PROGRAMMABLE PRECISION REFERENCES

The KIA431 Series integrated circuits are three-terminal programmable shunt regulator diodes. These monolithic IC voltage reference operate as a low temperature coefficient zener which is programmable from V_{ref} to 36 volts with two external resistors. These devices exhibit a wide operating current range of 1.0 to 100mA with a typical dynamic impedance of 0.22Ω.The characteristics of these references make them excellent replacements for zener diodes in many applications such as digital voltmeters, power supplies, and op amp circuitry. The 2.5 volt reference makes it convenient to obtain a stable reference from 5.0 volt logic supplies, and since the KIA431 Series operates as a shunt regulator, it can be used as either a positive or negative voltage reference.

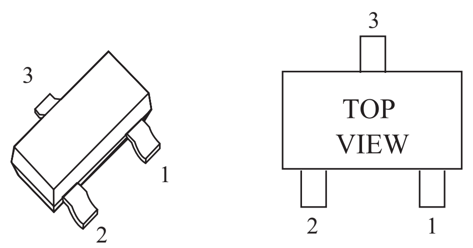
FEATURES

- Low Dynamic Output Impedance : 0.22Ω(Typ.).
- Sink Current Capability of 1.0 to 100mA.
- Equivalent Full-Range Temperature Coefficient of 50ppm/℃ (Typ.).
- Temperature Compensated for Operation Over Full Rated Operating Temperature Range.
- Minimum Cathode Current for Regualation : 600 μA(Max).
- Suffix **U** : Qualified to AEC-Q100.
  ex) KIA431BCM-RTK/HW**U**

LINE UP

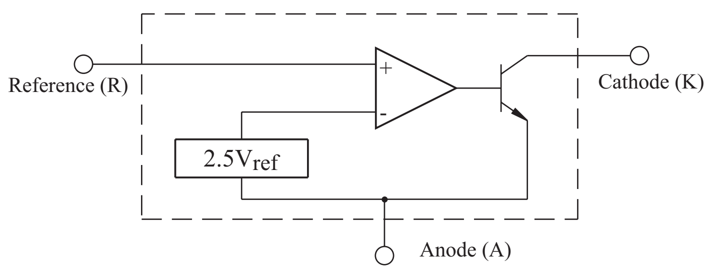
Type No.	Package	Marking
KIA431ACP	TO-92	-
KIA431BCP		-
KIA431ACF	SOT-89	3E
KIA431BCF		3F
KIA431ACM	SOT-23	4AC
KIA431BCM		4BC

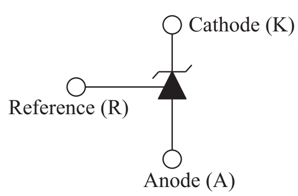
PIN CONFIGURATION (SOT-23)



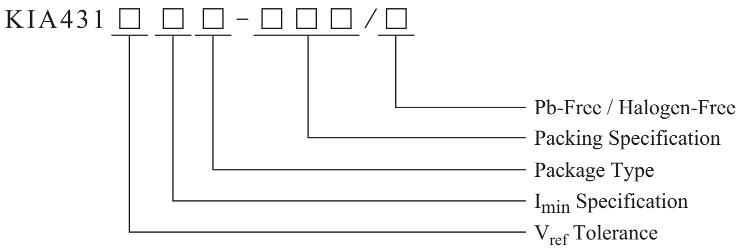
1. Cathode 2. Ref 3. Anode

BLOCK DIAGRAM





ORDERING INFORMATION



ITEM	V_{ref} Tolerance code		I_{min} Code		Package Code		Pb-Free / Halogen-Free	
	Code	Tolerance	Code	Spec.	Code	Package	P	Pb-Free
KIA431	A	±1.0%	C	0.6mA(Max)	P	TO-92	H	Halogen-Free
	B	±0.5%			F	SOT-89		
					M	SOT-23		

Packing Specification	TO-92	AT : Taping of AMMO PACK type
	SOT-89	RTF : RTF type
	SOT-23	RTK : RTK type

MAXIMUM RATINGS (Ta=25℃)

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

CHARACTERISTIC		SYMBOL	RATING	UNIT
Cathode To Anode Voltage		V_{KA}	37	V
Cathode Current Range, Continuous		I_K	-100 150	mA
Reference Input Current Range, Continuous		I_{ref}	-0.05 10	mA
Operating Junction Temperature		T_j	150	℃
Operating Temperature		T_{opr}	-40 85	℃
Storage Temperature		T_{stg}	-65 150	℃
Total Power Dissipation	KIA431P	P_D	700	mW
	KIA431F		800	
	KIA431M (Note1)		350	
Thermal Resistance	KIA431P	$R_{\theta JA}$	179	℃/W
	KIA431F		156	
	KIA431M (Note1)		357	

Note1) Package mounted on 99.5% Alumina 10×8×0.6mm

ELECTRICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTICS		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Reference Input Voltage	KIA431A	V_{ref}	Figure 1	$V_{KA}=V_{ref}$, I_K=10mA		2.470	2.495	2.520	V
	KIA431B					2.4825	2.495	2.5075	V
Reference Input Voltage Deviation Over Temperature Range		ΔV_{ref}	Figure 1 (Note 1)	$V_{KA}=V_{ref}$, I_K=10mA		-	7.0	30	mV
Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage		ΔV_{ref}/ ΔV_{KA}	Figure 2	I_K=10mA	ΔV_{KA}= 10V V_{ref}	-	-1.4	-2.7	mV/V
					ΔV_{KA}= 36V 10V	-	-1.0	-2.0	
Reference Input Current	Ta=25℃	I_{ref}	Figure 2	I_K=10mA, R1=10kΩ, R2=∞		0.5	1.8	2.5	㎂
	Ta=T_{opr}					-	-	6.5	
Reference Input Current Deviation Over Temperature Range		ΔI_{ref}	Figure 2	I_K=10mA, R1=10kΩ, R2=∞		-	0.8	2.5	㎂
Minimum Cathode Current For Regulation		I_{min}	Figure 1	$V_{KA}=V_{ref}$		-	300	600	㎂
Off-State Cathode Current		I_{off}	Figure 3	V_{KA}=36V, V_{ref}=0V		-	2.6	1000	nA
Dynamic Impedance		Z_{ka}	Figure 1 (Note 2)	$V_{KA}=V_{ref}$, I_K=1.0 100mA, f≦1.0kHz		-	0.22	-	Ω

FIGURE 1-TEST CIRCUIT FOR $V_{KA} = V_{ref}$

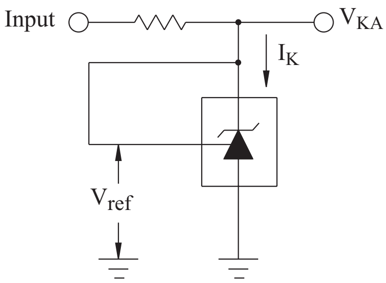
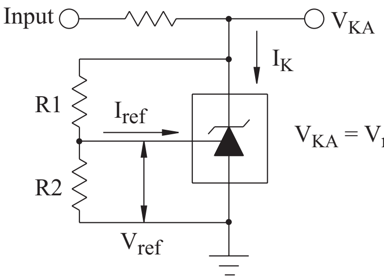
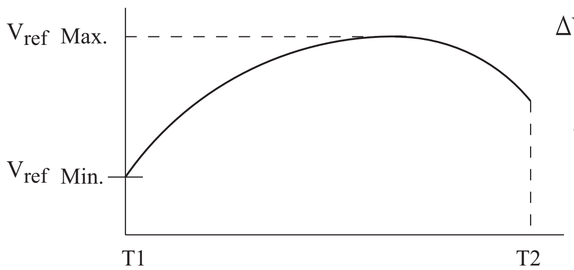


FIGURE 2-TEST CIRCUIT FOR $V_{KA} > V_{ref}$



$$V_{KA} = V_{ref}\left(1+\frac{R1}{R2}\right) + I_{ref} \times R1$$

Note 1:
The deviation parameter ΔV_{ref} is defined as the differences between the maximum and minimum values obtained over the full operating ambient temperature range that applies.



$\Delta V_{ref} = V_{ref\ (Max.)} - V_{ref\ (Min.)}$

$\Delta Ta = T_2 - T_1$

AMBIENT TEMPERATURE

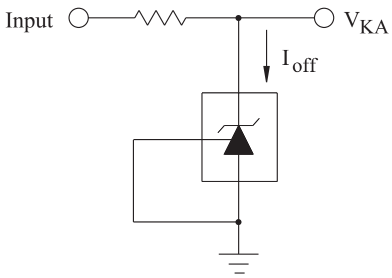
The average temperature coefficient of the Reference input voltage, ΔV_{ref}, is defined as:

$$\alpha V_{ref}\left(\frac{ppm}{°C}\right) = \frac{\left(\dfrac{\Delta V_{ref}}{V_{ref}\text{ at }25°C}\right) \times 10^6}{\Delta Ta}$$

$$= \frac{\Delta V_{ref} \times 10^6}{\Delta Ta(V_{ref}\text{ at }25°C)}$$

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

FIGURE 3-TEST CIRCUIT FOR I_{off}



Example : ΔV_{ref} = 8.0mV and slope is positive,
V_{ref} at 25°C=2.495V, ΔTa=70°C

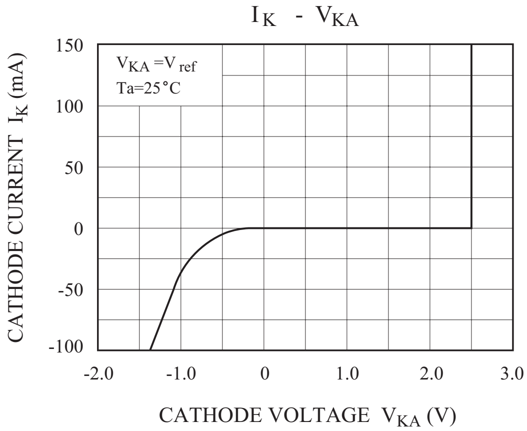
$$\alpha V_{ref} = \frac{0.008 \times 10^6}{70 \times (2.495)} = 45.8\ ppm/°C$$

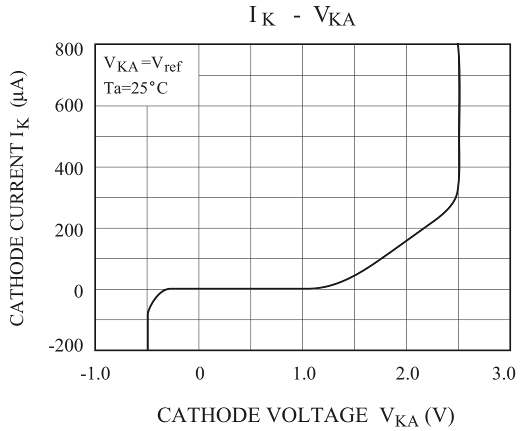
Note 2: The dynamic impedance Z_{ka} is defined as:

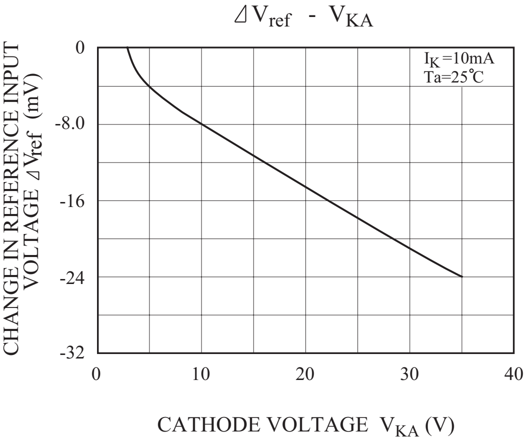
$$|Z_{ka}| = \frac{\Delta VKA}{\Delta Ik}$$

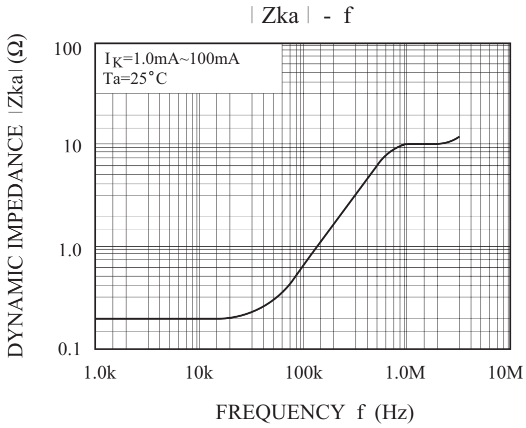
When the device is programmed with two external resistors, R1 and R2, (refer to Figure 2) the total dynamic impedance of the circuit is defined as:

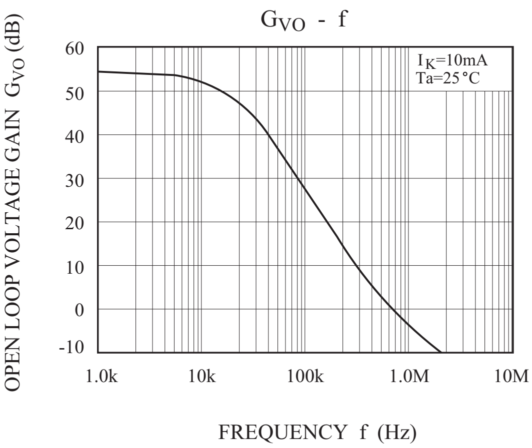
$$|Z_{ka'}| = |Z_{ka}|\left(1+\frac{R1}{R2}\right)$$

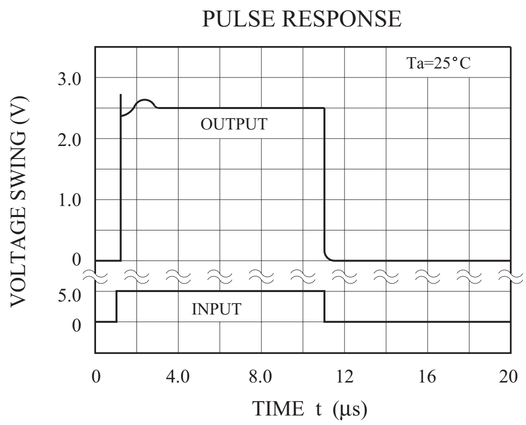

IK - VKA
VKA =V ref
Ta=25°C
CATHODE CURRENT IK (mA)
150
100
50
0
-50
-100
-2.0
-1.0
0
1.0
2.0
3.0
CATHODE VOLTAGE VKA (V)

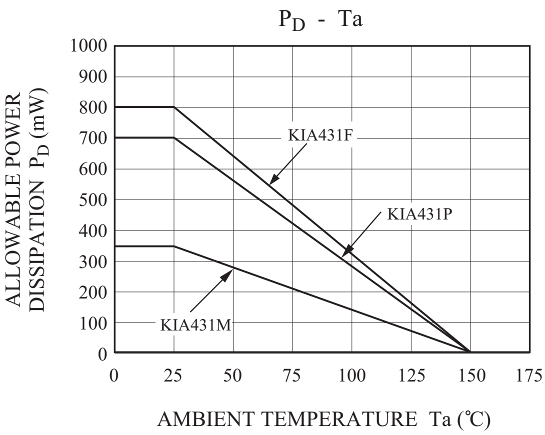

I K - VKA
VKA =Vref
Ta=25°C
CATHODE CURRENT IK (μA)
800
600
400
200
0
-200
-1.0
0
1.0
2.0
3.0
CATHODE VOLTAGE VKA (V)

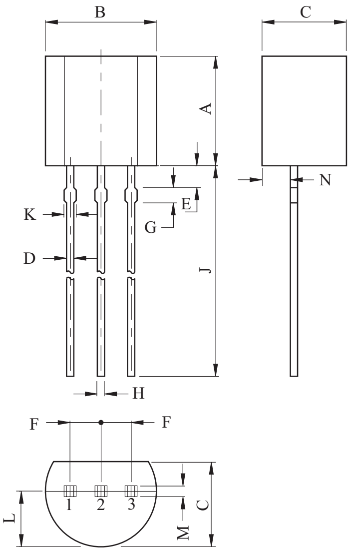

⊿Vref - VKA
IK=10mA
Ta=25℃
CHANGE IN REFERENCE INPUT
VOLTAGE ⊿Vref (mV)
0
-8.0
-16
-24
-32
0
10
20
30
40
CATHODE VOLTAGE VKA (V)


|Zka| - f
IK=1.0mA~100mA
Ta=25°C
DYNAMIC IMPEDANCE |Zka| (Ω)
100
10
1.0
0.1
1.0k
10k
100k
1.0M
10M
FREQUENCY f (Hz)


GVO - f
IK=10mA
Ta=25°C
OPEN LOOP VOLTAGE GAIN GVO (dB)
60
50
40
30
20
10
0
-10
1.0k
10k
100k
1.0M
10M
FREQUENCY f (Hz)


PULSE RESPONSE
Ta=25°C
OUTPUT
INPUT
VOLTAGE SWING (V)
3.0
2.0
1.0
0
5.0
0
0
4.0
8.0
12
16
20
TIME t (μs)

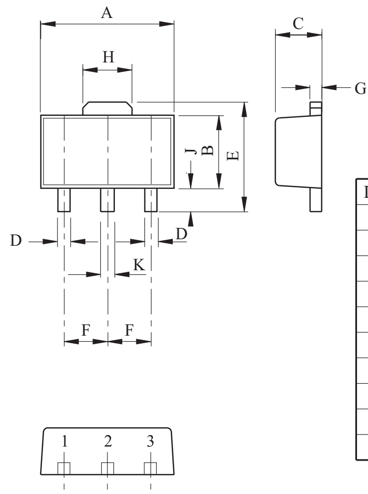

PD - Ta
KIA431F
KIA431P
KIA431M
ALLOWABLE POWER
DISSIPATION PD (mW)
1000
900
800
700
600
500
400
300
200
100
0
0
25
50
75
100
125
150
175
AMBIENT TEMPERATURE Ta (℃)



DIM	MILLIMETERS
A	4.70 MAX
B	4.80 MAX
C	3.70 MAX
D	0.45
E	1.00
F	1.27
G	0.85
H	0.45
J	14.00±0.50
K	0.55 MAX
L	2.30
M	0.45 MAX
N	1.00

1. REFERENCE
2. ANODE
3. CATHODE

TO-92

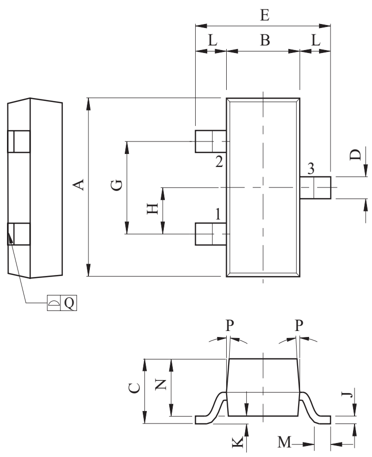


DIM	MILLIMETERS
A	4.70 MAX
B	2.50±0.20
C	1.70 MAX
D	0.45+0.15/-0.10
E	4.25 MAX
F	1.50±0.10
G	0.40 TYP
H	1.75 MAX
J	0.75 MIN
K	0.5+0.10/-0.05

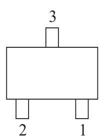
1. REFERENCE
2. ANODE
3. CATHODE

Heat Sink is common to ② (ANODE)

SOT-89



DIM	MILLIMETERS
A	2.93±0.20
B	1.30+0.20/-0.15
C	1.30 MAX
D	0.40+0.15/-0.05
E	2.40+0.30/-0.20
G	1.90
H	0.95
J	0.13+0.10/-0.05
K	0.00 ~ 0.10
L	0.55
M	0.20 MIN
N	1.00+0.20/-0.10
P	7°
Q	0.1 MAX



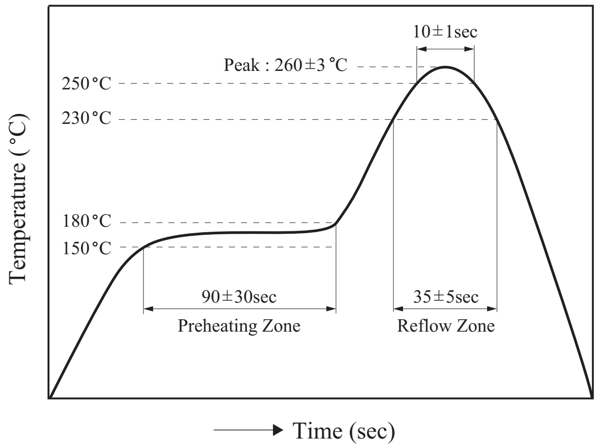
1. Cathode 2. Ref 3. Anode

SOT-23

PRECAUTION FOR USE

Lead-Free Soldering Condition.

Elements mounting styles of electronic devices are gaining in further diversification over recent years, and needs for components are all the more expanding in varieties. Especially, surface mounting is steadily penetrating into industrial segments as a world-wide popular technical trend. Although exposure to high temperature is inevitable during soldering we recommend limiting the soldering temperature to low levels as shown in figure for the sake of retaining inherent excellent reliability.



[Lead-Free Soldering Temperature Profile]

1. When employing solder reflow method

1) Soldering Condition

ⓐ Standard Condition : 250℃ (Temperature), 10±1sec. (Time)

ⓑ Peak Condition : 260±3℃

2) Recommend temperature profile

3) Precautions on heating method

When resin in kept exposed to high temperature for a long time, device reliability may be marred.
Therefore, it is essential to complete soldering in the shortest time possible to prevent temperature of resin from rising.

2. When employing halogen lamps or infrared-ray heaters

When halogen lamps or infrared-ray heaters are used, avoid direct irradiation onto resin surfaces; such devices cause extensive localized temperature rise.

※ Please keep a reflow solder operating when Surface Mount Package’s Soldering.