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March 2015

KA431S / KA431SA / KA431SL Programmable Shunt Regulator

Features

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

Description

The KA431S / KA431SA / KA431SL are three-terminal adjustable regulator series with a guaranteed thermal stability over the operating temperature range. The output voltage can be set to any value between V_{REF} (approximately 2.5 V) and 36 V with two external resistors. These devices have a typical dynamic output impedance of 0.2 Ω. Active output circuitry provides a sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications.

SOT-23F

MF- 1.Cathode 2. Ref 3. Anode
MF2- 1. Ref 2. Cathode 3. Anode

Ordering Information

Part Number	Operating Temperature Range	Output Voltage Tolerance	Top Mark	Package	Packing Method
KA431SMFTF	-25 to +85°C	2%	43A	SOT-23F 3L	Tape and Reel
KA431SMF2TF			43D		
KA431SAMFTF		1%	43B		
KA431SAMF2TF			43E		
KA431SLMFTF		0.5%	43C		
KA431SLMF2TF			43F		

Block Diagram

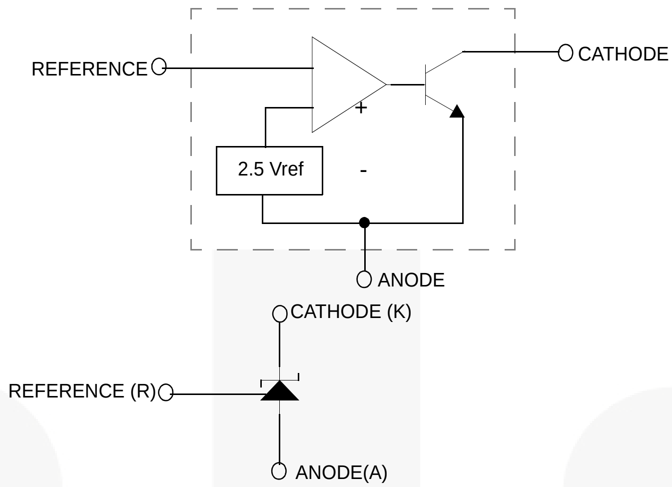


Figure 1. Block Diagram

Marking Information

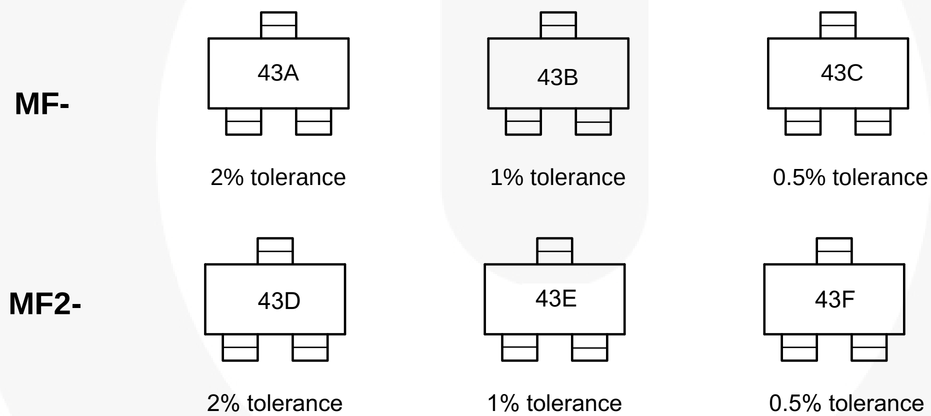


Figure 2. Top Mark (per package)

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°C unless otherwise noted.

Symbol	Parameter	Value	Unit
V_{KA}	Cathode Voltage	37	V
I_{KA}	Cathode Current Range (Continuous)	-100 ~ +150	mA
I_{REF}	Reference Input Current Range	-0.05 ~ +10	mA
$R_{\theta JA}$	Thermal Resistance Junction-Air[1,2] MF Suffix Package	350	°C/W
P_D	Power Dissipation[3,4] MF Suffix Package	350	mW
T_J	Junction Temperature	150	°C
T_{OPR}	Operating Temperature Range	-25 ~ +85	°C
T_{STG}	Storage Temperature Range	-65 ~ +150	°C

Notes:

1. Thermal resistance test board
   Size: 1.6mm x 76.2mm x 114.3mm (1S0P)
   JEDEC Standard: JESD51-3, JESD51-7.
2. Assume no ambient airflow.
3. T_{JMAX} = 150°C; Ratings apply to ambient temperature at 25°C.
4. 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	100	mA

Electrical Characteristics(5)

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Conditions		KA431S			KA431SA			KA431SL			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{REF}	Reference Input Voltage	$V_{KA} = V_{REF}$, I_{KA} = 10 mA		2.450	2.500	2.550	2.470	2.495	2.520	2.482	2.495	2.508	V
$\Delta V_{REF}/\Delta T$	Deviation of Reference Input Voltage Over-Temperature	$V_{KA} = V_{REF}$, I_{KA} = 10 mA, $T_{MIN} \le T_A \le T_{MAX}$			4.5	17.0		4.5	17.0		4.5	17.0	mV
$\Delta V_{REF}/\Delta V_{KA}$	Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	I_{KA} = 10 mA	ΔV_{KA} = 10 V - V_{REF}		-1.0	-2.7		-1.0	-2.7		-1.0	-2.7	mV/V
			ΔV_{KA} = 36 V - 10 V		-0.5	-2.0		-0.5	-2.0		-0.5	-2.0	
I_{REF}	Reference Input Current	I_{KA} = 10 mA, R1 = 10 kΩ, R2 = ∞			1.5	4.0		1.5	4.0		1.5	4.0	µA
$\Delta I_{REF}/\Delta T$	Deviation of Reference Input Current Over Full Temperature Range	I_{KA} = 10 mA, R1 = 10 kΩ, R2 = ∞ T_A = Full Range			0.4	1.2		0.4	1.2		0.4	1.2	µA
$I_{KA(MIN)}$	Minimum Cathode Current for Regulation	$V_{KA} = V_{REF}$			0.45	1.00		0.45	1.00		0.45	1.00	mA
$I_{KA(OFF)}$	Off - Stage Cathode Current	V_{KA} = 36 V, V_{REF} = 0			0.05	1.00		0.05	1.00		0.05	1.00	µA
Z_{KA}	Dynamic Impedance	$V_{KA} = V_{REF}$, I_{KA} = 1 to 100 mA, f ≥ 1.0 kHz			0.15	0.50		0.15	0.50		0.15	0.50	Ω

Note:

5. T_{MIN} = -25°C, T_{MAX} = +85°C

Test Circuits

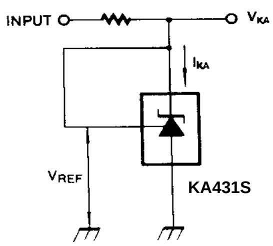


Figure 3. Test Circuit for $V_{KA} = V_{REF}$

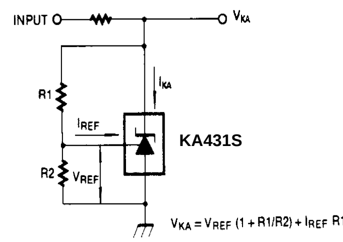


Figure 4. Test Circuit for $V_{KA} \geq V_{REF}$

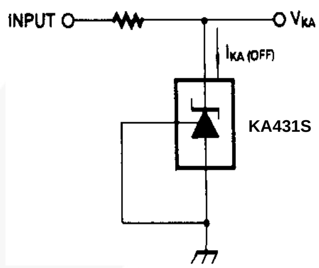


Figure 5. Test Circuit for $I_{KA(OFF)}$

Typical Applications

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

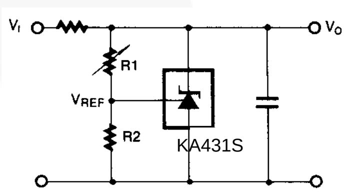


Figure 6. Shunt Regulator

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

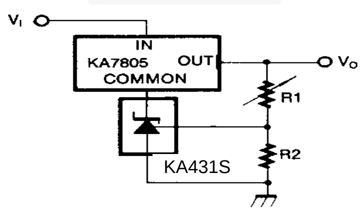


Figure 7. Output Control for Three-Terminal Fixed Regulator

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

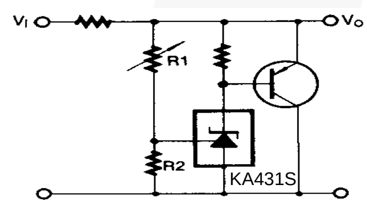


Figure 8. High Current Shunt Regulator

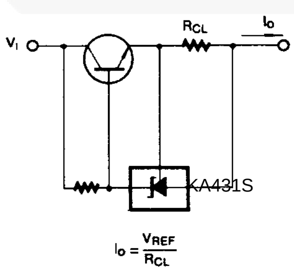


Figure 9. Current Limit or Current Source

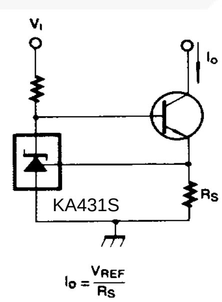


Figure 10. Constant-Current Sink

Typical Performance Characteristics

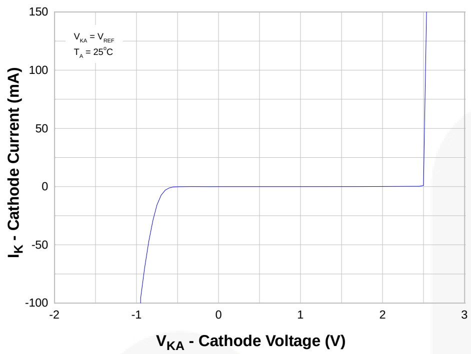


Figure 11. Cathode Current vs. Cathode Voltage

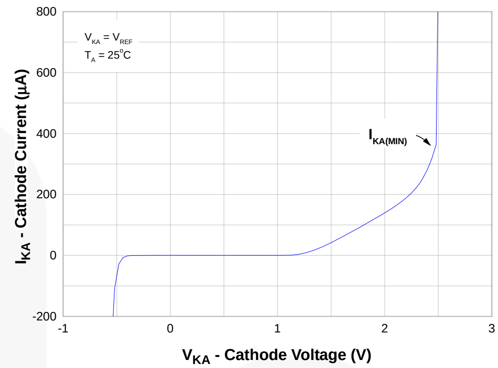


Figure 12. Cathode Current vs. Cathode Voltage

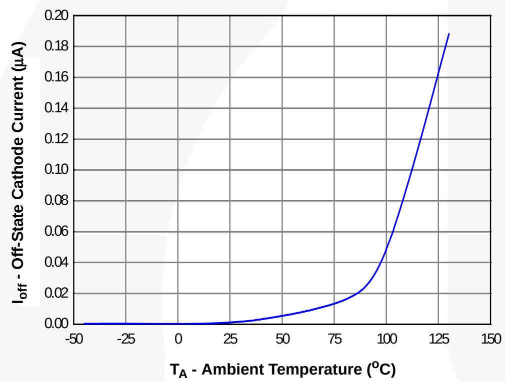


Figure 13. OFF-State Cathode Current vs. Ambient Temperature

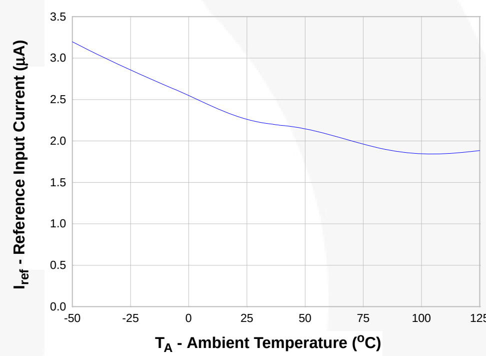


Figure 14. Reference Input Current vs. Ambient Temperature

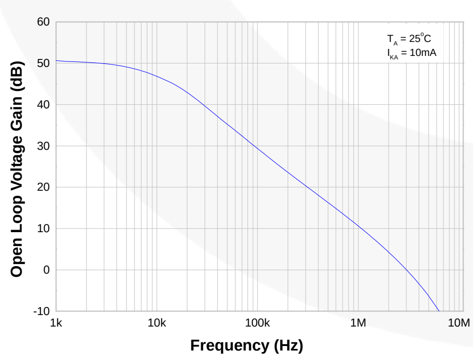


Figure 15. Frequency vs. Small Signal Voltage Amplification

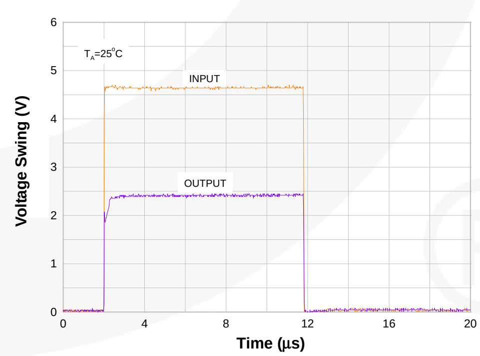


Figure 16. Pulse Response

Typical Performance Characteristics (Continued)

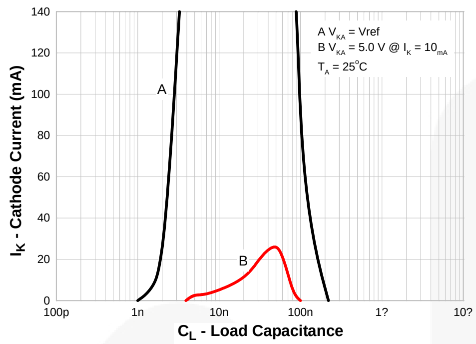


Figure 17. Stability Boundary Conditions

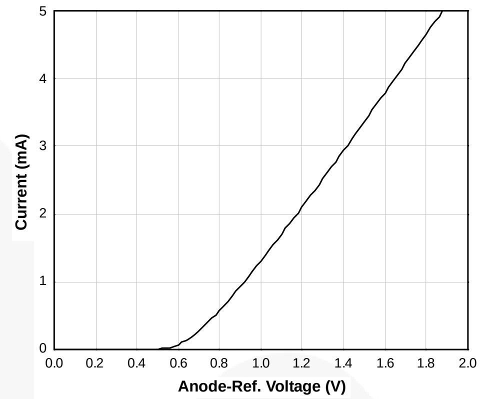


Figure 18. Anode-Reference Diode Curve

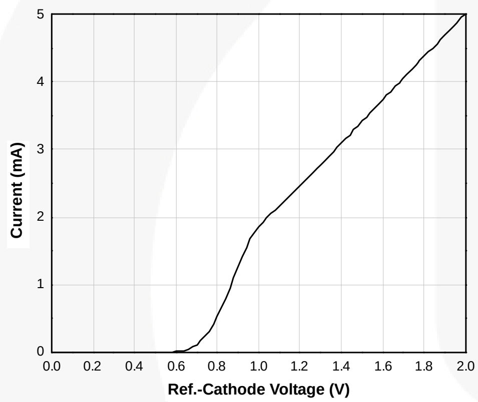


Figure 19. Reference-Cathode Diode Curve

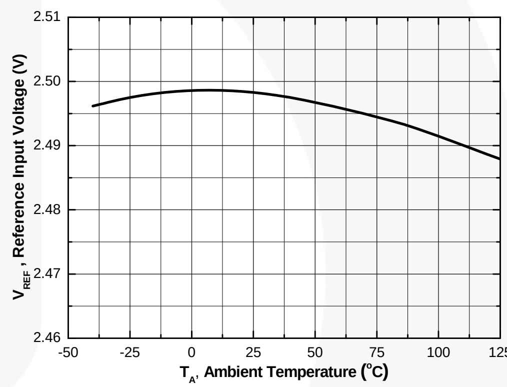
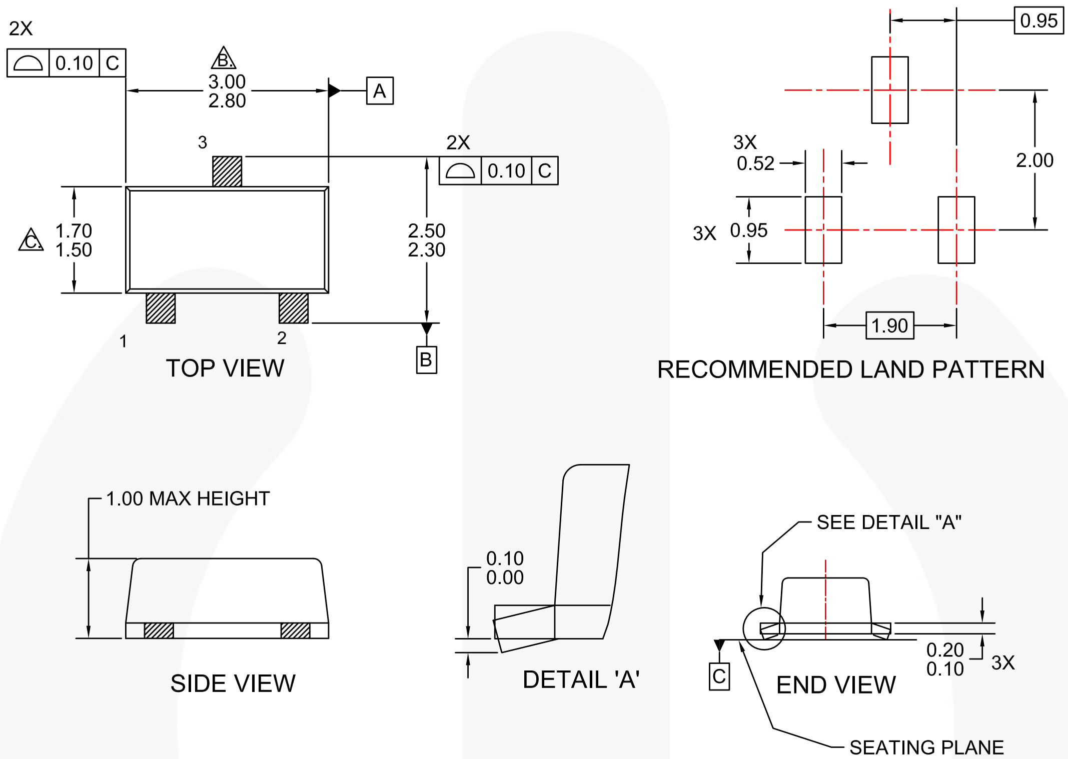
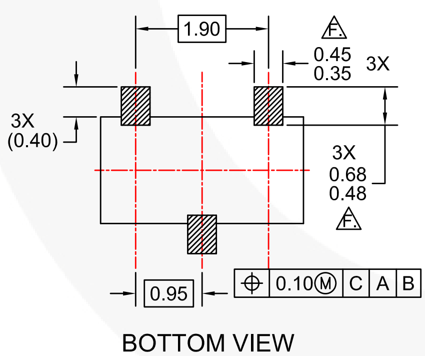


Figure 20. Reference Input Voltage vs. Ambient Temperature

Physical Dimensions





NOTES:

A. ALL DIMENSIONS ARE IN MILLIMETERS.

B. DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15mm PER END.

C. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.15mm PER SIDE.

D. DIMENSIONS B AND C ARE DETERMINED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH. BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.

E. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.

F. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08mm AND 0.15mm FROM THE LEAD TIP.

G. LANDPATTERN RECOMMENDATION PER IPC SOTFL95P240X100-4N (ADAPTED TO 3LD)

H. DRAWING FILE NUMBER AND REVISION: MKT-MA03EREV1.DWG

Figure 21. 3-LEAD, SOT23, FLAT LEAD, LOW PROFILE

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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