

PROGRAMMABLE PRECISION REFERENCES

The TL432A is a three-terminal Shunt Voltage Reference providing a highly accurate 1.24 V, 1.25V bandgap reference with 1.0 % tolerance.

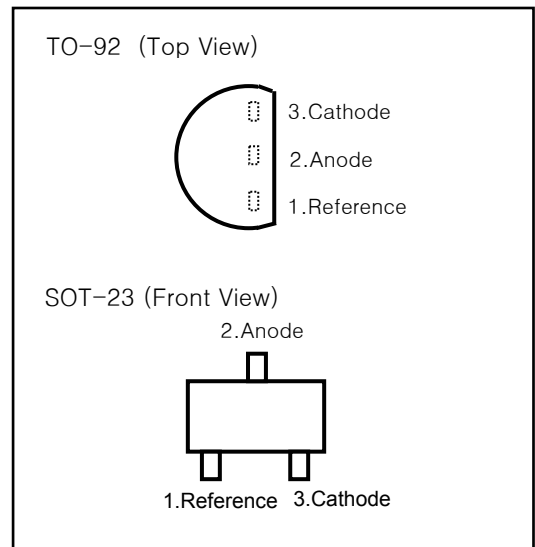
The TL432A thermal stability and wide operating current (100mA), makes it suitable for all variety of applications that are looking for a low cost solution with high performance. The TL432A is an ideal voltage reference in an isolated feed circuit for 3.0V to 3.3V switching mode power supplies.

FEATURES

- Low Voltage Operation : 1.24 V
- Programmable Out Voltage to 15V
- Sink Current Capability of 1 mA to 100 mA
- Equivalent Full-Range Temperature Coefficient of 50 ppm/°C
- Temperature Compensated for Operation over Full Rated Operating Temperature Range
- Trimmed Bandgap to 5%

APPLICATION

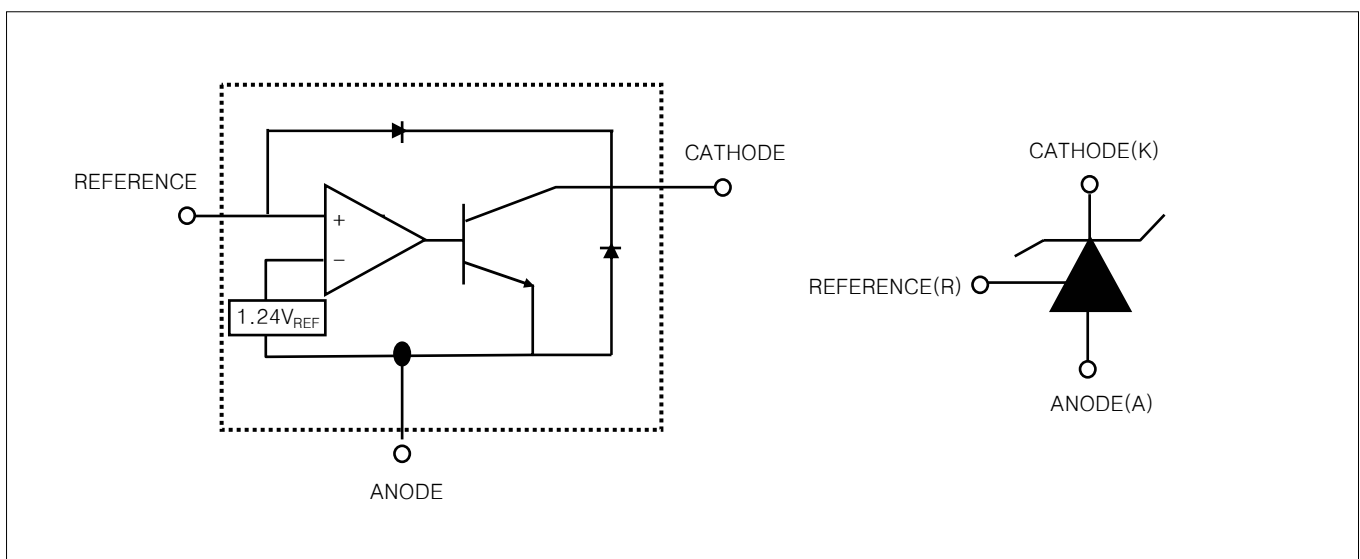
- Shunt Regulator
- Voltage Monitoring
- Current Source and Sink Circuits
- Analog and Digital Circuits Requiring Precision References
- Low Out Voltage (3.0V to 3.3V) Switching Power Supply Error Amplifier



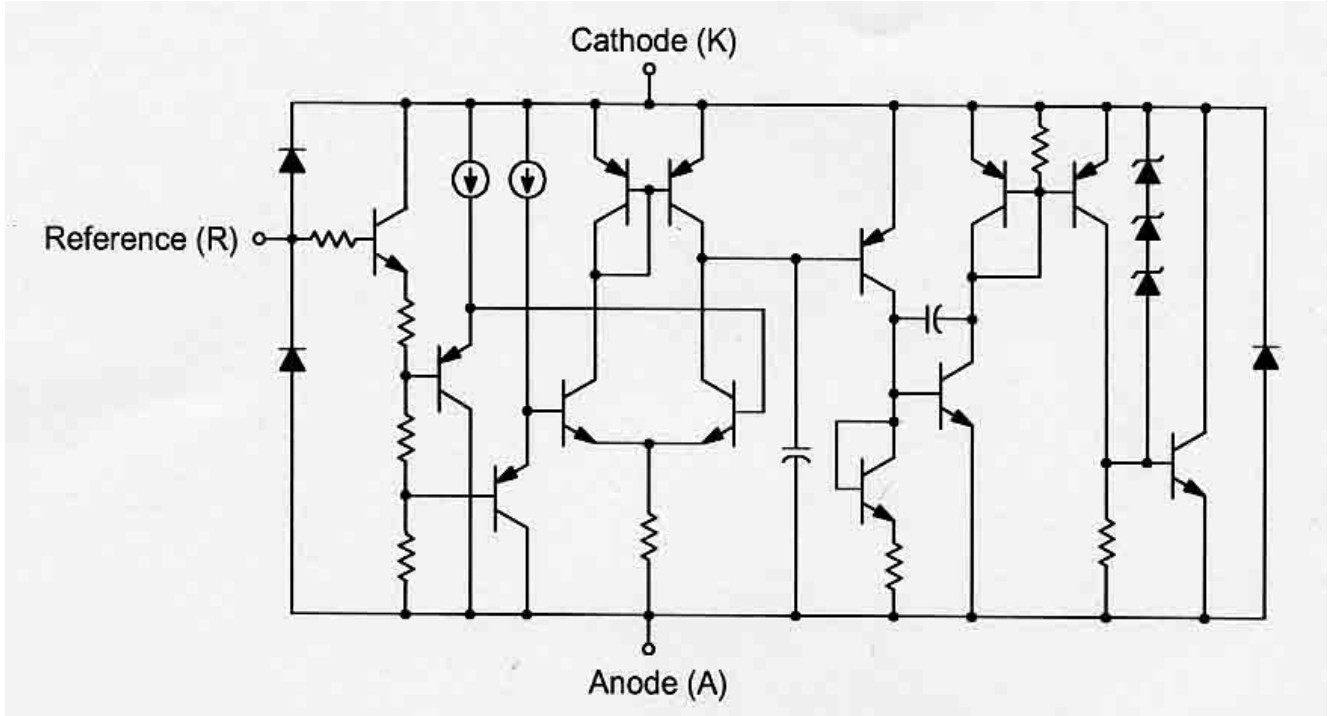
ORDERING INFORMATION

Device	Marking	Package
TL432-A	TL432-A	TO-92
TL432-C	TL432-C	
TL432-ASF	432	SOT-23
TL432-CSF		

FUNCTION BLOCK DIAGRAM



EQUIVALENT SCHEMATIC



All component values are nominal

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Cathode Voltage	V_{KA}	V_{REF}	15	V
Cathode Current	I_K	1	100	mA

DISSIPATION RATING TABLE1-FREE-AIR TEMPERATURE

Package	$T_A=25^\circ\text{C}$	Derating Factor	$T_A=70^\circ\text{C}$	$T_A=85^\circ\text{C}$	$T_A=125^\circ\text{C}$
	Power Rating	Above $T_A=25^\circ\text{C}$	Power Rating	Power Rating	Power Rating
TO-92	770mW	6.2mW/°C	491mW	398mW	-
SOT-89	-	-	-	-	-
SOT-23	230mW	1.8mW/°C	149mW	122mW	-

ABSOLUTE MAXIMUM RATINGS

(Full Operating Ambient Temperature Range Applies Unless Otherwise Noted)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Cathode Voltage	V_{KA}	15	V
Continuous Cathode Current Range	I_{KA}	100	mA
Reference Input Current Range	I_{REF}	-0.05 ~ 3	mA
Junction Temperature	T_J	-40 ~ 150	°C
Operating Temperature	T_{OPR}	0 ~70	°C
Storage Temperature	T_{STG}	-65~+150	°C
Total Power Dissipation	P_D	770	mW

TL432A/C ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Reference Input Voltage	V_{REF}	$V_{KA}=V_{REF}, I_K=10\text{mA}$	TL432A	1.228	1.24	1.252	V
			TL432C	1.233		1.247	
Deviation of Reference Input Voltage Over Full Temperature Range	$\Delta V_{REF}/\Delta T$	$V_{KA}=V_{REF}, I_K=10\text{mA}$ $T_A=\text{Full Range}$		10	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}	$R1=10\text{k}\Omega, R2=\infty$		0.5	1	μA	
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	$R1=10\text{k}\Omega, R2=\infty, T_a = \text{Full Range}$		0.05	0.3	μA	
Minimum Cathode Current for Regulation	$I_{KA\text{MIN}}$	$V_{ka}=V_{ref}$		60	80	μA	
Off-State Cathode Current	$I_{KA\text{OFF}}$	$V_{KA}=15\text{V}, V_{REF}=0$		0.04	0.5	μA	
Dynamic Impedance	Z_{KA}	$V_{KA}=V_{REF}, I_K=0.1\text{mA}\sim 20\text{mA}, f\leq 1.0\text{kHz}$		0.2	0.4	Ω	

Fig. 1 Test Circuit for $V_{KA} = V_{REF}$

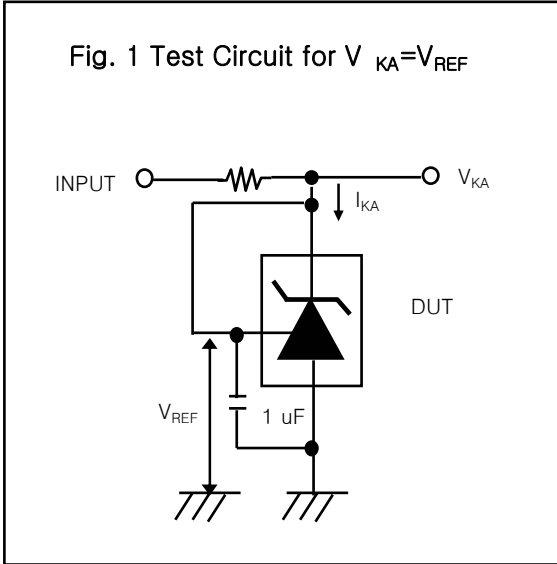


Fig. 2 Test Circuit for $V_{KA} \geq V_{REF}$

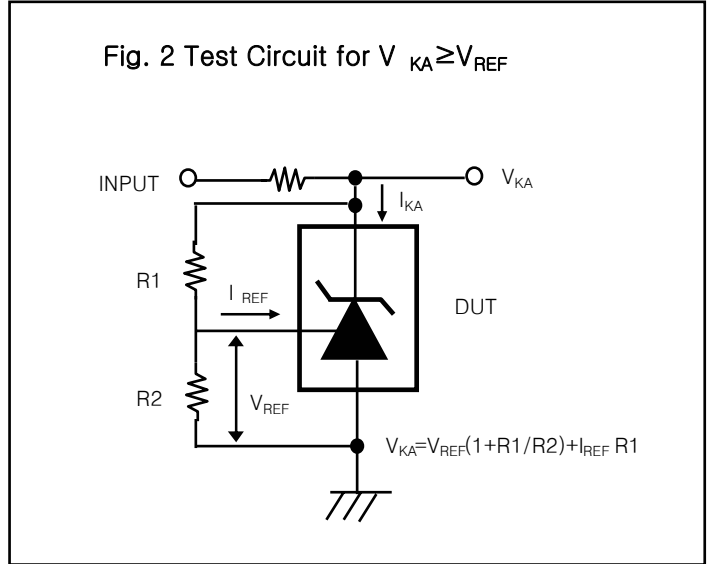
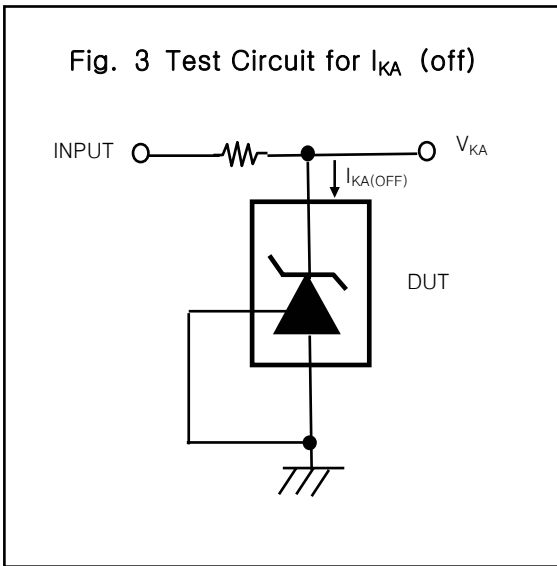
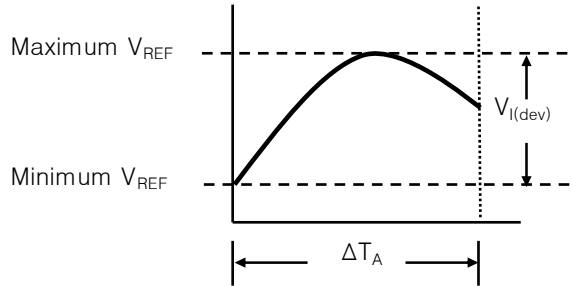


Fig. 3 Test Circuit for $I_{KA} \text{ (off)}$



The deviation parameters $V_{REF(DEV)}$ and $I_{REF(DEF)}$ 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_{REF} , is defined as :

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



Where :

ΔT_A is the recommended operating free-air temperature range of the device.

αV_{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°C , maximum $V_{REF}=1262\text{mV}$ at 0°C , $V_{REF}=1241\text{mV}$ at 25°C , $\Delta T_A=125^\circ\text{C}$ for TL431C

$$|\alpha V_{REF}| = \frac{\left(\frac{7.2\text{mV}}{1241\text{mV}} \right) \times 10^6}{125^\circ\text{C}} \approx 46\text{PPM}/^\circ\text{C}$$

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

Calculating Dynamic Impedance $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$

The dynamic impedance is defined as :

When the device is operating with two external resistors (see Figure 3), the total dynamic impedance of the circuit is given by :

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