



SL432xSF

Programmable Voltage Reference

Description

The SL432 series are 3-terminal precision shunt regulators that are programmable over a wide voltage range of 1.24V to 16V with $\pm 1.0\%$, $\pm 2.0\%$ tolerance. The SL432 series have a low dynamic impedance of $0.25\ \Omega$. These features make the SL432 series an excellent replacement for zener diodes in numerous applications circuits that require a precision reference voltage.

Features

- Programmable output voltage from 1.24V to 16V
- Voltage reference tolerance : $\pm 1.0\%$, $\pm 2.0\%$
- Sink current capability of $80\ \mu\text{A}$ to $30\ \text{mA}$

Ordering Information

Type NO.	Marking	Package Code
SL432xSF	42□	SOT-23F

□: Grade => 3: $\pm 2\%$, A: $\pm 1\%$

Outline Dimensions (Unit : mm)

Symbol

Functional block diagram

PIN Connections

1. Reference
2. Cathode
3. Anode



Absolute maximum ratings

[Ta=25°C]

Characteristic	Symbol	Rating	Unit
Cathode to Anode voltage	V_{KA}	18	V
Cathode Current	I_K	30	mA
Reference Input Current	I_{ref}	3	mA
Power Dissipation	P_D^*	350	mW
Junction Temperature	T_J	150	°C
Operating Temperature Range	T_{opr}	-40 ~ +85	°C
Storage Temperature Range	T_{stg}	-55 ~ +150	°C

* With PCB(8×8mm copper area) at glass epoxy board(t=1.7mm, area : 20×20mm)

Recommended operating conditions

Characteristic	Symbol	Rating		Unit
		Min.	Max.	
Cathode voltage	V_{KA}	V_{ref}	16	V
Cathode current	I_K	0.1	30	mA

Electrical Characteristics (Ta=25°C, unless otherwise noted.)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
Reference voltage (Fig.1)	V_{ref}	$V_{KA}=V_{ref}, I_K=10mA$	SL432ASF	1.228	1.240	1.252	V
			SL432SF	1.215		1.265	
Reference input voltage deviation over temperature (Fig.1, Note1,2)	ΔV_{ref}	$V_{KA}=V_{ref}, I_K=10mA$ @ -40°C ≤ Ta ≤ 85°C	-	10	20	mV	
Ratio of delta reference input voltage to delta cathode voltage (Fig.2)	$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	$I_K=10mA$ $V_{ref} \leq V_{KA} \leq 16V$	-	-1.0	-2.7	mV/V	
Reference current (Fig.2)	I_{ref}	$I_K=10mA$ $R1=10K\Omega, R2=\infty$	-	0.15	0.3	μA	
Reference input current deviation over temperature (Fig.2, Note 1,2)	ΔI_{ref}	$I_K=10mA$ $R1=10K\Omega, R2=\infty$	-	0.04	0.08	μA	
Minimum cathode current for Regulation	$I_{K(MIN)}$	$V_{KA}=V_{ref}$	-	55	80	μA	
Off-state cathode current (Fig.3)	$I_{K(off)}$	$V_{KA}=16V, V_{ref}=0V$	-	5	50	nA	
Dynamic impedance (Fig.1, Note3)	Z_{KA}	$V_{KA}=V_{ref}, f \leq 1.0KHz$ $0.1mA \leq I_K \leq 30mA$	-	0.25	0.4	Ω	

Fig. 1 Test circuit for $V_{KA}=V_{ref}$

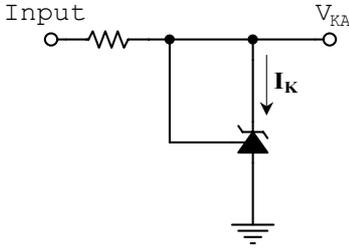
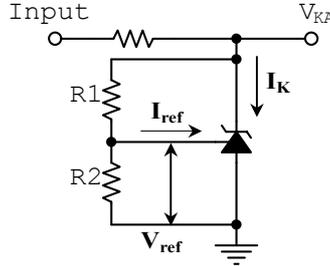
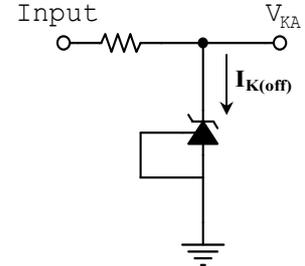


Fig. 2 Test circuit for $V_{KA}>V_{ref}$



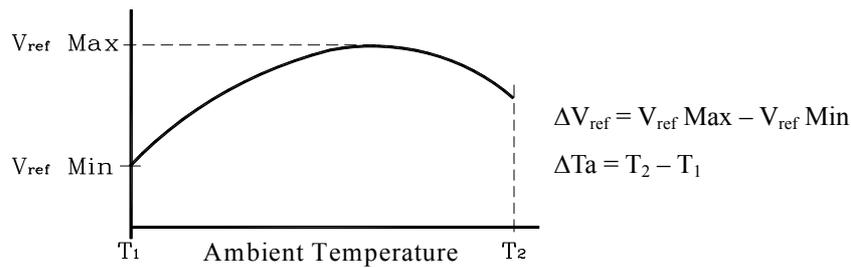
$$V_{ref} = V_{ref} \times \left(1 + \frac{R_1}{R_2}\right) + I_{ref} \times R_1$$

Fig. 3 Test circuit for $I_{K(off)}$



Note.

1. Ambient temperature range: $T_{LOW} = -40^{\circ}C$, $T_{High} = 85^{\circ}C$
2. The deviation parameters ΔV_{ref} and ΔI_{ref} are defined as the difference between the maximum value and minimum value obtained over the full operating ambient temperature range that applied.



The average temperature coefficient of the reference input voltage, αV_{ref} is defined as:

$$\alpha V_{ref} \left(\frac{\text{ppm}}{^{\circ}C}\right) = \frac{\left(\frac{\Delta V_{ref}}{V_{ref}(T_a = 25^{\circ}C)} \times 10^6\right)}{T_a}$$

αV_{ref} can be positive or negative depending on whether $V_{ref} \text{ Min}$ or $V_{ref} \text{ Max}$ occurs at the lower ambient temperature, refer to Fig. 8

Example : $\Delta V_{ref} = 10\text{mV}$ and the slope is positive,

$$\Delta V_{ref} @ 25^{\circ}C = 1.24\text{V}$$

$$\Delta T_a = 125^{\circ}C$$

$$\alpha V_{ref} \left(\frac{\text{ppm}}{^{\circ}C}\right) = \frac{\left(\frac{0.010}{1.241}\right) \times 10^6}{125} = 65\text{ppm}/^{\circ}C$$

3. The dynamic impedance Z_{KA} is defined as:

$$|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_K}$$

When the device is operating with two external resistors, R1 and R2, (refer to Fig.2) the total dynamic impedance of the circuit is given by:

$$|Z_{KA}'| = |Z_{KA}| \times \left(1 + \frac{R_1}{R_2}\right)$$

Electrical Characteristics Curves (Continue)

Fig.4 I_K vs V_{KA} (1)

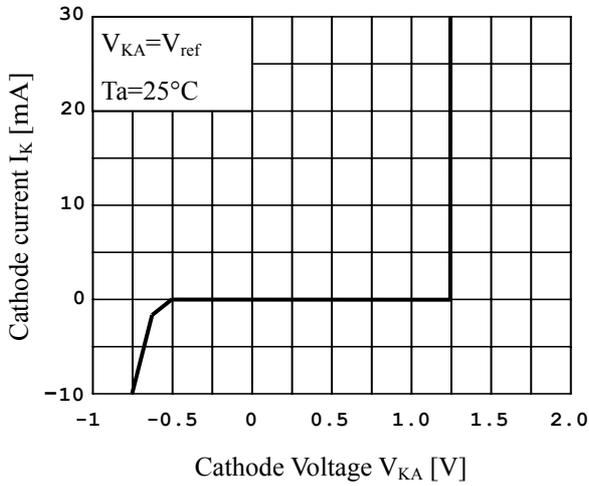


Fig.5 I_K vs V_{KA} (2)

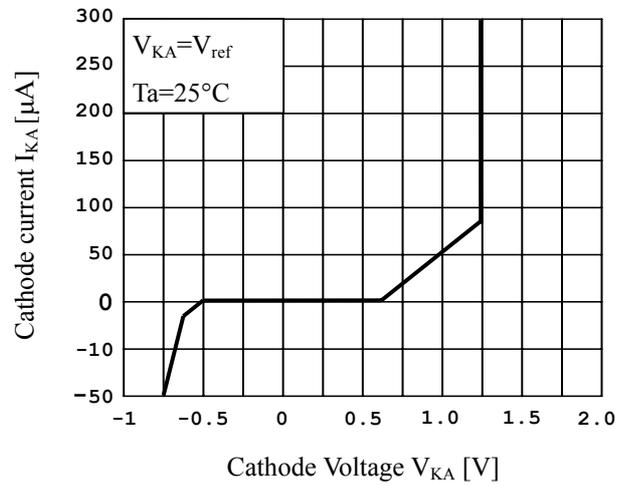


Fig.6 $I_{K(off)}$ vs V_{KA}

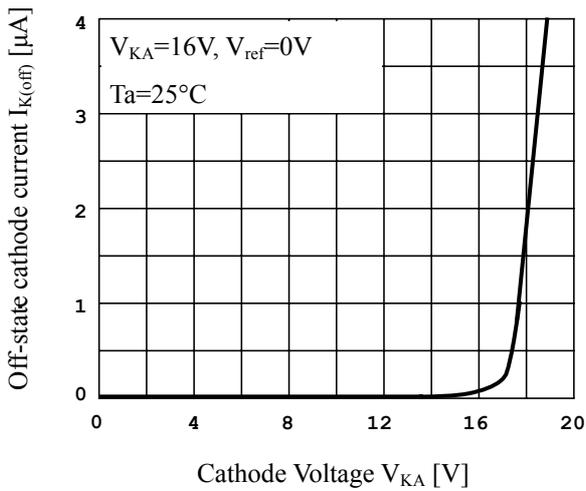


Fig.7 $\Delta V_{ref} / \Delta V_{KA}$ vs T_a

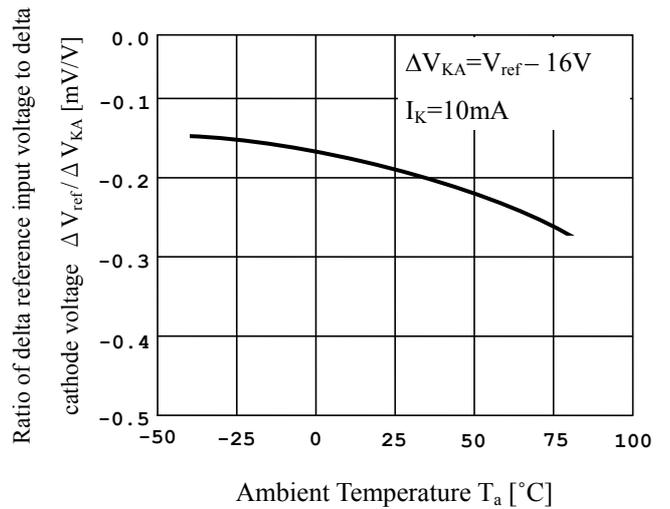


Fig.8 V_{ref} vs T_a

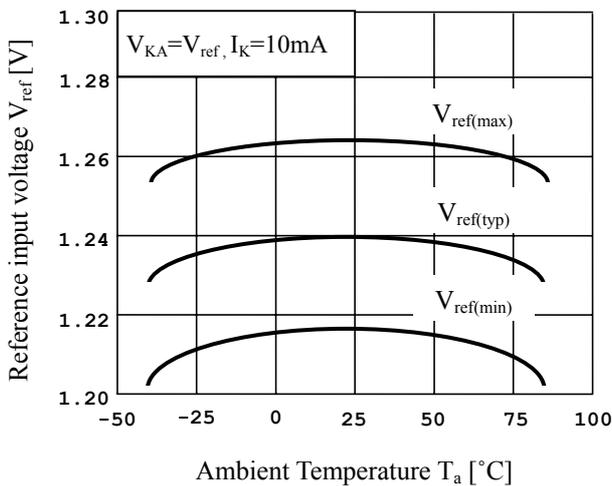
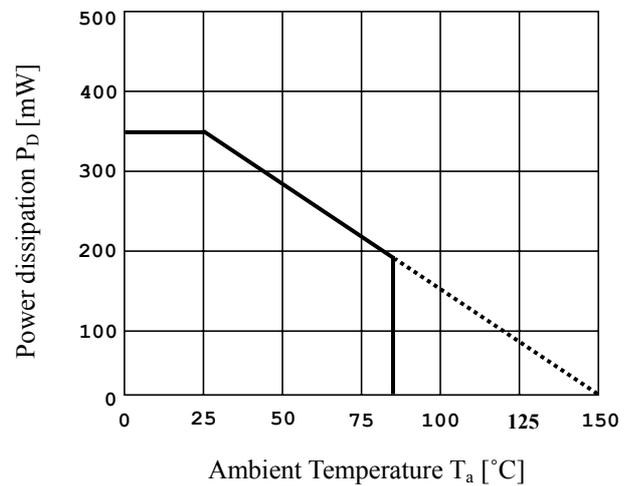
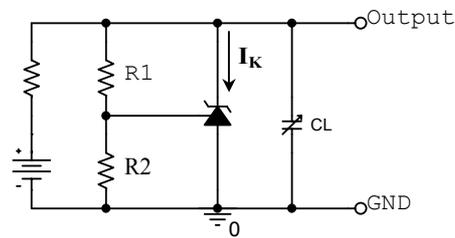
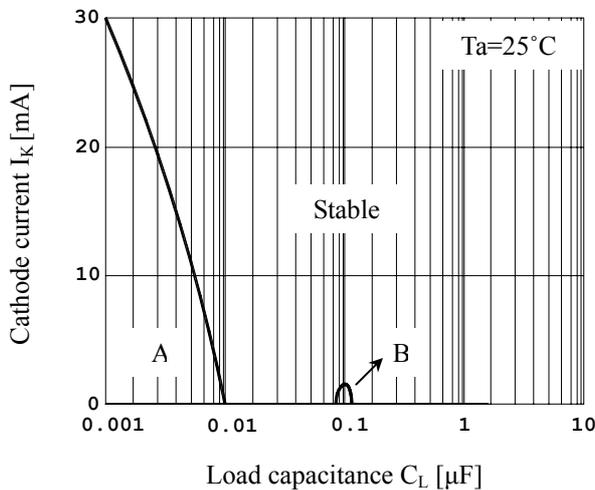


Fig.9 P_D vs T_a



Electrical Characteristics Curves

Fig.10 Stability Boundary Conditions



Unstable Regions	V_{KA}	R_1 [K Ω]	R_2 [K Ω]
A, B	V_{ref}	0	∞
A	10V	10	1.415

Fig.11 Test circuit for Fig. 10

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