

### PROGRAMMABLE PRECISION REFERENCES

The FA431Z/ZS/ZF 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 40 volts with two external resistors. These devices exhibit a wide operating current range of 1.0 to 100mA with a typical dynamic impedance of  $0.2\Omega$ . 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 FA431 Series operates as a shunt regulator, it can be used as either a positive or negative voltage reference.

### FEATURES

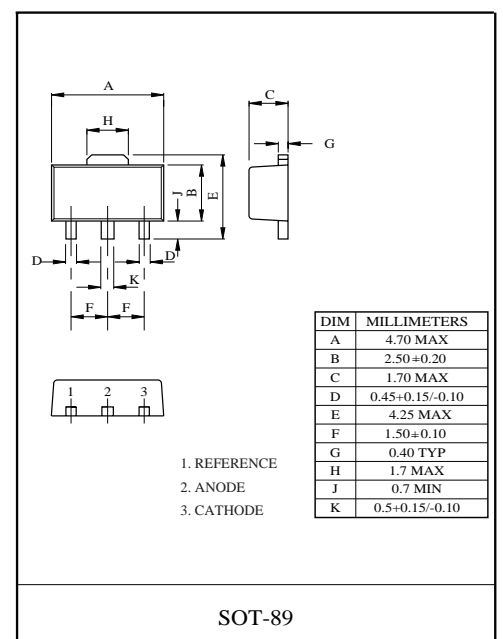
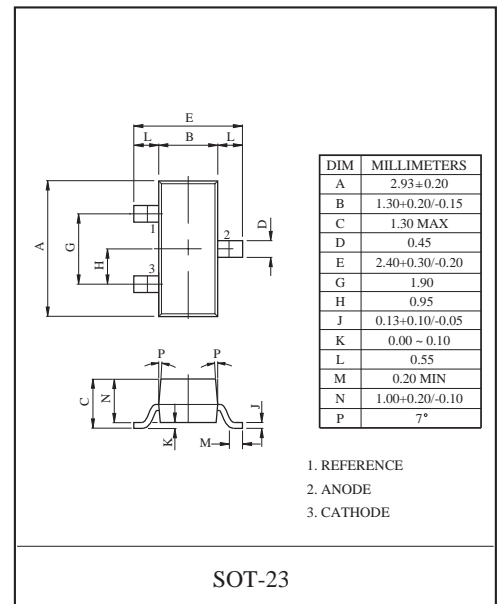
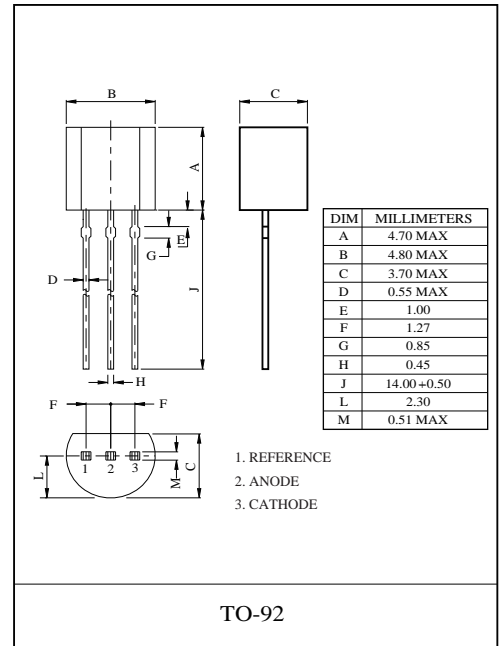
· Device Code Name :FA431 +  $V_{ref}$  Code + Package Code

ITEM	$V_{ref}$ Code		Package Code	
	Code	Tolerance (%)	Code	Package
FA431		$\pm 2.0$		TO-92
	A	$\pm 1.0$	F	SOT-89
	C	$\pm 0.5$	S	SOT-23

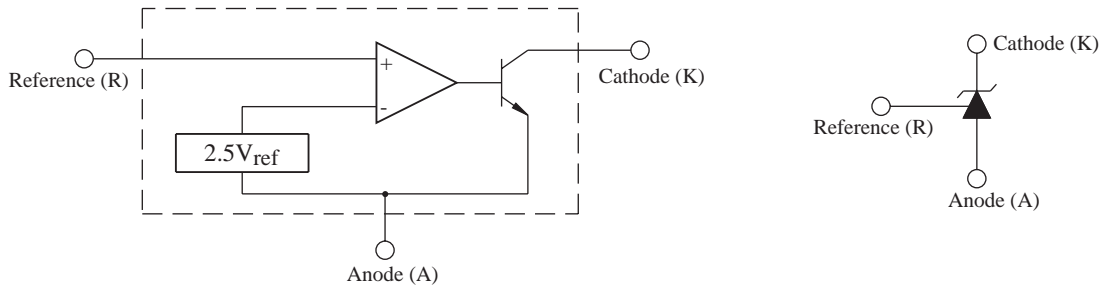
- Low Dynamic Output Impedance :  $0.2\Omega$  (Typ.).
- Sink Current Capability of 1.0 to 100mA.
- Equivalent Full-Range Temperature Coefficient of 50ppm/ $^{\circ}C$  (Typ.).
- Temperature Compensated for Operation Over Full Rated Operating Temperature Range.
- Low Output Noise Voltage.
- We declare that the material of product compliance with RoHS requirements.

### LINE UP

Type No.	Mark	Operating Voltage(V)	Package
FA431Z		2.5~36	TO-92
FA431ZA			
FA431ZC			
FA431ZF			
FA431ZAF			
FA431ZCF		2.5~36	SOT-89
FA431ZS			
FA431ZAS			
FA431ZCS	RA3		
FA431ACS	RA2		SOT-23



## BLOCK DIAGRAM



## MAXIMUM RATINGS (Ta=25°C)

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

CHARACTERISTIC		SYMBOL	RATING	UNIT
Cathode To Anode Voltage		$V_{KA}$	44	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	°C
Operating Temperature		$T_{opr}$	-40 ~ 85	°C
Storage Temperature		$T_{stg}$	-65 ~ 150	°C
Total Power Dissipation	FA431Z	$P_D$	700	mW
	FA431ZF (Note)		800	
	FA431ZS		200	

Note) Package mounted on a ceramic board. (600mm<sup>2</sup> × 0.8mm )

## ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Reference Input Voltage	FA431Z (2%)	$V_{ref}$	Figure 1	$V_{KA}=V_{ref}, I_K=10mA$	2.440	2.495	2.550	V	
	FA431ZA (1%)				2.470	2.495	2.520	V	
	FA431ZC (0.5%)				2.4825	2.495	2.5075	V	
	FA431ACS (0.5%)				2.487	2.500	2.512	V	
Reference Input Voltage Deviation Over Temperature Range		$\Delta V_{ref}$	Figure 1 (Note 1)	$V_{KA}=V_{ref}, I_K=10mA$	-	3	17	mV	
Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage		$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Figure 2	$I_K=10mA$	$\frac{\Delta V_{KA}}{10V \sim V_{ref}}$	-	-1.4	-2.7	mV/V
					$\frac{\Delta V_{KA}}{36V \sim 10V}$	-	-1.0	-2.0	
Reference Input Current		$I_{ref}$	Figure 2	$I_K=10mA, R1=10k\Omega, R2=\infty$	-	0.5	2.0	$\mu A$	
Reference Input Current Deviation Over Temperature Range		$\Delta I_{ref}$	Figure 2	$I_K=10mA, R1=10k\Omega, R2=\infty$	-	0.4	1.2	$\mu A$	
Minimum Cathode Current For Regulation		$I_{min}$	Figure 1	$V_{KA}=V_{ref}$	-	0.25	0.5	mA	
Off-State Cathode Current		$I_{off}$	Figure 3	$V_{KA}=40V, V_{ref}=0V$	-	170	900	nA	
Dynamic Impedance		$Z_{ka}$	Figure 1 (Note 2)	$V_{KA}=V_{ref}, I_K=1.0 \sim 100mA,$ $f \leq 1.0kHz$	-	0.27	0.5	$\Omega$	

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

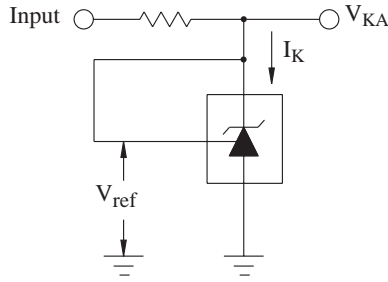
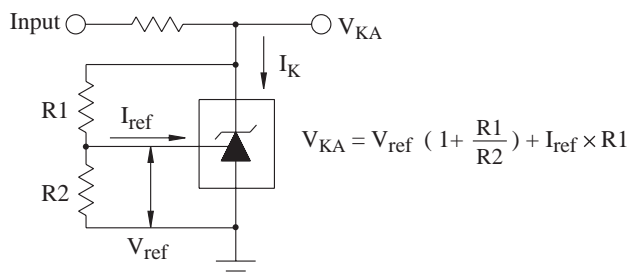
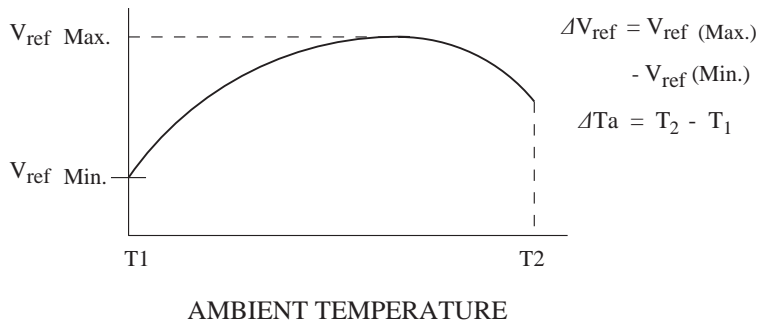


FIGURE 2-TEST CIRCUIT FOR  $V_{KA} > V_{ref}$



Note 1:

The deviation parameter  $\Delta V_{ref}$  is defined as the differences between the maximum and minimum values obtained over the full operating ambient temperature range that applies.



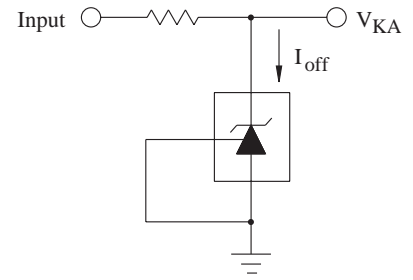
The average temperature coefficient of the Reference input voltage,  $\alpha V_{ref}$ , is defined as:

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

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

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

FIGURE 3-TEST CIRCUIT FOR  $I_{off}$



Example :  $\Delta V_{ref} = 8.0\text{mV}$  and slope is positive,  
 $V_{ref} \text{ at } 25^\circ\text{C} = 2.495\text{V}$ ,  $\Delta Ta = 70^\circ\text{C}$

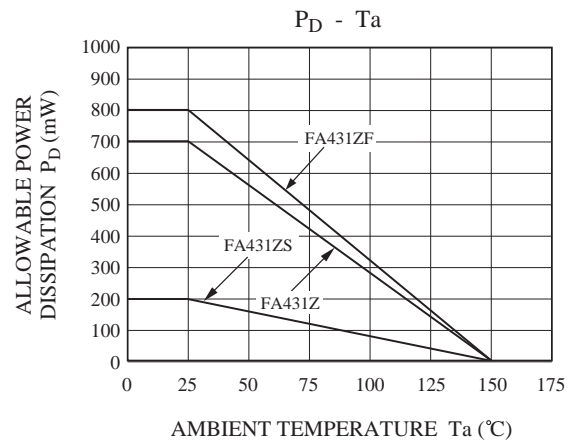
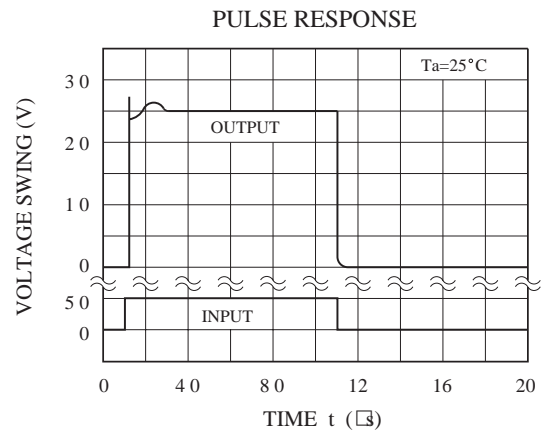
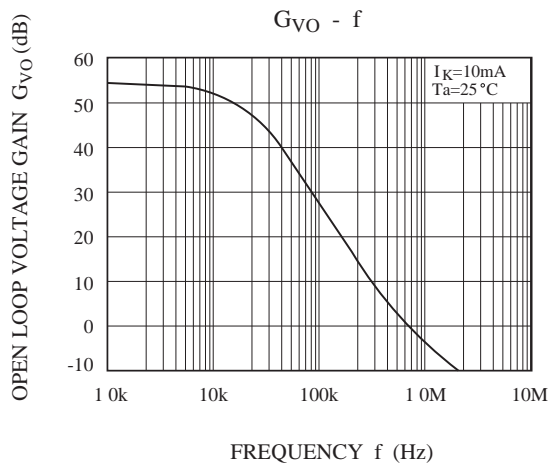
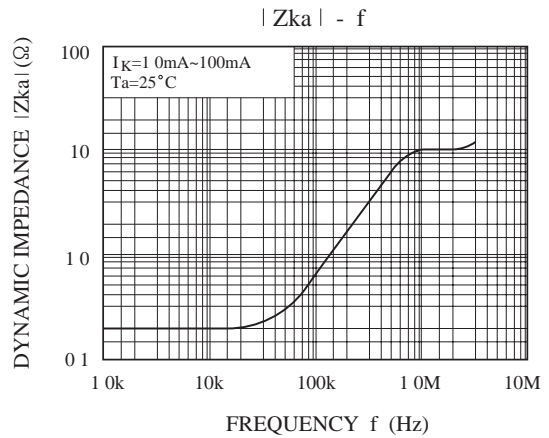
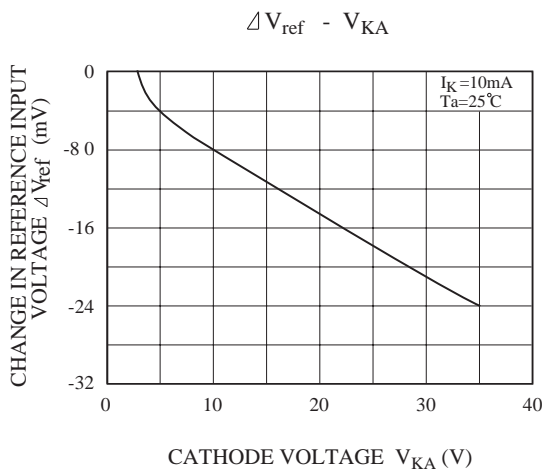
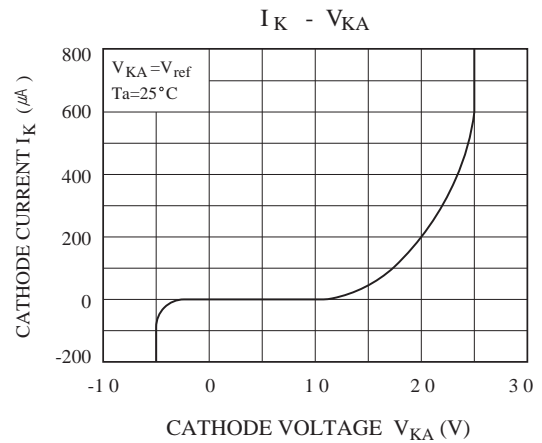
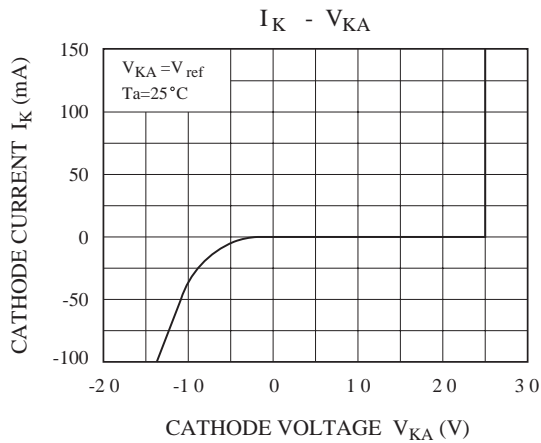
$$\alpha V_{ref} = \frac{0.008 \times 10^6}{70 \times (2.495)} = 45.8 \text{ ppm}/^\circ\text{C}$$

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

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

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:

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



## PRECAUTION FOR USE

### SOLDERING

#### Flat Package (SMD Package)

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.

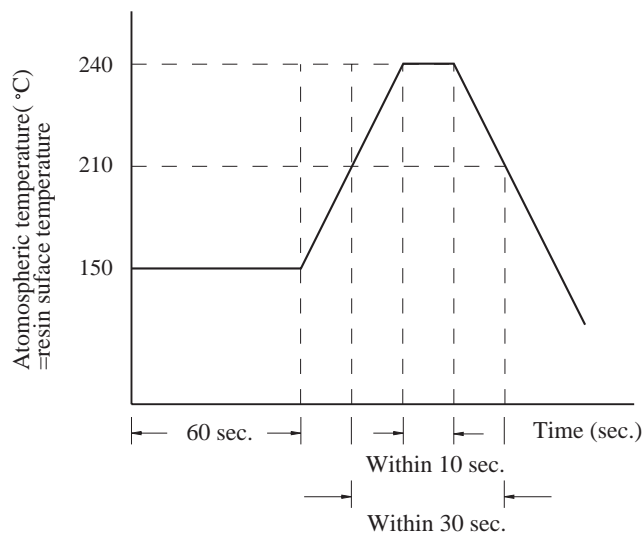


Fig. 6

(a) When employing solder reflow method

- ① Atmospheric temperature around resin surfaces must be less than 240 °C, not exceeding the time length of 10 sec.
- ② Recommend temperature profile
- ③ Precautions on heating method

When resin is 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.

(b) 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 SMD package's soldering.