

Programmable Shunt Regulator

KA431A, KA431L

Description

The KA431A and KA431L are three-terminal adjustable regulators 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 0.2Ω . Active output circuitry provides a sharp turn-on characteristic, making these devices excellent replacements for Zener diodes in many applications.

Features

- Programmable Output Voltage to 36 V
- Low Dynamic Output Impedance: 0.2Ω (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

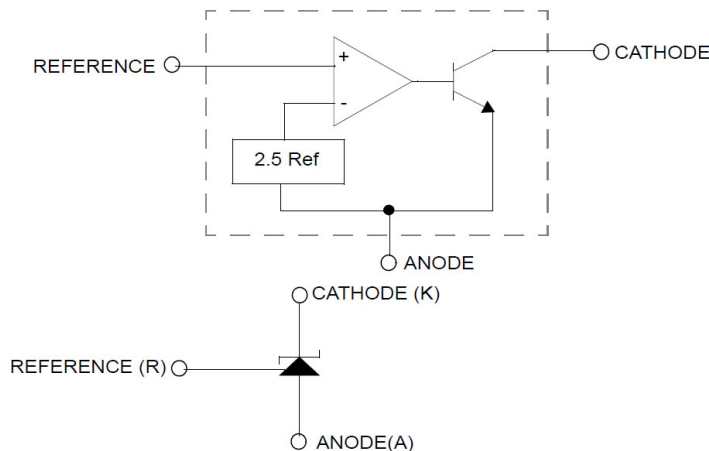
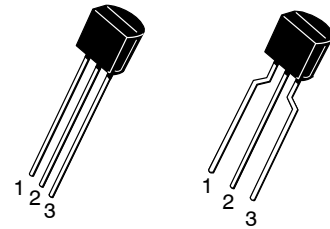


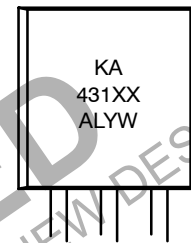
Figure 1. Block Diagram



TO-92
CASE 135AN

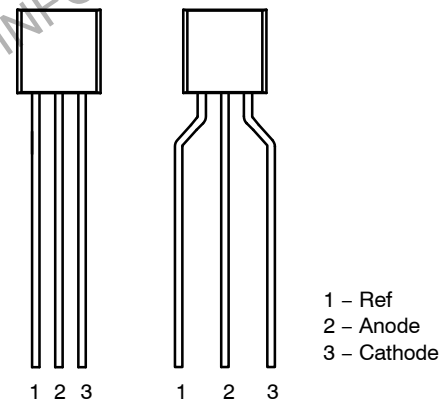
TO-92
CASE 135AR

MARKING DIAGRAM



KA431XX = Specific Device Code
A = Assembly Location
L = Wafer Lot
YW = Assembly Start Week

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

KA431A, KA431L

ABSOLUTE MAXIMUM RATINGS

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	mA
P_D	Power Dissipation	770	mW
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	160	°C/W
T_{OPR}	Operating Temperature Range	-25 to +85	°C
T_J	Junction Temperature	150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{KA}	Cathode Voltage	V_{REF}	36	V
I_{KA}	Cathode Current	1	100	mA

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

ELECTRICAL CHARACTERISTICS (Values are at $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	KA431A			KA431L			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{REF}	Reference Input Voltage	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{ mA}$	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	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{ mA}$, $T_{MIN} \leq T_A \leq T_{MAX}$ (Note 1)	-	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	$I_{KA} = 10\text{ mA}$, $\Delta V_{KA} = 10\text{ V} - V_{REF}$	-	-1.0	-2.7	-	-1.0	-2.7	mV/V
		$\Delta V_{KA} = 36\text{ V} - 10\text{ V}$	-	-0.5	-2.0	-	-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	-	1.5	4.0	μA
$\Delta I_{REF}/\Delta T$	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	-	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	mA
$I_{KA(OFF)}$	Off - Stage Cathode Current	$V_{KA} = 36\text{ V}$, $V_{REF} = 0$	-	0.05	1.00	-	0.05	1.00	μA
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	-	0.15	0.50	Ω

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

KA431A, KA431L

TEST CIRCUIT

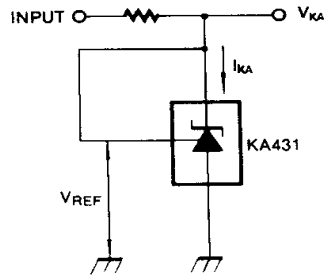


Figure 2. Test Circuit for $V_{KA} = V_{REF}$

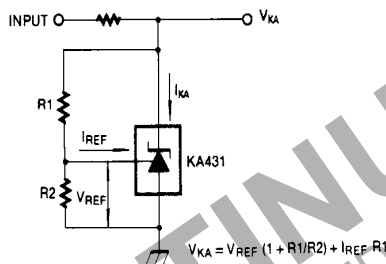


Figure 3. Test Circuit for $V_{KA} \geq V_{REF}$

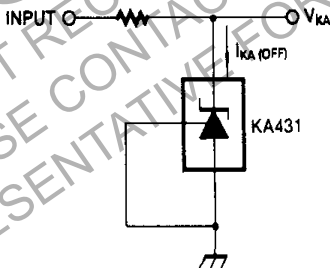


Figure 4. Test Circuit for $I_{KA(OFF)}$

TYPICAL PERFORMANCE CHARACTERISTICS

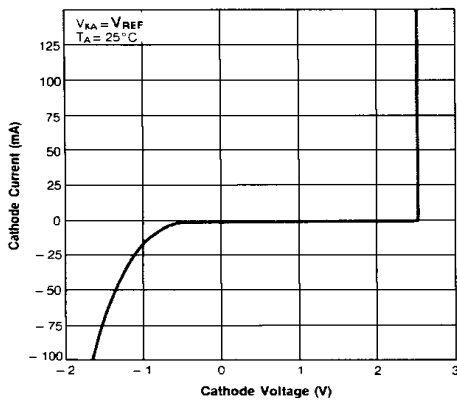


Figure 5. Cathode Current vs. Cathode Voltage

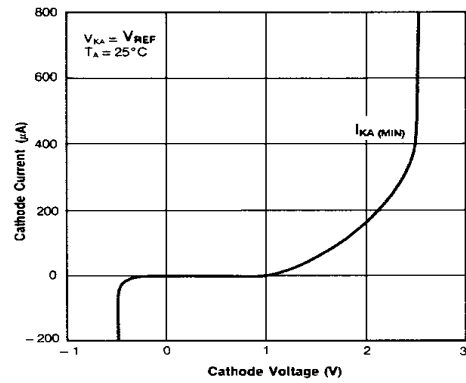


Figure 6. Cathode Current vs. Cathode Voltage

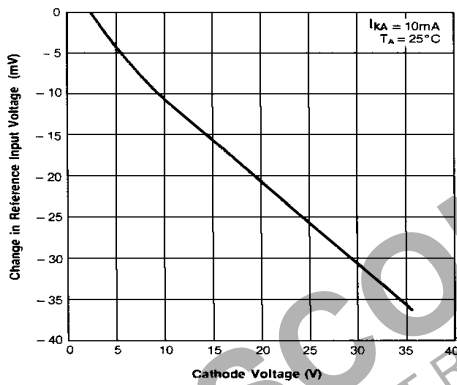


Figure 7. Change in Reference Input Voltage vs. Cathode Voltage

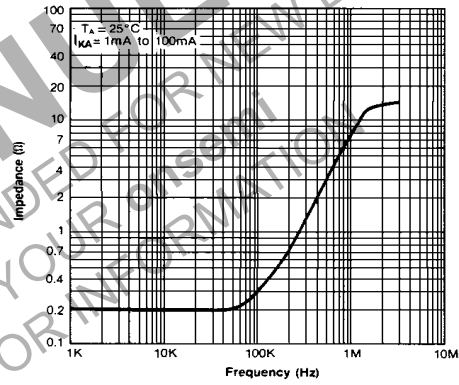


Figure 8. Dynamic Impedance Frequency

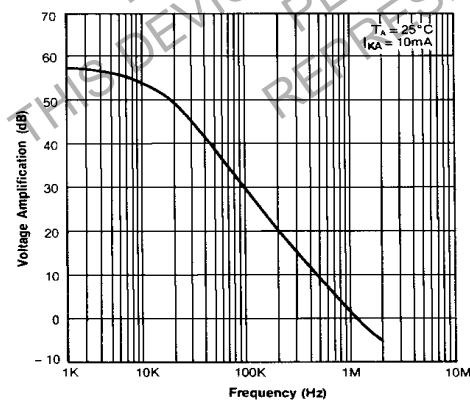


Figure 9. Small Signal Voltage Amplification vs. Frequency

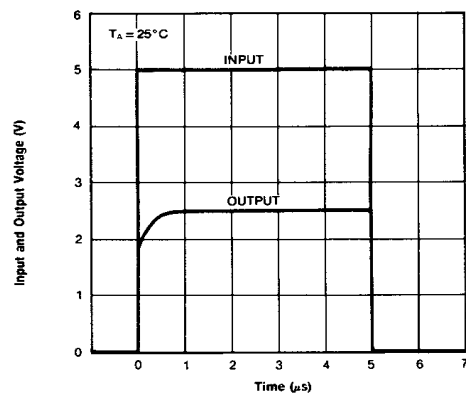


Figure 10. Pulse Response

KA431A, KA431L

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

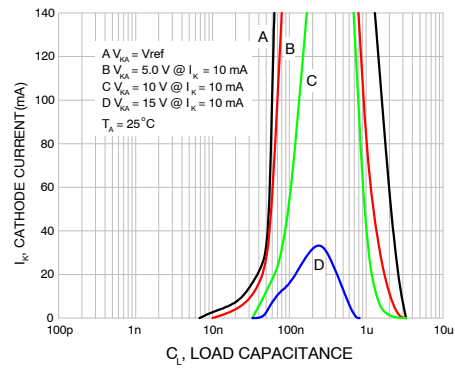


Figure 11. Stability Boundary Conditions

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KA431A, KA431L

TYPICAL APPLICATION

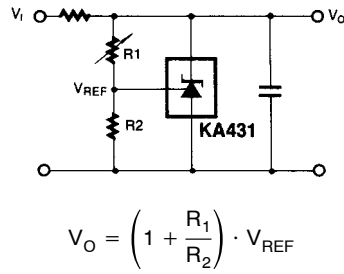


Figure 12. Shunt Regulator

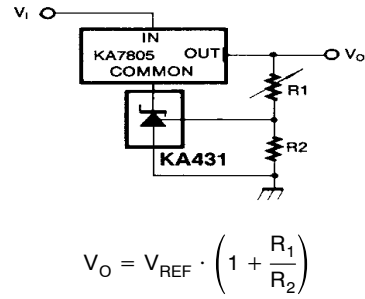


Figure 13. Output Control for Three-Terminal Fixed Regulator

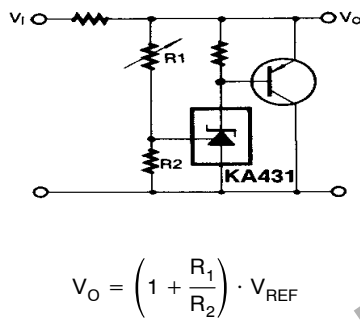


Figure 14. High-Current Shunt Regulator

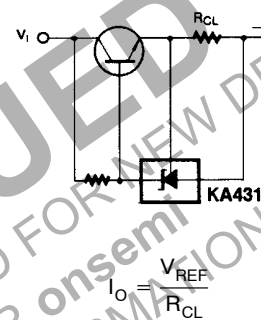


Figure 15. Current Limit or Current Source

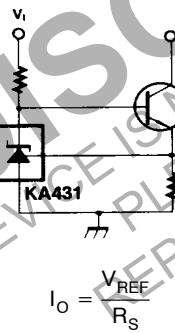


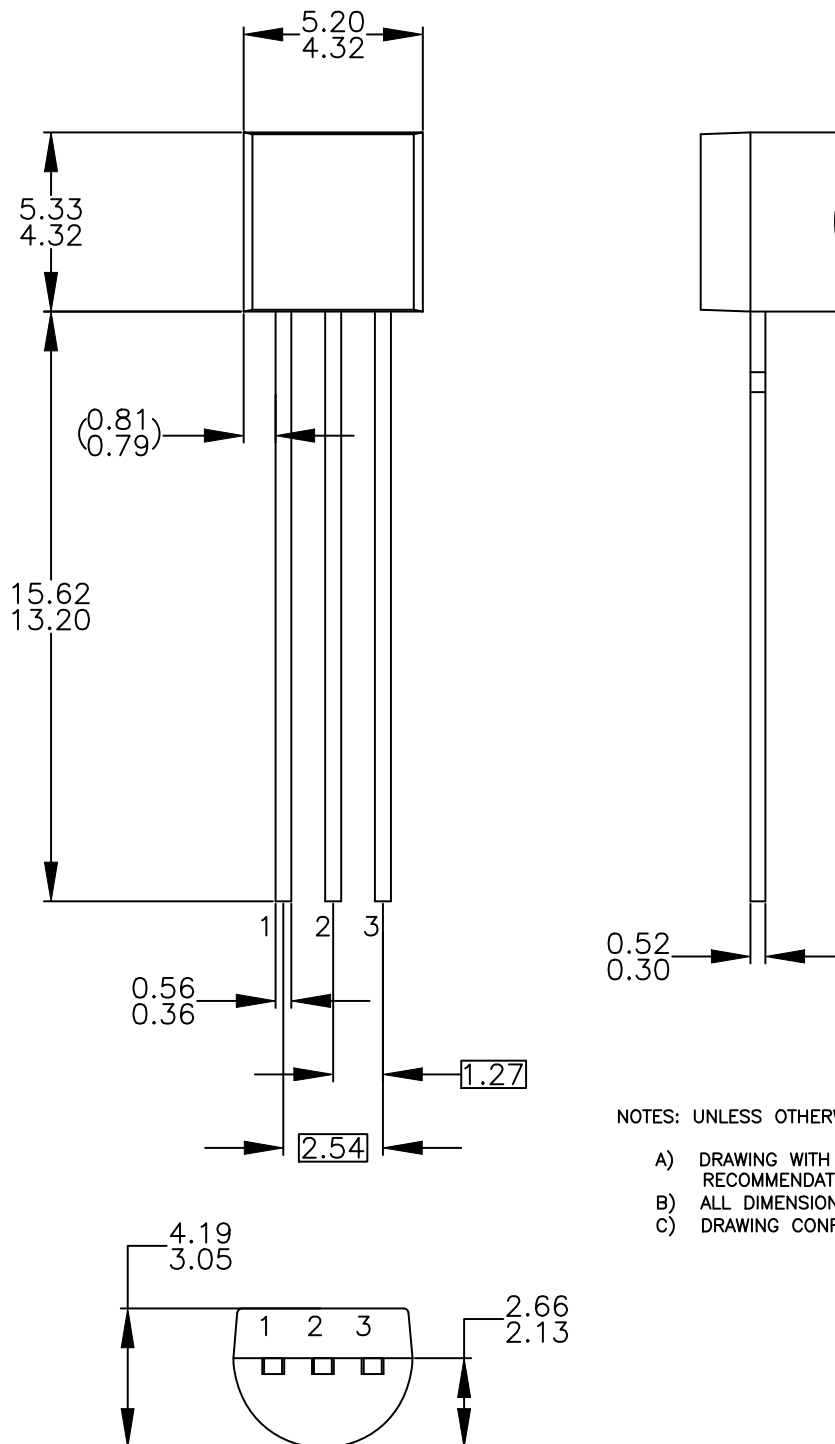
Figure 16. Constant-Current Sink

ORDERING INFORMATION

Part Number	Operating Temperature Range	Output Voltage Tolerance	Tom Mark	Package	Packing Method
KA431AZBU	-25 ~ +85°C	1%	KA431AZ	TO-92	Bulk
KA431AZTA			KA431AZ	TO-92	Ammo
KA431LZTA		0.5%	KA431LZ	TO-92	Ammo

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CASE 135AN
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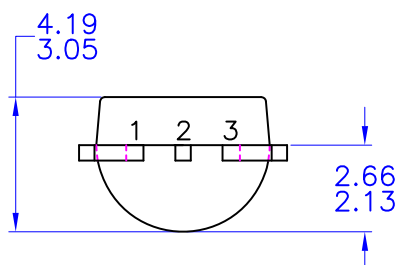
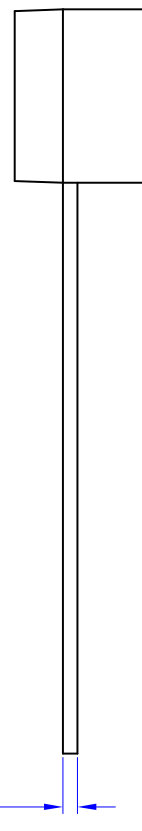
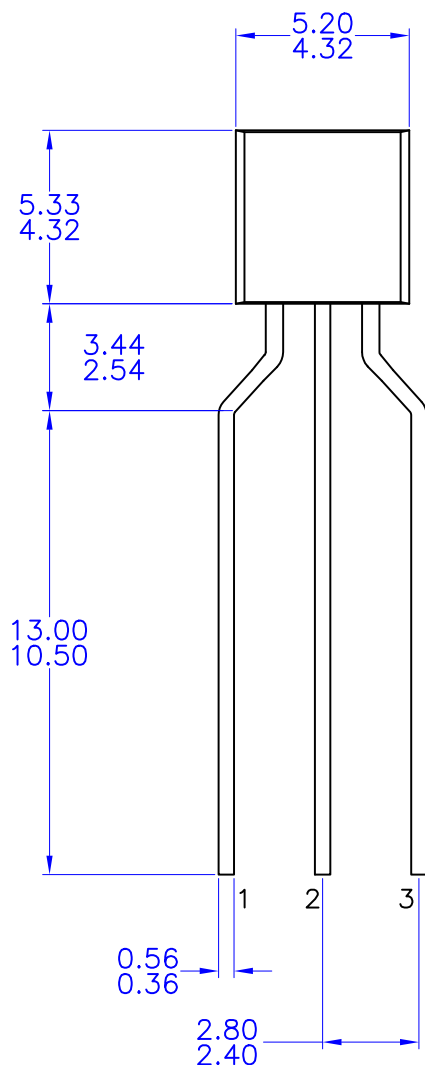
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