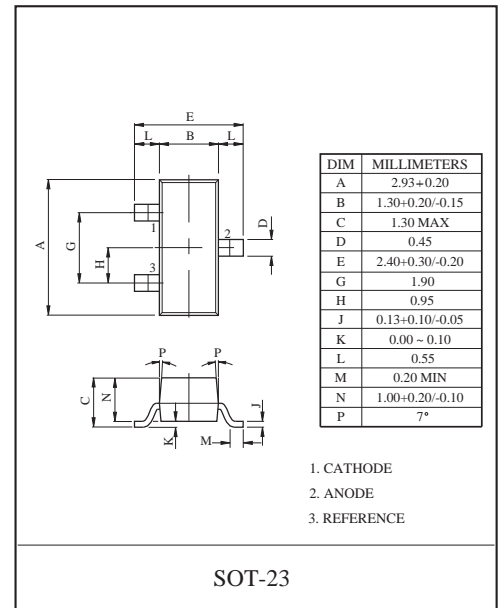## PROGRAMMABLE PRECISION REFERENCES

The FA431ZCSR 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 0.2Ω .
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
FA431ZCSR operates as a shunt regulator,
it can be used as either a positive or negative voltage reference.

| DIM	MILLIMETERS
A	2.93+0.20
B	1.30+0.20/-0.15
C	1.30 MAX
D	0.45
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°

1. CATHODE

2. ANODE

3. REFERENCE

SOT-23

FEATURES

· Divice Code Name :FA431 + V_{ref} Code + Package Code

ITEM	V_{ref} Code		Package Code	
	Code	Tolerance (%)	Code	Package
FA431ZCSR	C	±0.5	S	SOT-23

· Low Dynamic Output Impedance : 0.2Ω (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.

· Low Output Noise Voltage.

MARK: LA3

BLOCK DIAGRAM
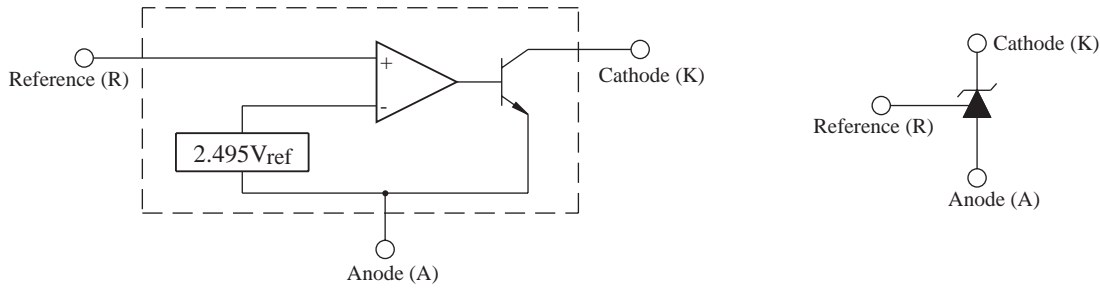
MAXIMUM RATINGS (Ta=25℃)

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

CHARACTERISTIC	SYMBOL	RATING	UNIT
Cathode To Anode Voltage	V_{KA}	36	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 ~125	℃
Storage Temperature	T_{stg}	-65 ~ 150	℃
Total Power Dissipation	P_D	200	mW

ELECTRICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTICS		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Reference Input Voltage	FA431ZCSR (0.5%)	V_{ref}	Figure 1	$V_{KA}=V_{ref}$, $I_K=10mA$		2.482	2.495	2.507	V
Reference Input Voltage Deviation Over Temperature Range		$\varDelta V_{ref}$	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		$\varDelta V_{ref}/$ $\varDelta V_{KA}$	Figure 2	$I_K=10mA$	$\varDelta V_{KA}=$ $10V \sim V_{ref}$	-	-1.4	-2.7	mV/V
					$\varDelta V_{KA}=$ $36V \sim 10V$	-	-1.0	-2.0	
Reference Input Current		I_{ref}	Figure 2	$I_K=10mA$, $R1=10k\Omega$, $R2=\infty$		-	0.5	2.0	μA
Reference Input Current Deviation Over Temperature Range		$\varDelta I_{ref}$	Figure 2	$I_K=10mA$, $R1=10k\Omega$, $R2=\infty$		-	0.4	1.2	μA
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	Ω

FIGURE 1-TEST CIRCUIT FOR $V_{KA} = V_{ref}$
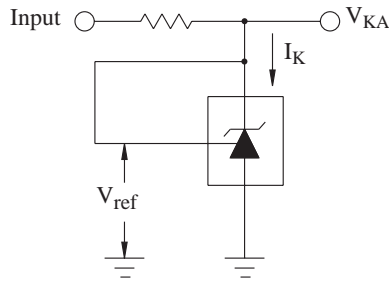
FIGURE 2-TEST CIRCUIT FOR $V_{KA} > V_{ref}$

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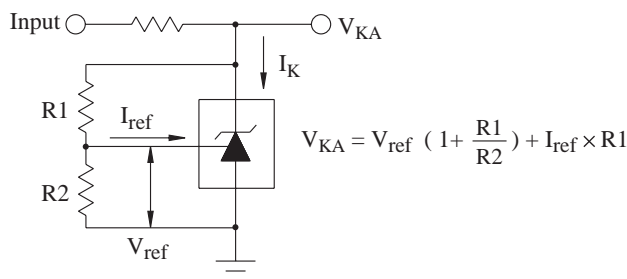
Note 1:

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.
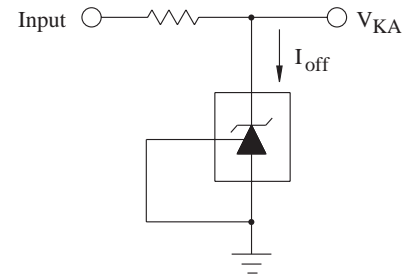

$$\Delta V_{ref} = V_{ref\,(Max.)} - V_{ref\,(Min.)}$$

$$\Delta Ta = T_2 - T_1$$

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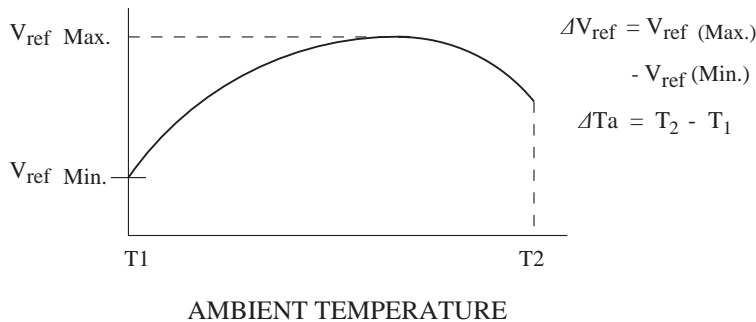
The average temperature coefficient of the Reference input voltage, ΔV_{ref}, is defined as:

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

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

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 : $\Delta V_{ref} = 8.0mV$ and slope is positive,
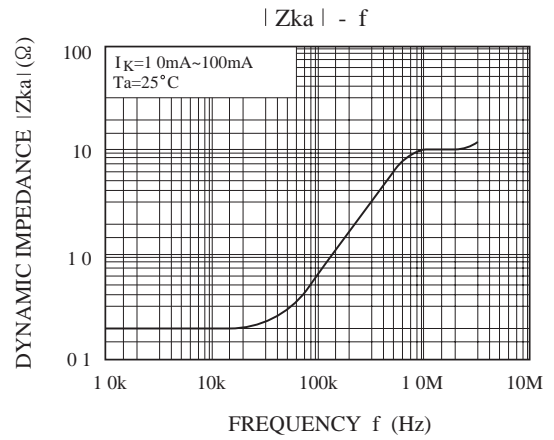V_{ref} at $25℃ = 2.500V$, $\Delta Ta = 70℃$
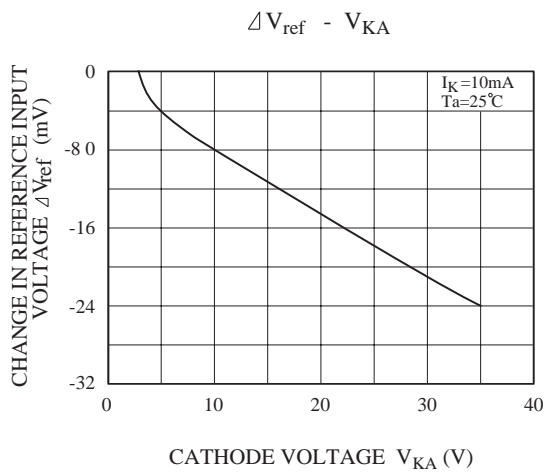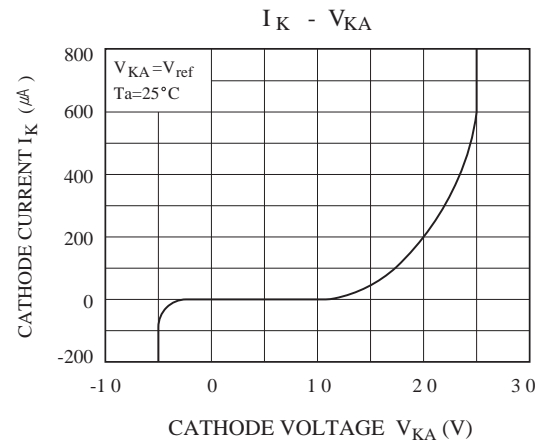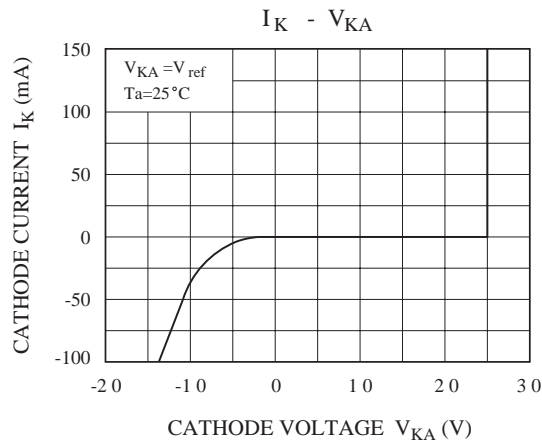
$$\alpha V_{ref} = \frac{0.008 \times 10^6}{70 \times (2.500)} = 45.8\ ppm/℃$$

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:

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

I_K - V_{KA}

CATHODE CURRENT I_K (mA)

$V_{KA} = V_{ref}$
Ta=25°C

CATHODE VOLTAGE V_{KA} (V)

I_K - V_{KA}

CATHODE CURRENT I_K (μA)

$V_{KA} = V_{ref}$
Ta=25°C

CATHODE VOLTAGE V_{KA} (V)

$\triangle V_{ref}$ - V_{KA}

CHANGE IN REFERENCE INPUT VOLTAGE $\triangle V_{ref}$ (mV)

I_K=10mA
Ta=25°C

CATHODE VOLTAGE V_{KA} (V)

$|Zka|$ - f

DYNAMIC IMPEDANCE $|Zka|$ (Ω)

I_K=10mA~100mA
Ta=25°C

FREQUENCY f (Hz)

G_{VO} - f

OPEN LOOP VOLTAGE GAIN G_{VO} (dB)

I_K=10mA
Ta=25°C

FREQUENCY f (Hz)

PULSE RESPONSE

VOLTAGE SWING (V)

Ta=25°C

OUTPUT

INPUT

TIME t (□s)

P_D - Ta

ALLOWABLE POWER DISSIPATION P_D (mW)

FA431ZCSR

AMBIENT TEMPERATURE Ta (°C)

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.
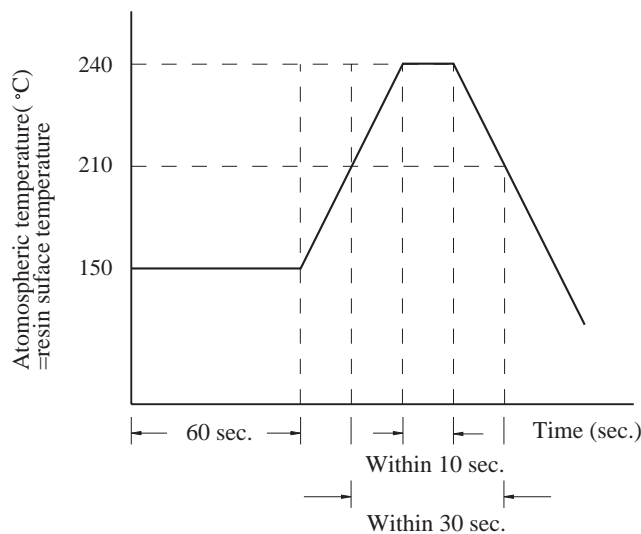

Fig. 6

(a) When employing solder reflow method

   ① Atmospheric temperature around resin surfaces must be less than 240 ℃, not exceeding the time length of 10 sec.

   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.

(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.