

## FEATURES

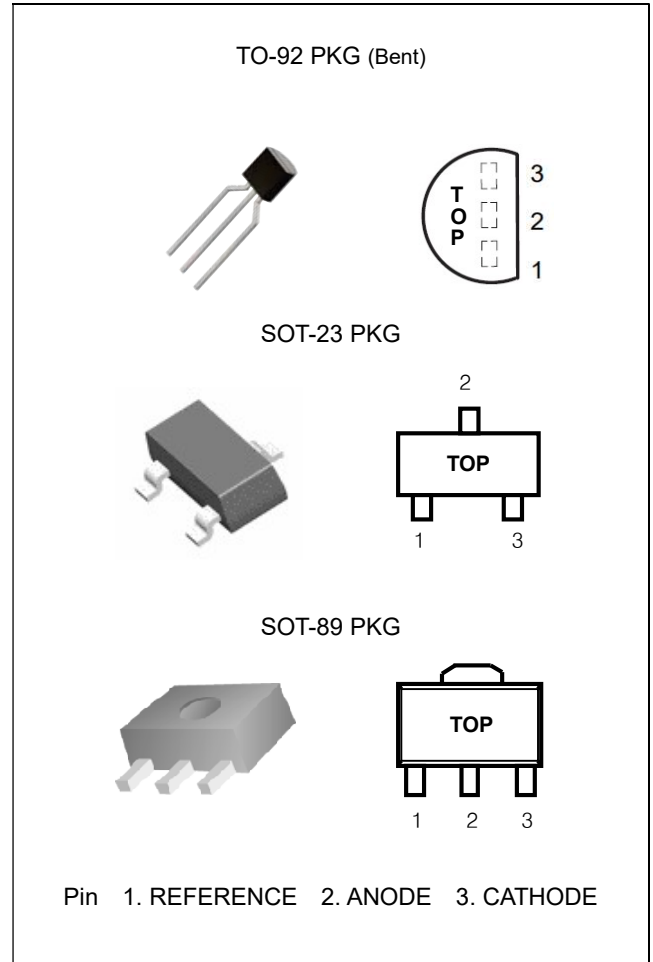
- Programmable Output Voltage to 18V
- Low Voltage Operation from 1.24 V
- Sink Current Capability of 1mA to 100mA
- Equivalent Full Range Temperature Coefficient of 50ppm/°C
- Temperature Compensated for Operation over Full Rated Operating Temperature Range
- Low Output Noise Voltage
- Available in TO-92, SOT-89 and SOT-23-3L Packages

## APPLICATIONS

- 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 bandgap 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
TL432xTA	TO-92 (Tape, Bent)
TL432xSF	SOT-23-3L
TL432xF	SOT-89-3L

\* Refer to the ordering information for the details.

## ABSOLUTE MAXIMUM RATINGS

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

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Cathode Voltage	$V_{KA}$	-	20	V
Cathode Current Range	$I_{KA}$	-	100	mA
Reference Input Current Range	$I_{REF}$	-	3	mA
Junction Temperature Range	$T_J$	-40	150	°C
Storage Temperature Range	$T_{STG}$	-65	150	°C

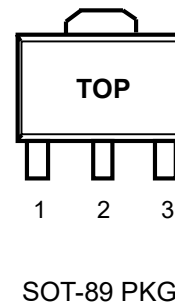
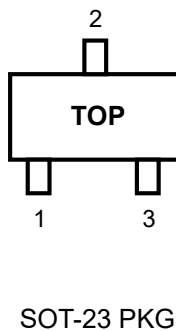
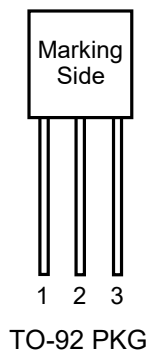
## RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Cathode Voltage	$V_{KA}$	$V_{REF}$	18	V
Cathode Current	$I_{KA}$	0.1	100	mA
Operating Temperature Range	$T_{OPR}$	-40	125	°C

## ORDERING INFORMATION

VREF	Package	Tolerance	Order No.	Marking	Supplied As
1.24V	TO-92	0.5%	TL432CTA	TL432-C	Tape & Ammo Pack
		1%	TL432ATA	TL432-A	Tape & Ammo Pack
	SOT-23	0.5%	TL432CSF	432	Tape & Reel
		1%	TL432ASF	432	Tape & Reel
	SOT-89	0.5%	TL432CF	432	Tape & Reel
		1%	TL432AF	432	Tape & Reel

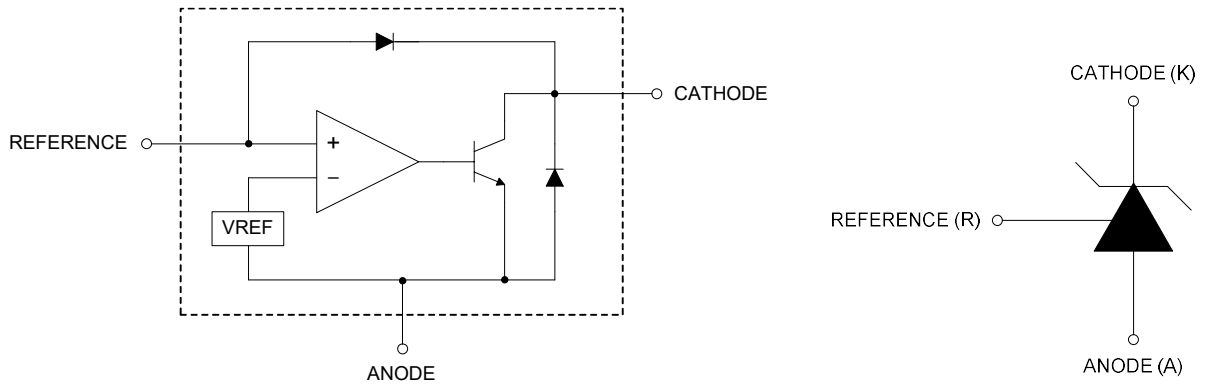
## PIN CONFIGURATION



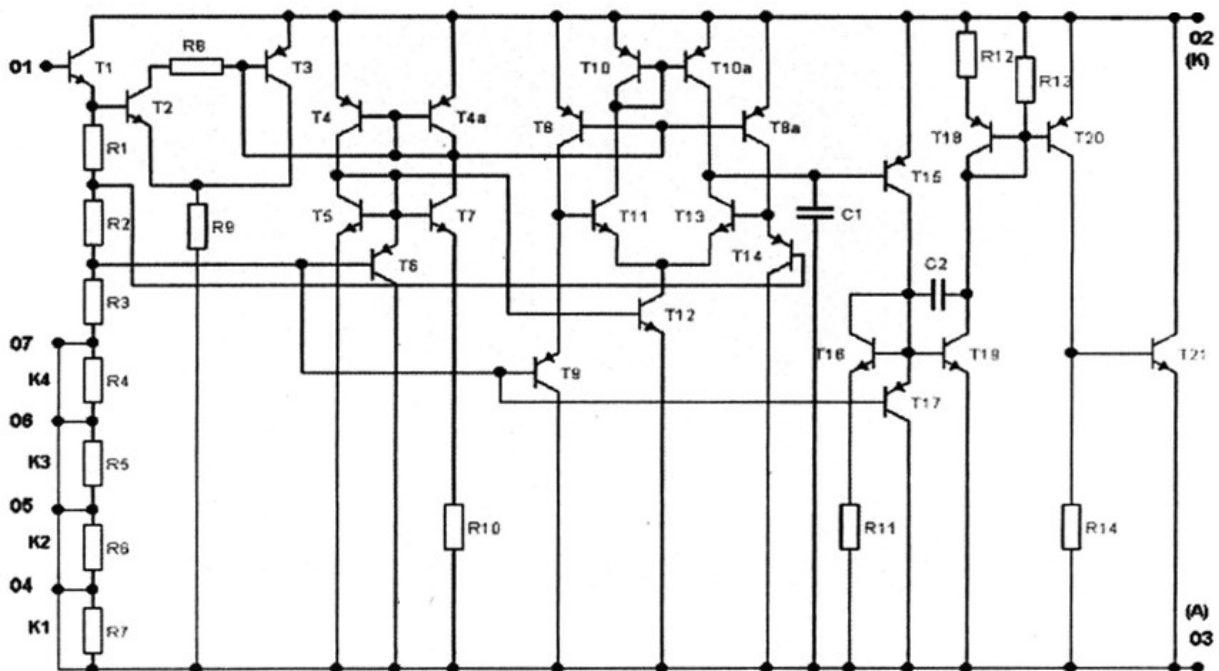
## PIN DESCRIPTION

Pin No.	TO-92 / SOT-23 / SOT-89	
	Pin Name	Pin Description
1	REFERENCE	Reference Voltage
2	ANODE	Ground
3	CATHODE	Input Supply Voltage

## BLOCK DIAGRAM



## EQUIVALENT SCHEMATIC



\* All component values are nominal.

## ELECTRICAL CHARACTERISTICS

(T<sub>A</sub>=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
Reference Input Voltage	V <sub>REF</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>K</sub> =10mA	TL432C	1.234	1.240	1.246	V
			TL432A	1.228	1.240	1.252	
Deviation of Reference Input Voltage (Note 1)	ΔV <sub>REF</sub> /ΔT	V <sub>KA</sub> = V <sub>REF</sub> , I <sub>K</sub> = 10mA T <sub>A</sub> = Full Range		15	25	mV	
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	ΔV <sub>REF</sub> /ΔV <sub>KA</sub>	V <sub>KA</sub> = 1.25V to 14.5V		1.0	2.7	mV/V	
Reference Input Current	I <sub>REF</sub>	R1=10kΩ, R2=∞		0.25	0.5	μA	
Deviation of Reference Input Current (Note 1)	ΔI <sub>REF</sub> /ΔT	R1=10kΩ, R2=∞, T <sub>A</sub> = Full Range		0.05	0.3	μA	
Minimum Cathode Current for Regulation	I <sub>K(MIN)</sub>	V <sub>KA</sub> = V <sub>REF</sub>		60	80	μA	
Off-State Cathode Current	I <sub>K(OFF)</sub>	V <sub>KA</sub> = 16V, V <sub>REF</sub> = 0		0.04	0.5	μA	
Dynamic Impedance (Note 2)	Z <sub>KA</sub>	V <sub>KA</sub> = V <sub>REF</sub> , I <sub>K</sub> = 0.1mA~100mA f ≤ 1kHz		0.2	0.4	Ω	

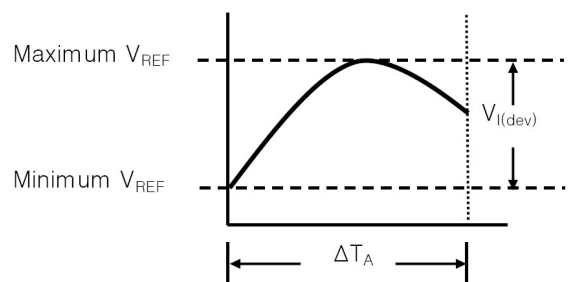
(Note 1) The deviation parameters ΔV<sub>REF</sub>/ΔT<sub>A</sub> and ΔI<sub>REF</sub>/ΔT<sub>A</sub> are defined as the differences between the maximum and minimum values obtained over the recommended temperature range. The average full-range temperature coefficient of the reference voltage, αV<sub>REF</sub>, 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:

ΔT<sub>A</sub> is the recommended operating free-air temperature range of the device.

αV<sub>REF</sub> can be positive or negative, depending on whether minimum V<sub>REF</sub> or maximum V<sub>REF</sub>, respectively, occurs at the lower temperature.

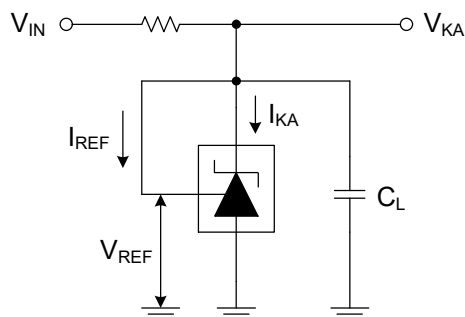


(Note 2) The dynamic impedance is defined as:  $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$

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

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

## TEST CIRCUITS



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

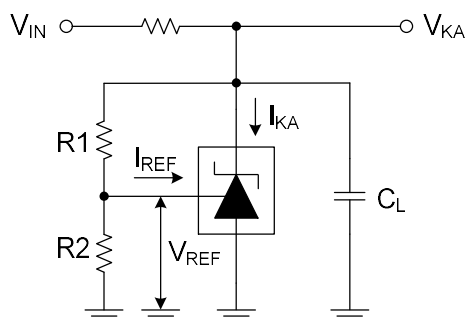
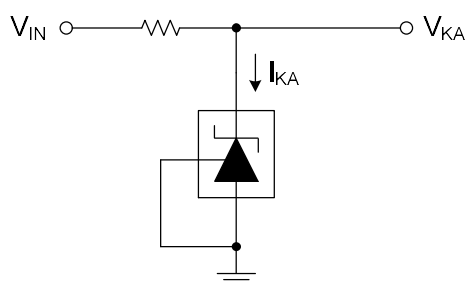


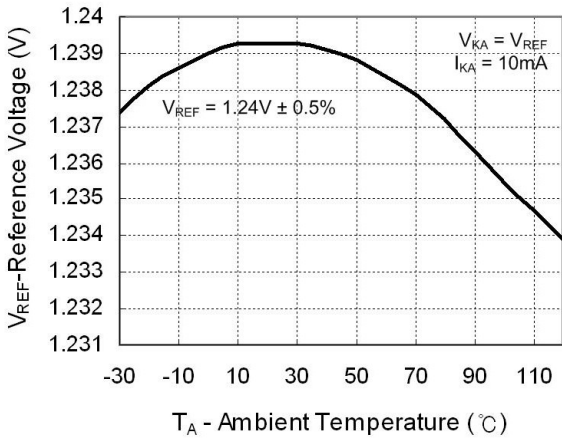
Fig 2. Test circuit for  $V_{KA} \geq V_{REF}$  >



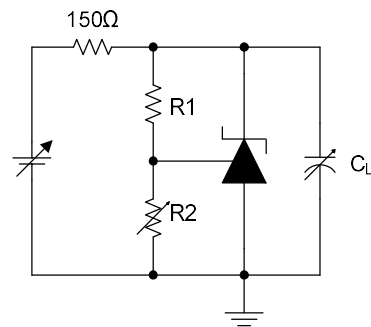
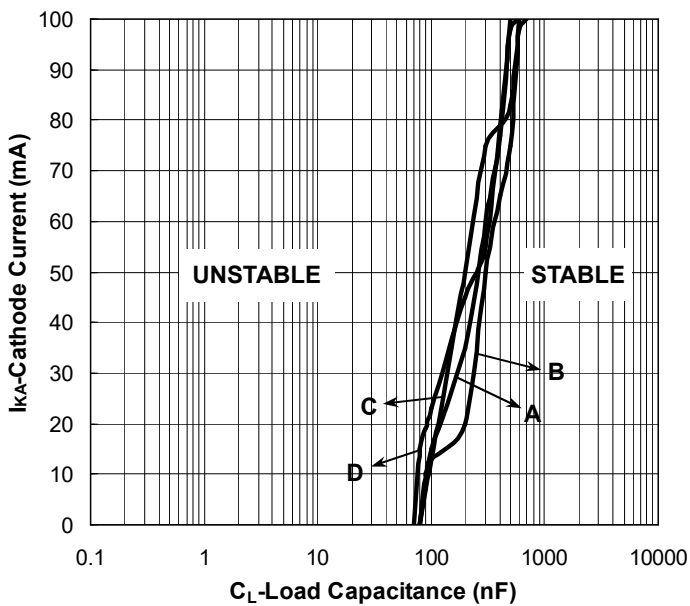
< Fig 3. Test circuit for  $I_{KA(OFF)}$  >

## 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  $V_{KA} = 5.0\text{V}$ ,  $R1 = 10\text{k}\Omega$ ,  $R2 = 3.3\text{k}\Omega$
- C  $V_{KA} = 10.0\text{V}$   $R1 = 10\text{k}\Omega$ ,  $R2 = 1.42\text{k}\Omega$
- D  $V_{KA} = 15.0\text{V}$   $R1 = 10\text{k}\Omega$ ,  $R2 = 900\Omega$

## REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.