AUK Semiconductor

A431x

Programmable Voltage Reference

Description

The A431 series are 3-terminal precision shunt regulators that are programmable over a wide voltage range of 2.495V to 16V with ±0.5%, ±1.0% tolerance. The A431 series have a low dynamic impedance of 0.15Ω. These features make the A431 series an excellent replacement for zener diodes in numerous applications circuits that require a precision reference voltage.

Features

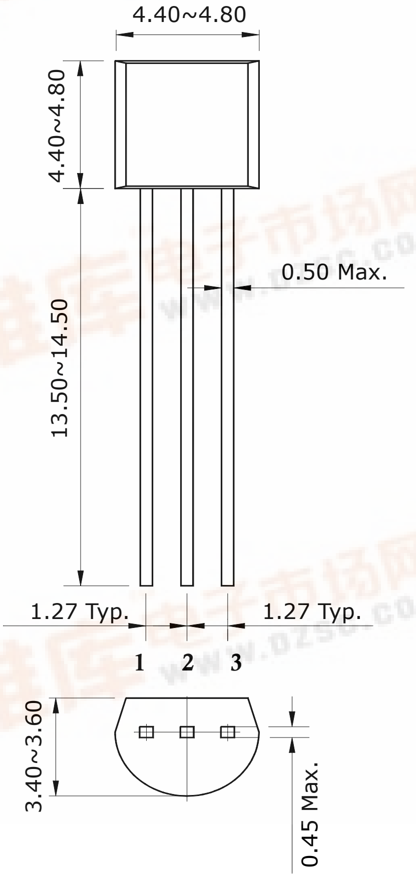
- Programmable output voltage from 2.495V to 16V
- Voltage reference tolerance : ±0.5%, ±1.0%
- Cathode current capability of 1mA to 100mA

Ordering Information

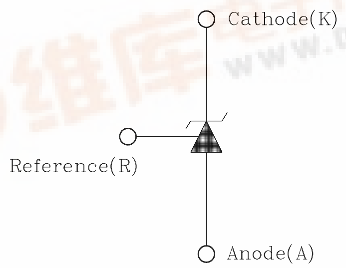
Type NO.	Marking	Package Code
A431x	A431□	TO-92

□ : Grade => A:±1% , B:±0.5%

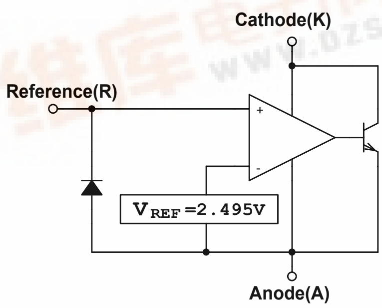
Outline Dimensions (Unit : mm)



Symbol



Functional block diagram



PIN Connections
1. Reference
2. Anode
3. Cathode

Absolute maximum ratings

[Ta=25℃]

Characteristic	Symbol	Rating	Unit
Cathode to Anode voltage	V_{KA}	18	V
Cathode current	I_K	150	mA
Reference input current	I_{ref}	10	mA
Power Dissipation	P_D	625	mW
Junction Temperature	T_J	150	℃
Operating temperature range	T_{opr}	-40 ~ +85	℃
Storage temperature range	T_{stg}	-55 ~ +150	℃

Recommended operating conditions

Characteristic	Symbol	Rating		Unit
		Min.	Max.	
Cathode to Anode voltage	V_{KA}	V_{ref}	16	V
Cathode current	I_K	1	100	mA

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

Characteristic	Symbol	Condition		Min.	Typ.	Max.	Unit
Reference voltage (Fig.1)	V_{ref}	$V_{KA}=V_{ref}$, $I_K=10mA$	A431B	2.482	2.495	2.508	V
			A431A	2.470		2.520	
Reference input voltage deviation over temperature (Fig.1, Note1,2)	ΔV_{ref}	$V_{KA}=V_{ref}$, $I_K=10mA$ @ $0^\circ C \leq Ta \leq 70^\circ C$		-	7	30	mV
Ratio of delta reference input voltage to delta cathode voltage (Fig.2)	$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	$I_K=10mA$ $V_{ref} \leq V_{KA} \leq 16V$	$\triangle V_{ref}=V_{ref(16V)}-V_{ref}$ $\triangle V_{KA}=V_{KA(16V)}-V_{ref}$	-	-1.0	-2.7	mV/V
Reference current (Fig.2)	I_{ref}	$I_K=10mA$ $R1=10K\Omega$, $R2=\infty$		-	1.8	4.0	μA
Reference input current deviation over temperature (Fig.2, Note 1,2)	ΔI_{ref}	$I_K=10mA$ $R1=10K\Omega$, $R2=\infty$ @ $0^\circ C \leq Ta \leq 70^\circ C$		-	0.4	2.5	μA
Minimum cathode current for regulation	$I_{K(MIN)}$	$V_{KA}=V_{ref}$		-	0.35	1.0	mA
Off-state cathode current (Fig.3)	$I_{K(off)}$	$V_{KA}=16V$, $V_{ref}=0V$		-	2.7	1000	nA
Dynamic impedance (Fig.1, Note3)	Z_{KA}	$V_{KA}=V_{ref}$, $f \leq 1.0KHz$ $1.0mA \leq I_K \leq 100mA$		-	0.15	0.5	Ω

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

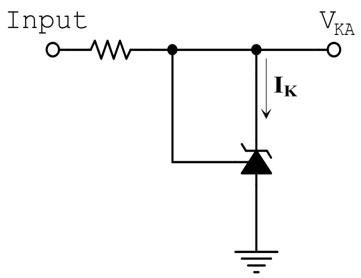


Fig. 2 Test circuit for $V_{KA}>V_{ref}$

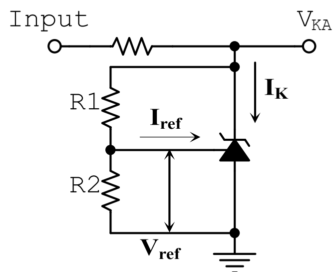
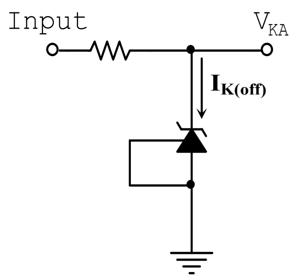


Fig. 3 Test circuit for $I_{K(off)}$

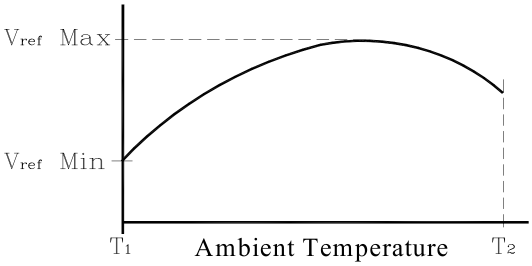


$$V_{KA} = V_{ref} \times (1 + \frac{R_1}{R_2}) + I_{ref} \times R_1$$

Note.

1. Ambient temperature range: $T_{LOW} = 0℃$, $T_{High} = 70℃$

2. The deviation parameters $\triangle V_{ref}$ and $\triangle I_{ref}$ are defined as the difference between the maximum value and minimum value obtained over the full operating ambient temperature range that applied.



$\Delta V_{ref} = V_{ref}\text{ Max} - V_{ref}\text{ Min}$

$\Delta Ta = T_2 - T_1$

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

$$\alpha V_{ref}(\frac{ppm}{℃}) = \frac{(\frac{\Delta V_{ref}}{V_{ref}(T_a = 25℃)} \times 10^6)}{\Delta T_a}$$

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

Example : $\triangle V_{ref} = 30mV$ and the slope is positive,

$\triangle V_{ref}$ @ 25℃ = 2.495V

$\triangle Ta = 70℃$

$$\alpha V_{ref}(\frac{ppm}{℃}) = \frac{(\frac{0.03}{2.495}) \times 10^6}{70} = 171ppm/℃$$

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:

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

Electrical Characteristics Curves (Continue)

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

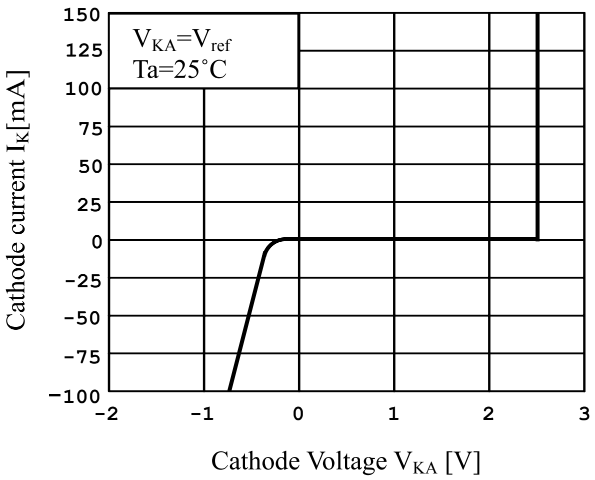


Fig.5 I_K vs V_{KA} (2)

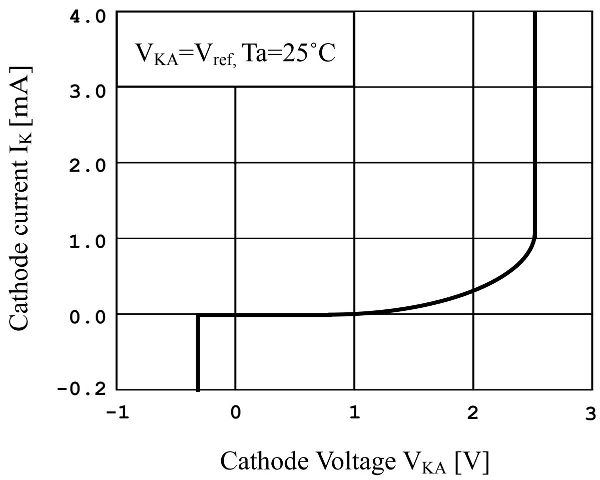


Fig.6 $I_{K(off)}$ vs V_{KA}

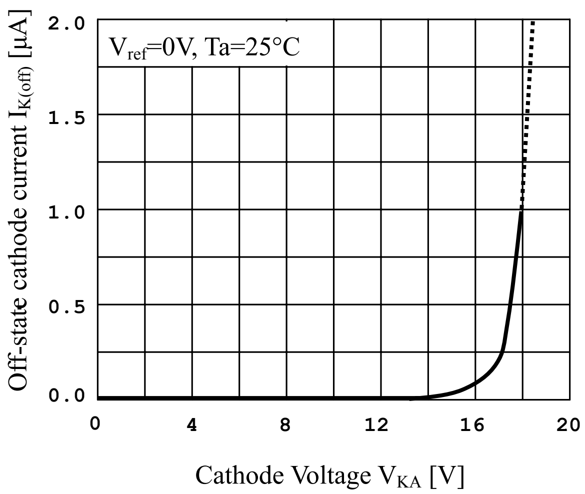


Fig.7 $\Delta V_{ref}/\Delta V_{KA}$ vs T_a

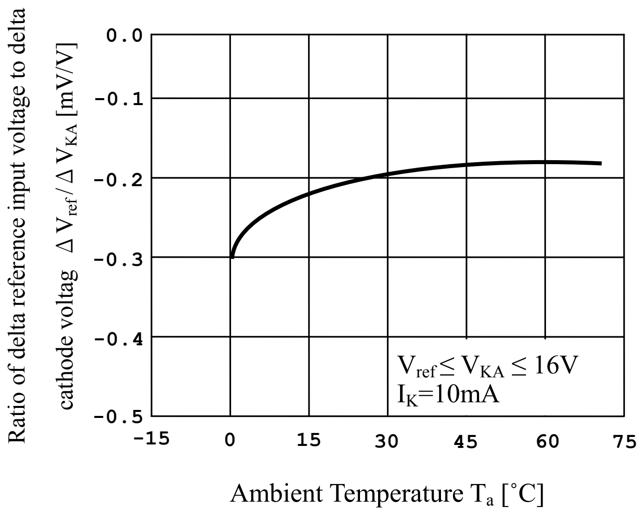


Fig.8 V_{ref} vs T_a

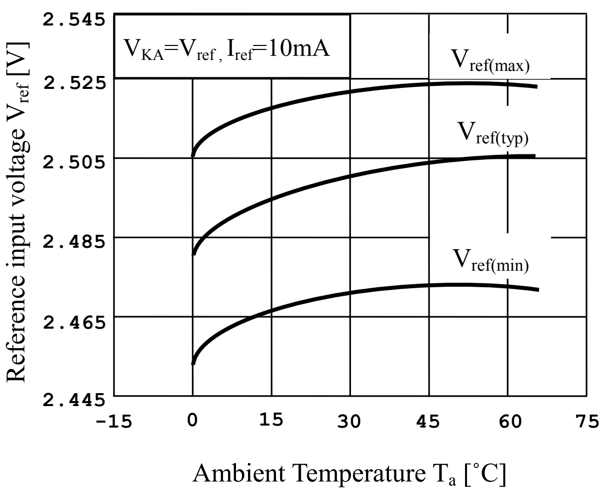
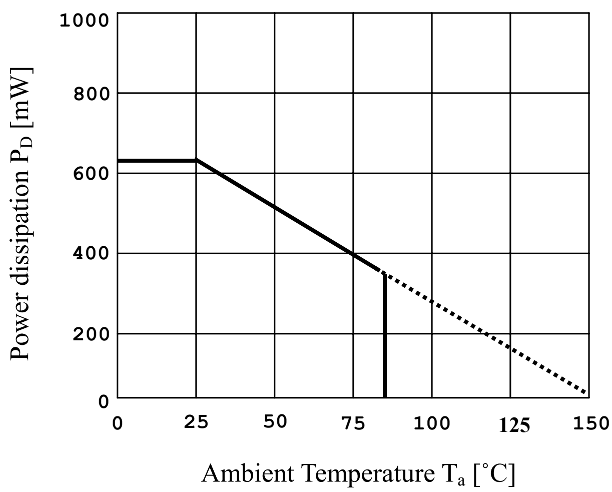
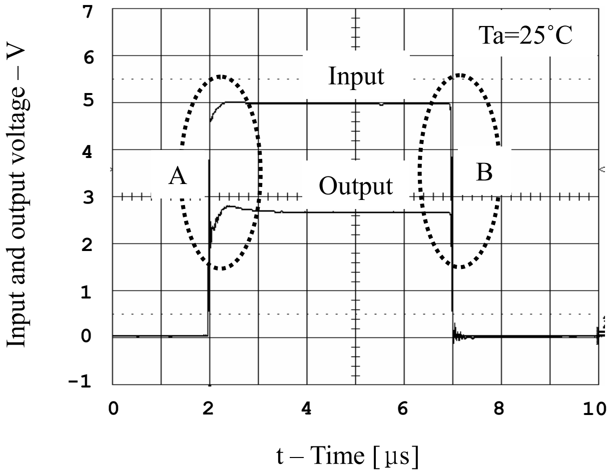


Fig.9 P_D vs T_a



Electrical Characteristics Curves

Fig.10 Pulse Response



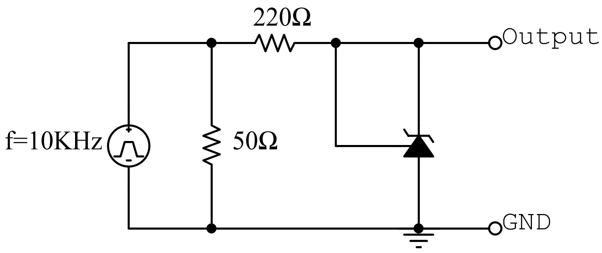


Fig.11 Test circuit for Fig. 10

Fig.12 Pulse Response (Magnify A of Fig.10)

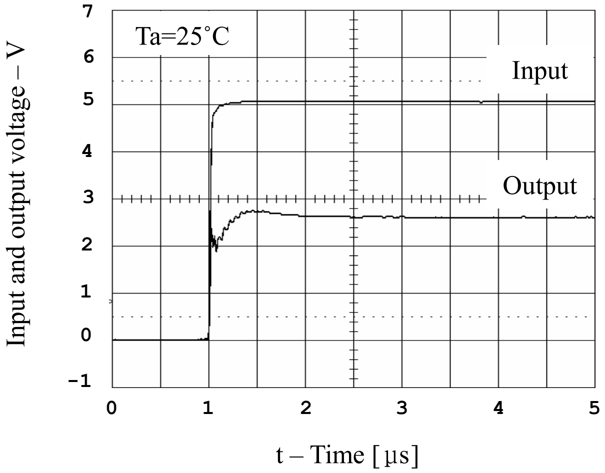


Fig.13 Pulse Response (Magnify B of Fig.10)

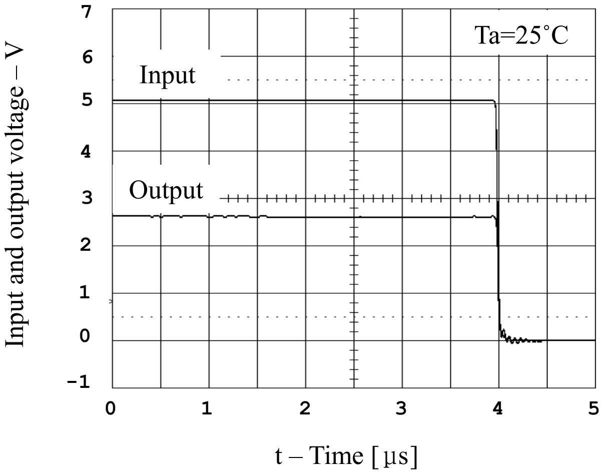
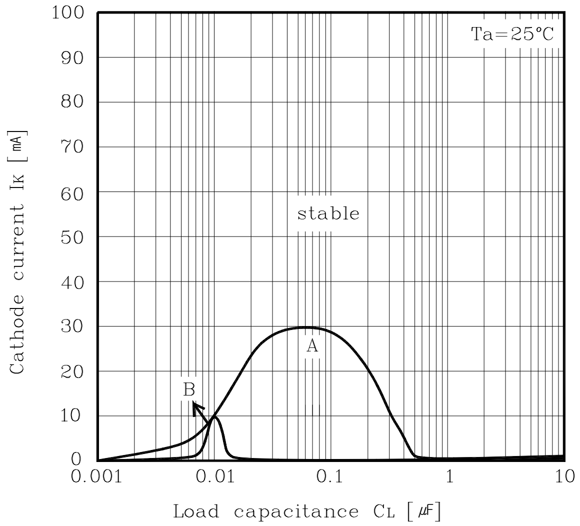
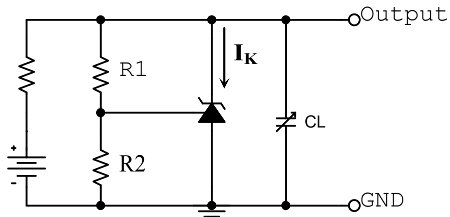


Fig.14 Stability Boundary Conditions





Unstable Regions	V_{KA}	R_1 [KΩ]	R_2 [KΩ]
A	V_{ref}	0	∞
B	10V	10	3.325

Fig.15 Test circuit for Fig. 14