RA0431

Low-Voltage Adjustable Precision Shunt Regulator

Features

- Low voltage operation to 1.24V
- 1% reference voltage tolerance
- Output voltage adjustable from V_{ref} to 12V
- Low 80µA operational cathode current
- 0.25Ω typical output impedance
- SOT23-5 package

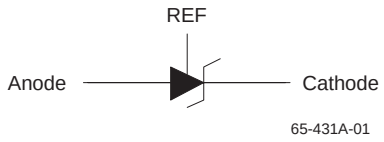
Applications

- Voltage reference for discrete power circuits

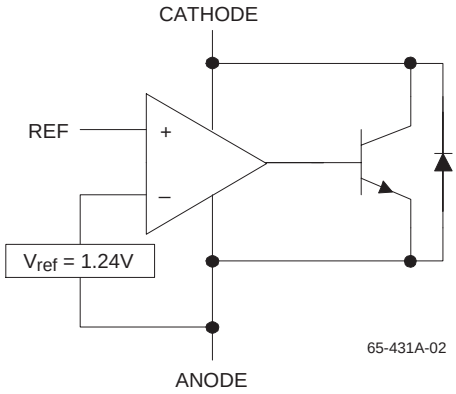
Description

The RA0431 is a low-voltage 3-terminal adjustable precision voltage reference regulator. It has an excellent thermal stability over the standard commercial temperature range. The output voltage can be set to any value between Vref (1.24V) and 12V using two external resistors. The RA0431 operates from a lower voltage (1.24V) than the traditional shunt regulator references which operate from 2.5V. When used with an optocoupler, the RA0431 will be an ideal voltage reference in an isolated feedback circuit for use in switched-mode power supplies and modular DC-DC converters. The RA0431 has a low output impedance of active output circuitry offering a very sharp turn-on characteristic. The RA0431 will be an excellent replacement for low-voltage zener diodes in many applications such as on-board regulation and adjustable power supplies.

Symbol

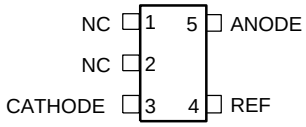


Block Diagram



Pin Assignments

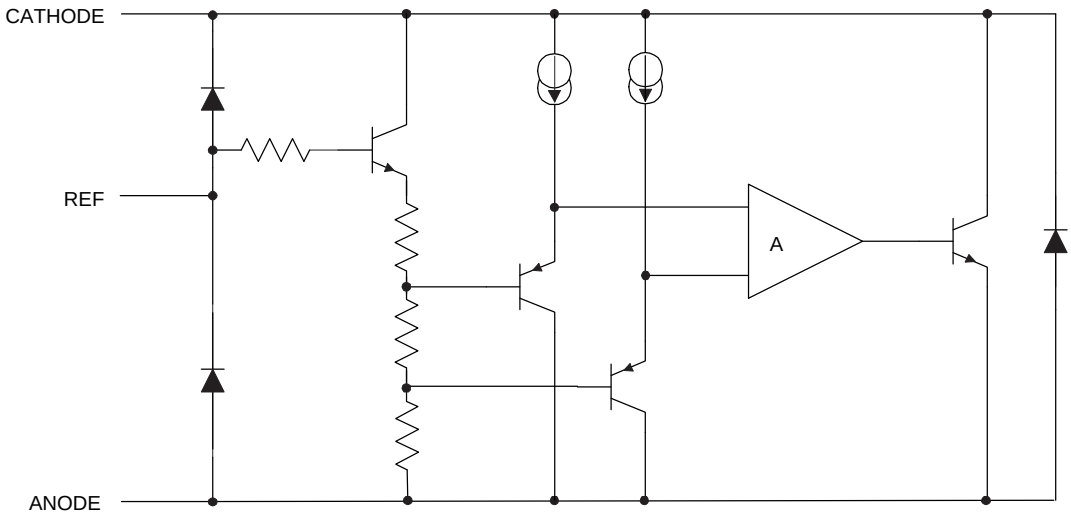
SOT-23 PACKAGE
(TOP VIEW)



NC = No internal connection

65-431A-03

Equivalent Schematic



65-431A-04

Absolute Maximum Ratings

Ratings are over full operating free-air temperature range unless otherwise noted.

Cathode voltage, V_{KA}	13.2V
Continuous cathode current I_K	–20mA to 20mA
Reference current, I_{ref}	–0.05mA to 3mA
Power dissipation	See Dissipation Rating Table
Storage temperature range	-65° to 150°C

Notes:

1. Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

Recommended Operating Conditions

Parameter	Min.	Max.	Units
Cathode voltage, V_{KA}	V_{REF}	12	V
Cathode current, I_K	0.1	15	mA
Operating temperature range in free-air, T_A	0	70	°C

Dissipation Rating Table

Package	Power Rating $T_A \leq 25°C$	Derating Factor $T_A \geq 25°C$	Power Rating $T_A = 70°C$
SOT23-5	150mW	1.2mW/°C	96mW

Electrical Specifications

T_A = 25°C (unless otherwise noted), at free-air

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
V_{ref}	Reference Voltage	$V_{KA} = V_{ref}$, T_A = 25°C	1.228	1.24	1.252	V
		I_K = 10mA, T_A = 0 to 70°C	1.221		1.259	
$V_{ref\ (dev)}$	V_{ref} deviation over full temperature range (see note 2)	$V_{KA} = V_{ref}$, I_K = 10mA, See note 2 and Figure 1.		4	12	mV
$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Ratio of V_{ref} change in cathode voltage change	I_K = 10mA, $\Delta V_{KA} = V_{ref}$ to 6V. See figure 2.		-1.5	-2.7	$\frac{mV}{V}$
I_{ref}	Reference terminal current	I_K = 10mA, R1 = 10KΩ, R2 = ∞ See figure 2.		0.15	0.5	µA
$I_{ref(dev)}$	I_{ref} deviation over full temperature range (see note 2)	I_K = 10mA, R1 = 10KΩ, R2 = ∞ See note 1 & figure 2.		0.05	0.3	µA
$I_{K(min)}$	Minimum cathode current for regulation	$V_{KA} = V_{ref}$ See figure 1.		55	80	µA
I_{off}	Off-state cathode current	V_{KA} = 6V, V_{ref} = 0 See figure 3.		0.001	0.1	µA
$\|Z_{KA}\|$	Dynamic impedance (see note 3)	$V_{KA} = V_{ref}$, f ≤ 1KHz I_K = 0.1mA to 15mA, See figure 1.		0.25	0.4	Ω

Notes:

1. Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.
2. Full temperature range is 0°C to 70°C.
3. The deviation parameters $V_{ref(dev)}$ and $I_{ref(dev)}$ are defined as the differences between the maximum and minimum values obtained over the rated temperature range. The average full-range temperature coefficient of the reference input voltage, ∞V_{ref}, is defined as:

$$|\infty V_{ref}|\langle ppm/°C\rangle = \frac{\{V_{ref(dev)}/V_{ref}\langle T_A = 25°C\rangle\} \times 10^6}{\Delta T_A}$$

   where ΔT_A is the rated operating free-air temperature range of the device.

   ∞V_{ref} can be positive or negative depending on whether minimum V_{ref} or maximum V_{ref}, respectively, occurs at the lower temperature.
4. The dynamic impedance is defined as: $|Z_{KA}| = \Delta V_{KA} / \Delta I_K$

   When the device is operating with two external resistors (see Figure 2), the total dynamic impedance of the circuit is given by:

$$|Z_{KA}| = \frac{\Delta V}{\Delta I} \approx |Z_{KA}| \times \left(1 + \frac{R_1}{R_2}\right)$$

Parameter Measurement Information

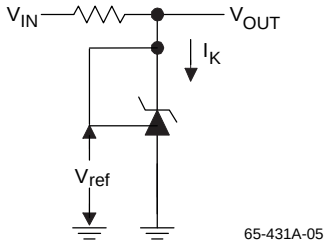


Figure 1. Test Circuit for $V_{KA} = V_{REF}$, $V_{OUT} = V_{KA} = V_{REF}$

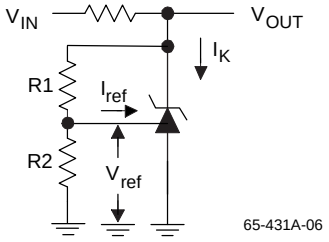


Figure 2. Test Circuit for $V_{KA} > V_{REF}$, $V_{OUT} = V_{KA} = V_{REF} \times (1+R1/R2) + I_{REF} \times R1$

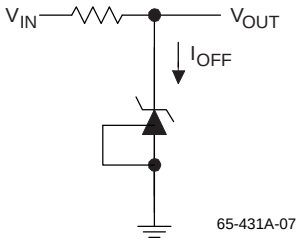


Figure 3. Test Circuit for I_{OFF}

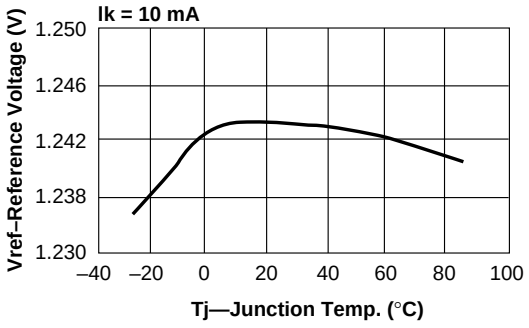


Figure 4. Reference Voltage vs. Junction Temp.

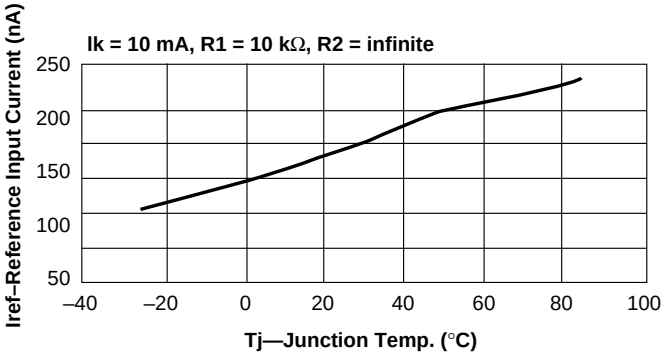


Figure 5. Reference Input Current vs. Junction Temp.

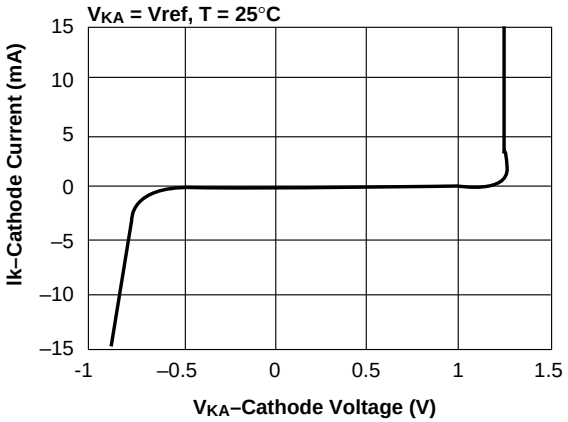


Figure 6. Cathode Current vs. Cathode Voltage

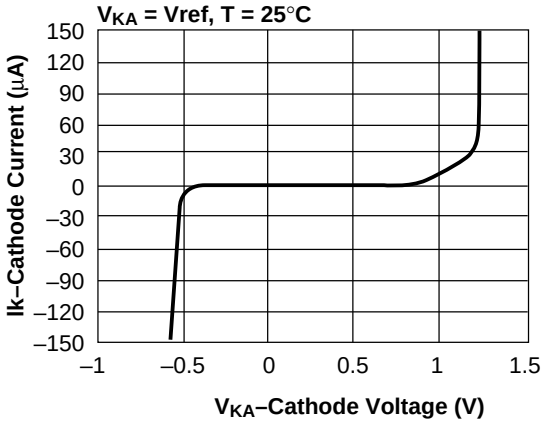


Figure 7. Cathode Current vs. Cathode Voltage

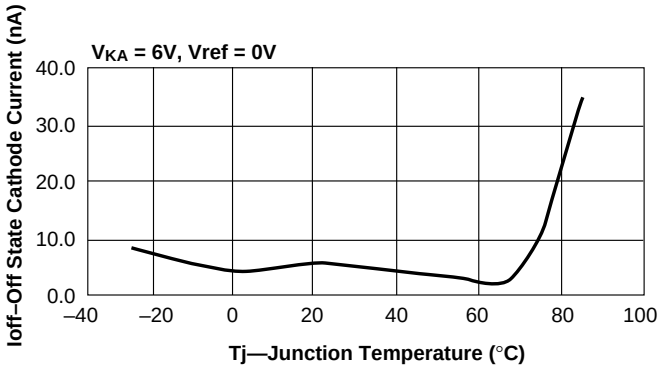


Figure 8. Off-State Cathode Current vs. Junction Temperature

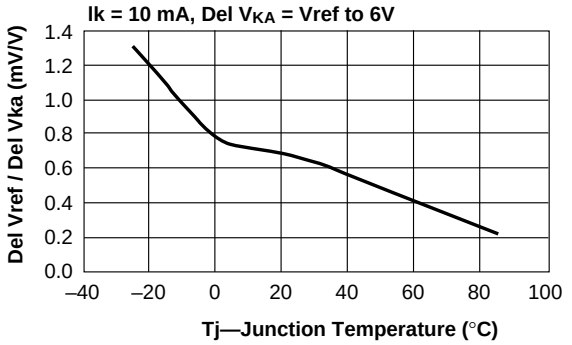


Figure 9. Ratio of Delta Reference Voltage to Delta Cathode Voltage vs. Junction Temperature

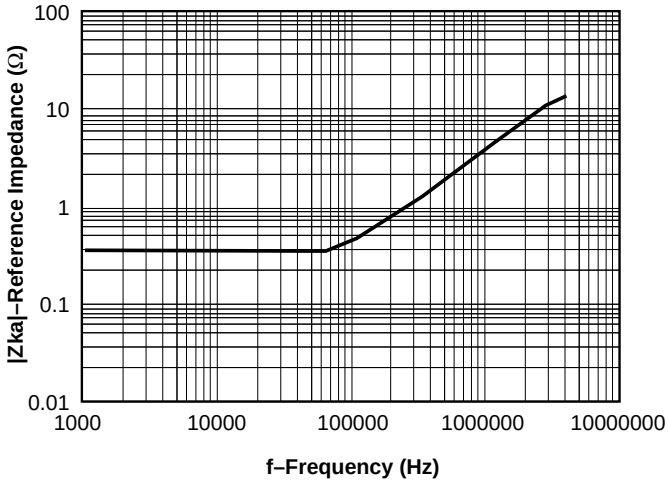


Figure 10. Reference Impedance vs. Frequency

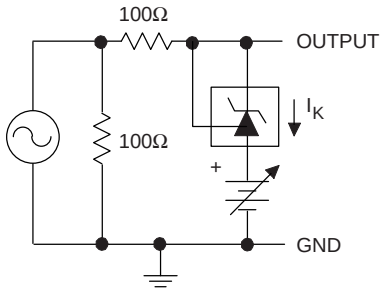


Figure 11. Test Circuit for Reference Impedance

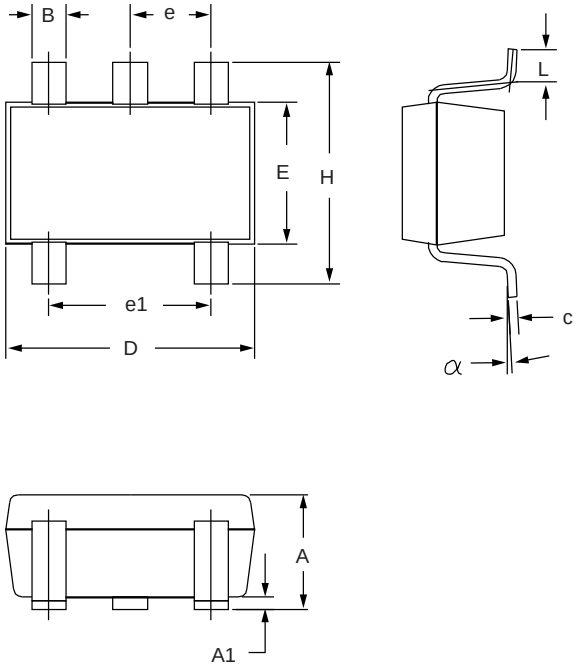
Mechanical Dimensions (continued)

SOT23-5 Package

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.170	.195	.90	1.45	
A1	.014	.020	.00	.15	
B	.008	.020	.20	.50	
c	.003	.010	.08	.25	
D	.106	.122	2.70	3.10	
E	.059	.071	1.50	1.80	
e	.037 BSC		.95 BSC		
e1	.075 BSC		1.90 BSC		
H	.087	.126	2.20	3.20	
L	.004	.024	.10	.60	
α	0°	10°	0°	10°	

Notes:

1. Package outline exclusive of mold flash & metal burr.
2. Package outline exclusive of solder plating.
3. EIAJ Ref Number SC-74A.



Notes:

Ordering Information

Product Number	Package
RA0431M	SOT23-5