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March 2015

# FAN431A

## Programmable Shunt Regulator

### Features

- Programmable Output Voltage to 36 V
- Low Dynamic Output Impedance: 0.2  $\Omega$  (Typical)
- Sink Current Capability: 1.0 to 100 mA
- Equivalent Full-Range Temperature Coefficient of 50 ppm/ $^{\circ}\text{C}$  (Typical)
- Temperature Compensated for Operation Over Full Rated Operating Temperature Range
- Low Output Noise Voltage
- Fast Turn-on Response

### Description

The FAN431A is a three-terminal output adjustable regulator with thermal stability over the full operating temperature range. The output voltage can be set to any value between  $V_{\text{REF}}$  (approximately 2.5 V) and 36 V with two external resistors. This device has a typical dynamic output impedance of 0.2  $\Omega$ . Active output circuit provides a sharp turn-on characteristic, making this device excellent replacements for zener diodes in many applications.

TO-92



1. Ref 2. Anode 3. Cathode

### Ordering Information

Part Number	Operating Temperature Range	Output Voltage Tolerance	Top Mark	Package	Packing Method
FAN431AZXA	-25 to +85 $^{\circ}\text{C}$	1%	FAN431A	TO-92 3L	Ammo

FAN431A — Programmable Shunt Regulator

## Block Diagram

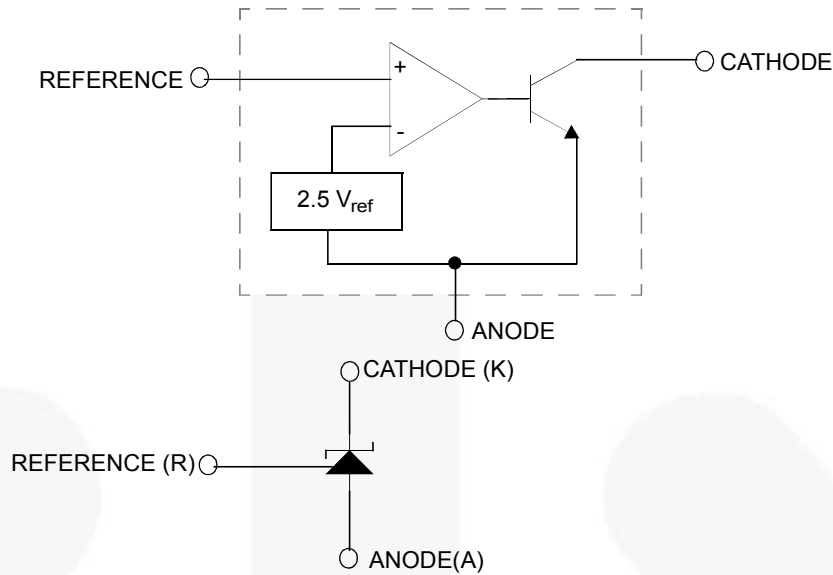


Figure 1. Block Diagram

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit
$V_{KA}$	Cathode Voltage	37	V
$I_{KA}$	Cathode current Range (Continuous)	-100 to +150	mA
$I_{REF}$	Reference Input Current Range	-0.05 to +10.00	mA
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient <sup>(1,2)</sup> Z Suffix Package	132	$^\circ\text{C}/\text{W}$
$P_D$	Power Dissipation <sup>(3,4)</sup> Z Suffix Package	940	mW
$T_J$	Junction Temperature	150	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature Range	-25 to +85	$^\circ\text{C}$
$T_{STG}$	Storage Temperature Range	-65 to +150	$^\circ\text{C}$

### Notes:

- Thermal resistance test board  
Size: 1.6 mm x 76.2 mm x 114.3 mm (1S0P)  
JEDEC Standard: JESD51-3, JESD51-7.
- Assume no ambient airflow.
- $T_{JMAX} = 150^\circ\text{C}$ , Ratings apply to ambient temperature at  $25^\circ\text{C}$ .
- Power dissipation calculation:  $P_D = (T_J - T_A) / R_{\theta JA}$ .

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Unit
$V_{KA}$	Cathode Voltage	$V_{REF}$	36	V
$I_{KA}$	Cathode Current	1.0	100	mA

## Electrical Characteristics<sup>(5)</sup>

Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Conditions	FAN431A			Unit
			Min.	Typ.	Max.	
$V_{REF}$	Reference Input Voltage	$V_{KA} = V_{REF}, I_{KA} = 10\text{ mA}$	2.470	2.495	2.520	V
$\Delta V_{REF}/\Delta T$	Deviation of Reference Input Voltage Over-Temperature	$V_{KA} = V_{REF}, I_{KA} = 10\text{ mA}, T_{MIN} \leq T_A \leq T_{MAX}$		4.5	17.0	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Change in Cathode Voltage	$I_{KA} = 10\text{ mA}$	$\Delta V_{KA} = 10\text{ V} - V_{REF}$	-1.0	-2.7	mV/V
			$\Delta V_{KA} = 36\text{ V} - 10\text{ V}$	-0.5	-2.0	
$I_{REF}$	Reference Input Current	$I_{KA} = 10\text{ mA}, R_1 = 10\text{ k}\Omega, R_2 = \infty$		1.5	4.0	$\mu\text{A}$
$\Delta I_{REF}/\Delta T$	Deviation of Reference Input Current Over Full Temperature Range	$I_{KA} = 10\text{ mA}, R_1 = 10\text{ k}\Omega, R_2 = \infty, T_A = \text{Full Range}$		0.4	1.2	$\mu\text{A}$
$I_{KA(MIN)}$	Minimum Cathode Current for Regulation	$V_{KA} = V_{REF}$		0.45	1.00	mA
$I_{KA(OFF)}$	Off-Stage Cathode Current	$V_{KA} = 36\text{ V}, V_{REF} = 0$		0.05	1.00	$\mu\text{A}$
$Z_{KA}$	Dynamic Impedance	$V_{KA} = V_{REF}, I_{KA} = 1\text{ to }100\text{ mA}, f \geq 1.0\text{ kHz}$		0.15	0.50	$\Omega$

**Note:**

5.  $T_{MIN} = -25^\circ\text{C}, T_{MAX} = +85^\circ\text{C}$ .

Test Circuits

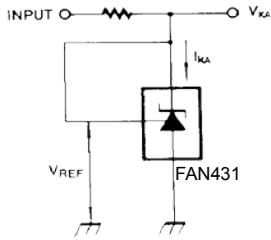


Figure 2. Test Circuit for  $V_{KA} = V_{REF}$

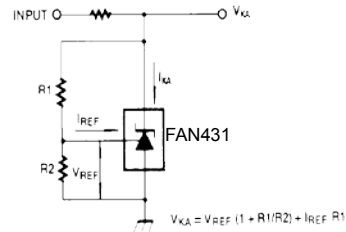


Figure 3. Test Circuit for  $V_{KA} \geq V_{REF}$

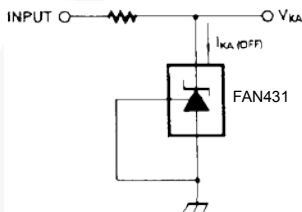


Figure 4. Test Circuit for  $I_{KA(OFF)}$

Typical Applications

$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{ref}$$

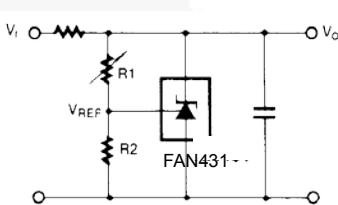


Figure 5. Shunt Regulator

$$V_O = V_{ref} \left(1 + \frac{R_1}{R_2}\right)$$

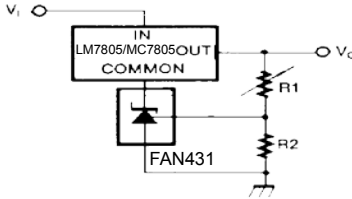


Figure 6. Output Control for Three-Terminal Fixed Regulator

$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{ref}$$

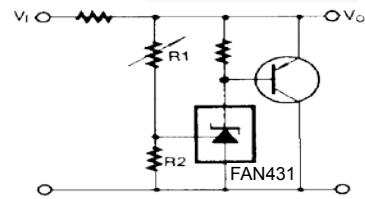


Figure 7. High-Current Shunt Regulator

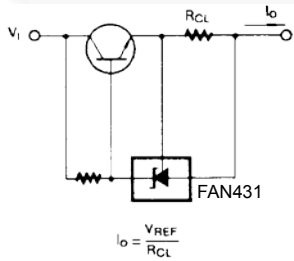


Figure 8. Current Limit or Current Source

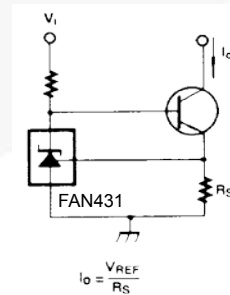


Figure 9. Constant-Current Sink

## Typical Performance Characteristics

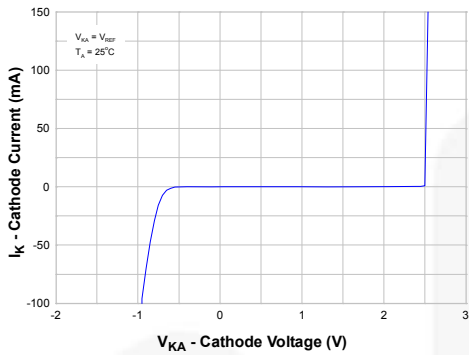


Figure 10. Cathode Current vs. Cathode Voltage

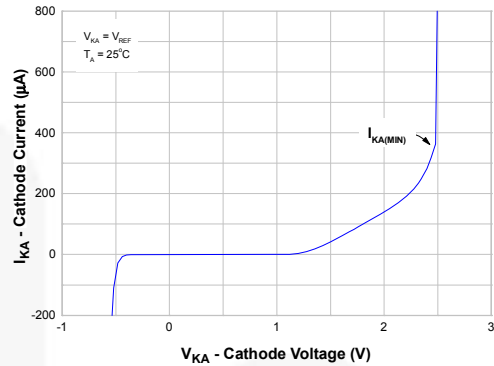


Figure 11. Cathode Current vs. Cathode Voltage

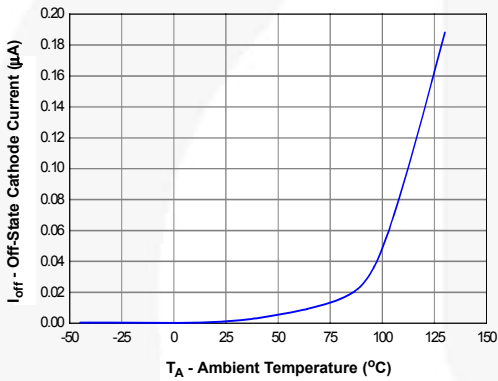


Figure 12. OFF-State Cathode Current vs. Ambient Temperature

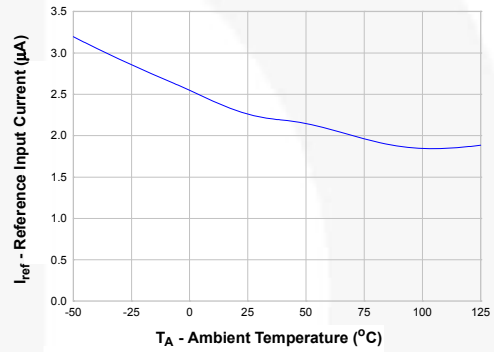


Figure 13. Reference Input Current vs. Ambient Temperature

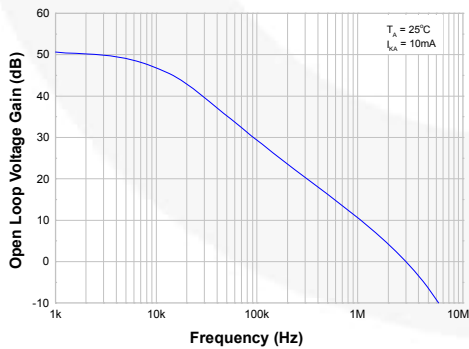


Figure 14. Frequency vs. Small Signal Voltage Amplification

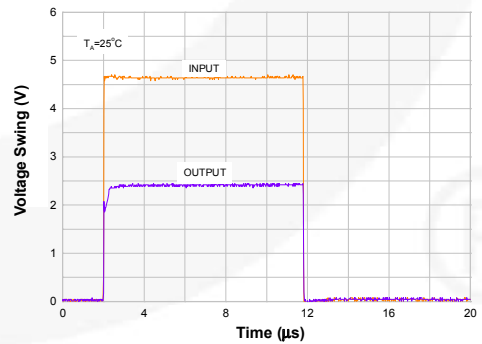


Figure 15. Pulse Response

Typical Performance Characteristics (Continued)

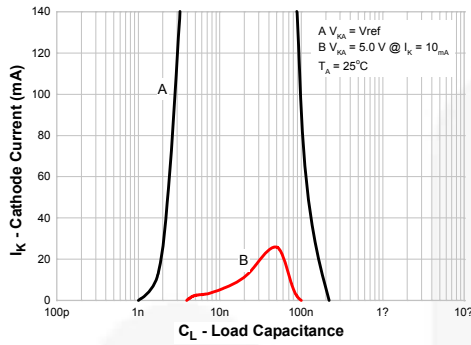


Figure 16. Stability Boundary Conditions

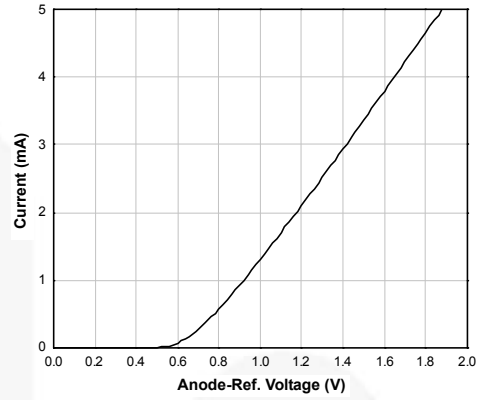


Figure 17. Anode-Reference Diode Curve

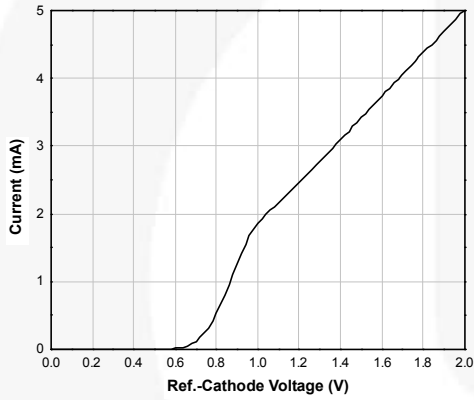


Figure 18. Reference-Cathode Diode Curve

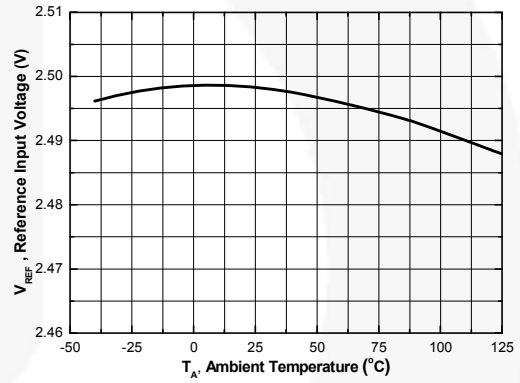


Figure 19. Reference Input Voltage vs. Ambient Temperature

Physical Dimensions

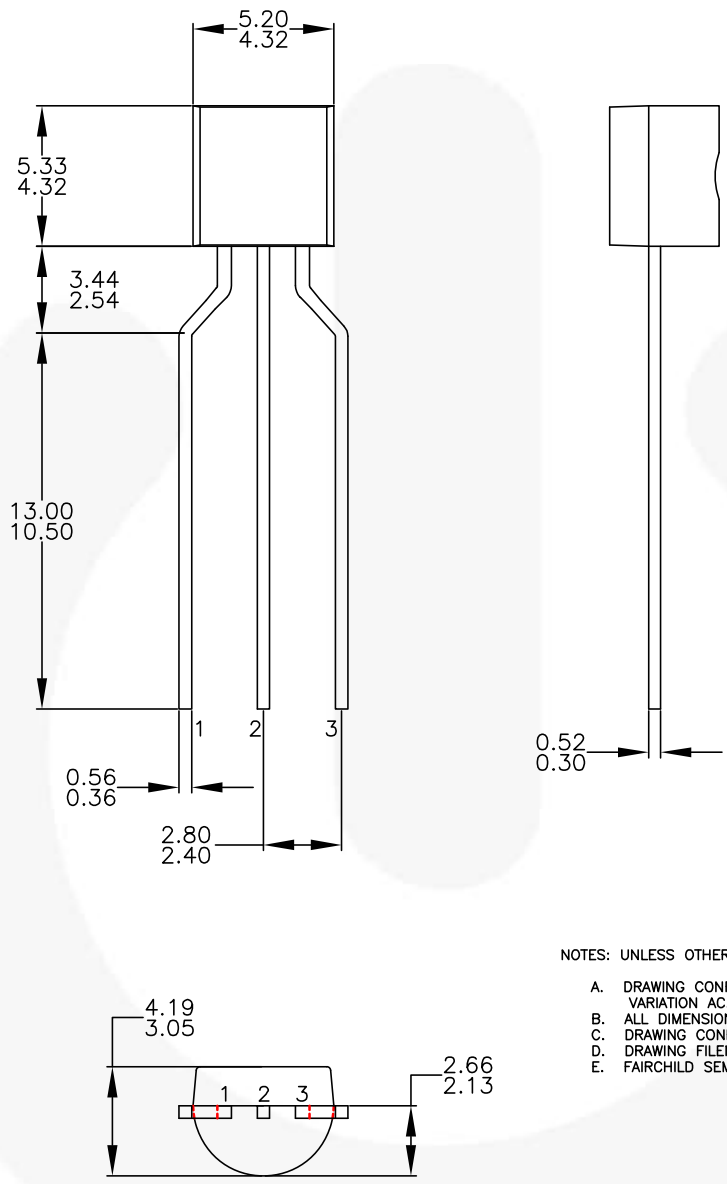


Figure 20. 3-Lead, TO-92, Molded, 0.200 in Line Spacing Lead Form






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