ,  $R2 = 3.3k\Omega$
- C  $V_{KA}=10.0V$   $R1=10k\Omega$ ,  $R2 = 1.42k\Omega$
- D  $V_{KA}=15.0V$   $R1=10k\Omega$ ,  $R2 = 900\Omega$

# **Low Voltage(1.24V) Adjustable Precision Shunt Regulator    TL432/A/C**

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## **REVISION NOTICE**

The description in this data sheet can be revised without any notice to describe its electrical characteristics properly.