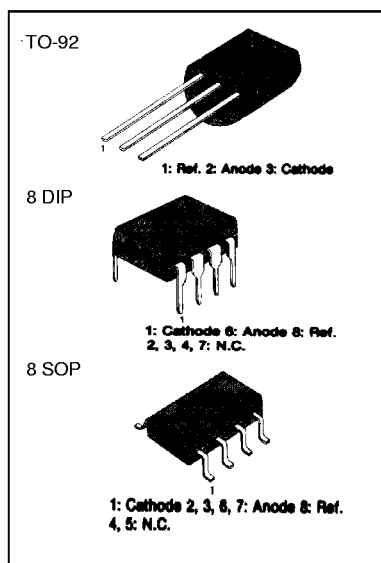


PROGRAMMABLE SHUNT REGULATOR

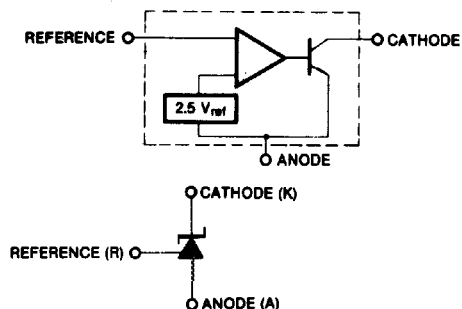
The TL431/A/L are three-terminal adjustable regulator series with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between V_{REF} (approximately 2.5 volts) and 36 volts with two external resistors. These devices have a typical dynamic output impedance of 0.2Ω . Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications.

FEATURES

- Programmable output voltage to 36 volts
- Low dynamic output impedance 0.20 typical
- Sink current capability of 1.0 to 100mA
- Equivalent full-range temperature coefficient of $50\text{ppm}/^\circ\text{C}$ typical
- Temperature compensated for operation over full rated operating temperature range
- Low output noise voltage
- Fast turn-on response



BLOCK DIAGRAM



ORDERING INFORMATION

Device	Operating Temperature	Package
TL431CLP	-25 ~ +85°C	TO-92
TL431N	-25 ~ +85°C	8 DIP
TL431M	-25 ~ +85°C	8 SOP
TL431ACL	-25 ~ +85°C	TO-92
TL431AM	-25 ~ +85°C	8 SOP
TL431LCLP	-25 ~ +85°C	TO-92

ABSOLUTE MAXIMUM RATINGS

(Operating temperature range applies unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Cathode Voltage	V_{KA}	37	V
Cathode current Range (Continuous)	I_{KA}	-100 ~ + 150	mA
Reference Input Current Range	I_{REF}	0.05 ~ + 10	mA
Power Dissipation D, Z Suffix Package	P_D	770	mW
N Suffix Package		1000	mW
Operating Temperature Range	T_{OPR}	-25 ~ + 85	°C
Storage Temperature Range	T_{STG}	-65 ~ + 150	°C

RECOMMENDED OPERATING CONDITIONS

Characteristic	Symbol	Min	Typ	Max	Unit
Cathode Voltage	V_{KA}	V_{REF}		36	V
Cathode Current	I_{KA}	1.0		100	mA

ELECTRICAL CHARACTERISTICS ($T_A = +25^\circ\text{C}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	TL431			TL431A			TL431L			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Reference Input Voltage	V _{REF}	V _{KA} =V _{REF} , I _{KA} =10mA	2.440	2.495	2.550	2.470	2.495	2.520	2.482	2.495	2.508	V
Deviation of Reference Input Voltage Over-Temperature (Note 1)	DV _{REF} /DT	V _{KA} =V _{REF} , I _{KA} =10mA T _{MIN} ≤T _A ≤T _{MAX}		4.5	17		4.5	17		4.5	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	DV _{REF} /DI _{KA}	I _{KA} = 10mA		- 10	- 2.7		- 1.0	- 2.7		- 1.0	- 2.7	mV/W
		DV _{KA} =36V-10V		-0.5	-2.0		-0.5	-2.0		-0.5	-2.0	
Reference Input Current	I _{REF}	I _{KA} =10mA, R ₁ =10KΩ, R ₂ =∞	1.5	4		1.5	4		1.5	4		μA
Deviation of Reference Input Current Over Full Temperature Range	DI _{REF} /DT	I _{KA} =10mA, R ₁ =10KΩ, R ₂ =∞ T _A =Full Range		0.4	1.2		0.4	1.2		0.4	1.2	μA
Minimum Cathode Current for Regulation	I _{KA(MIN)}	V _{KA} =V _{REF}		0.45	1.0		0.45	1.0		0.45	1.0	mA
Off - Stage Cathode Current	I _{KA(OFF)}	V _{KA} =36V, V _{REF} =0		0.05	1.0		0.05	1.0		0.05	1.0	μA
Dynamic Impedance (Note 2)	Z _{KA}	V _{KA} =V _{REF} , I _{KA} =1 to 100mA f 1.0KΩ	0.15	0.5		0.15	0.5		0.15	0.5		Ω

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

TEST CIRCUITS

Fig. 1 Test Circuit for $V_{KA}=V_{REF}$

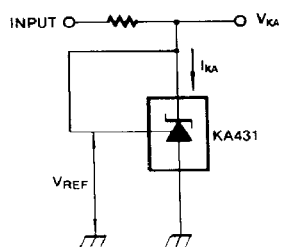


Fig. 2 Test Circuit for $V_{KA} \geq V_{REF}$

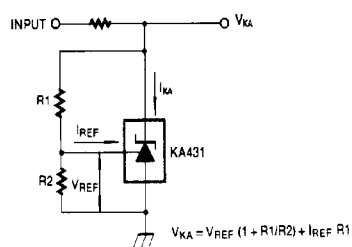
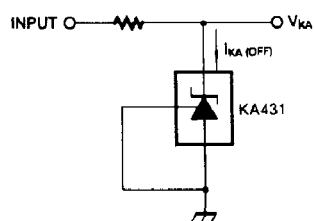


Fig. 3 Test Circuit for $I_{KA(OFF)}$



TYPICAL PERFORMANCE CHARACTERISTICS

Fig. 4 Cathode Current vs. Cathode Voltage

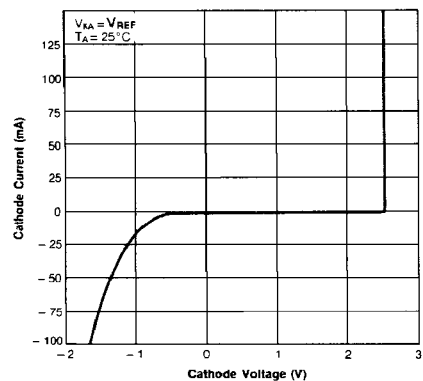


Fig. 5 Cathode Current vs. Cathode Voltage

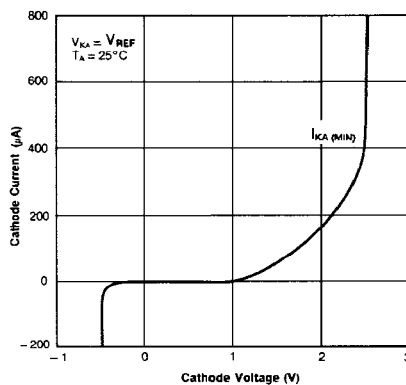


Fig. 6 Change in Reference Input Voltage vs. Cathode Voltage

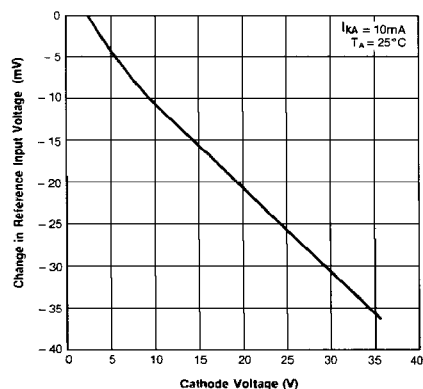


Fig. 7 Dynamic Impedance Frequency

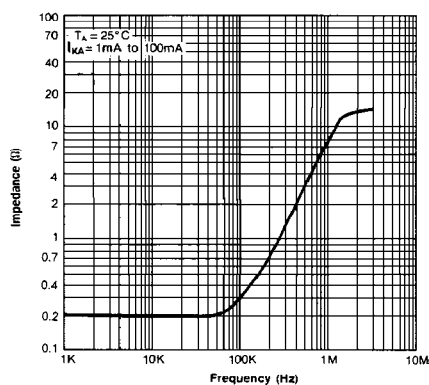


Fig. 8 Small Signal Voltage Amplification vs. Frequency

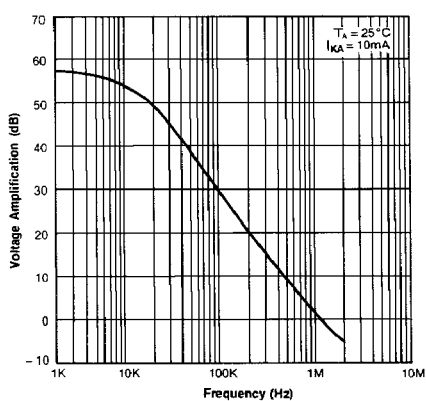
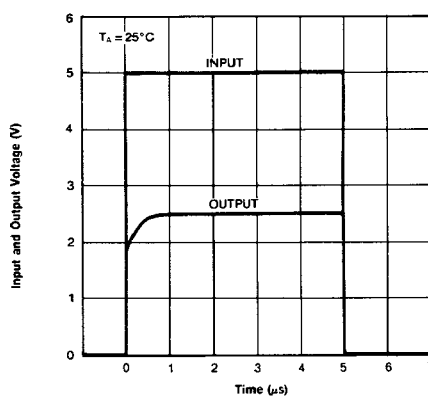


Fig. 9 Pulse Response



TL431/A/L (KA431)

PROGRAMMABLE SHUNT REGULATOR

TYPICAL APPLICATIONS

Fig. 10 Shunt Regulator

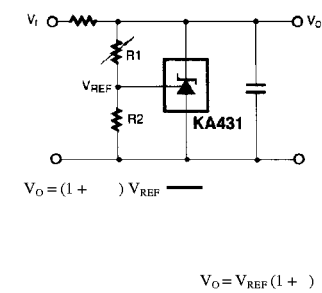


Fig.11 Output Control for a Three-Terminal Fixed Regulator

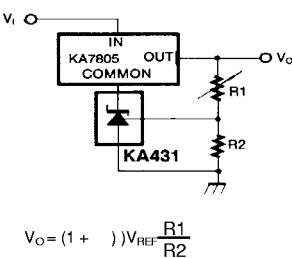


Fig-12 High Current Shunt Regulator

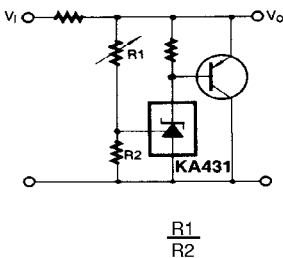


Fig. 13 Current Limit or Current Source

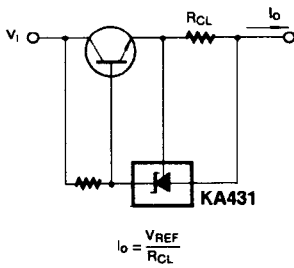
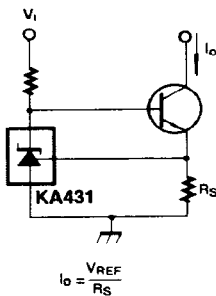


Fig. 14 Constant-Current Sink



R1
R2

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