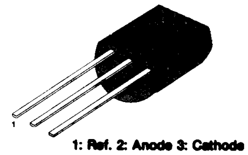
PROGRAMMABLE SHUNT REGULATOR

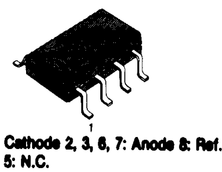
The LM431 Series are three-terminal adjustable regulator series with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between V_{REF} (approximately 2.5 volts) and 36 volts with two external resistors These devices have a typical dynamic output impedance of 0.2Ω Active output circuitry provides a very sharp turn-on characteristic, making these devices excel lent replacement for zener diodes in many applications.

·TO-92



8 DIP

8 SOP



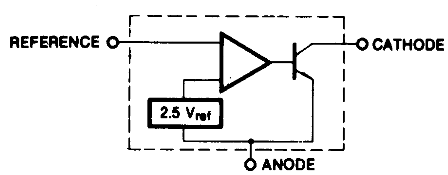
FEATURES

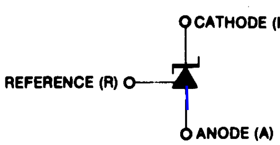
- Programmable output voltage to 36 volts
- Low dynamic output impedance 0.20 typical
- Sink currant capability of 1.0 to 100mA
- Equivalent full-range temperature coefficient of 50ppm/°C typical
- Temperature compensated for operation over full rated operating temperature range
- Low output noise voltage
- Fast turn-on response

ORDERING INFORMATION

Device	Operating Temperature	Package
LM431ACZ (TL431CLP) (KA431Z)	-25 ~ + 85 °C	TO-92
TL431CP (KA431)	-25 ~ + 85 °C	8 DIP
LM431ACM (TL431CD) (KA431D)	-25 ~ + 85 °C	8 SOP
LM431BCZ (TL431ACLP) (KA431AZ)	-25 ~ + 85 °C	TO-92
LM431BCM (TL431ACD) (KA431AD)	-25 ~ + 85 °C	8 SOP
LM431CCZ (KA431LZ)	-25 ~ + 85 °C	TO-92

BLOCK DIAGRAM





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 N Suffix Package	P_D	 770 1000	 mW 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 °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, DV_{KA}=10V-V_{REF}		- 10	- 2.7		- 1.0	- 2.7		- 1.0	- 2.7	mV/W
		I_{KA} =10mA, DV_{KA}=36V-10V		-0.5	-2.0		-0.5	-2.0		-0.5	-2.0	mV/W
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 °C, T_{MAX}= +85 °C

TEST CIRCUITS

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

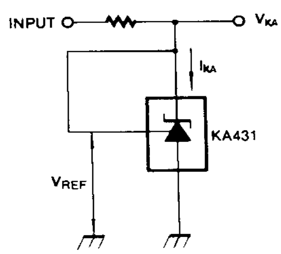


Fig. 2 Test Circuit for $V_{KA} \geq V_{REF}$

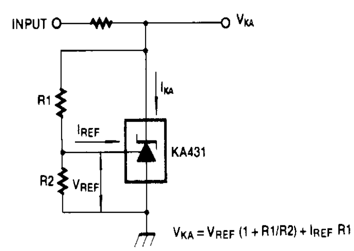
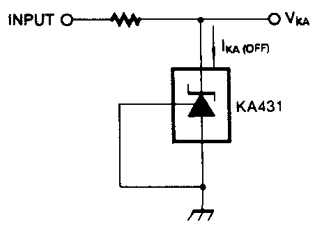


Fig. 3 Test Circuit for $I_{KA(OFF)}$



TYPICAL PERFORMANCE CHARACTERISTICS

Fig. 4 Cathode Current vs. Cathode Voltage

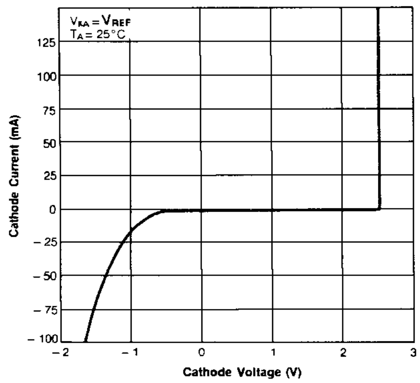


Fig. 5 Cathode Current vs. Cathode Voltage

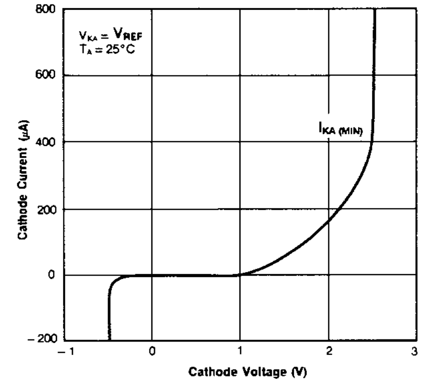


Fig. 6 Change In Reference Input Voltage vs. Cathode Voltage

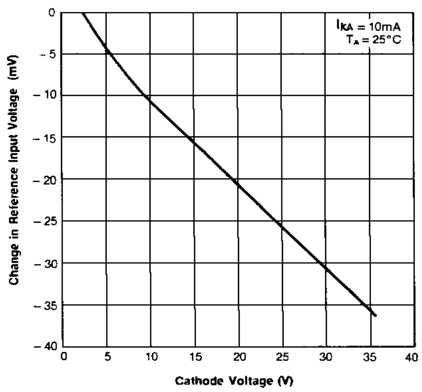


Fig. 7 Dynamic Impedance Frequency

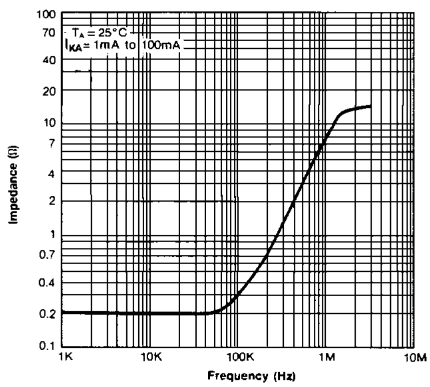


Fig. 8 Small Signal Voltage Amplification vs. Frequency

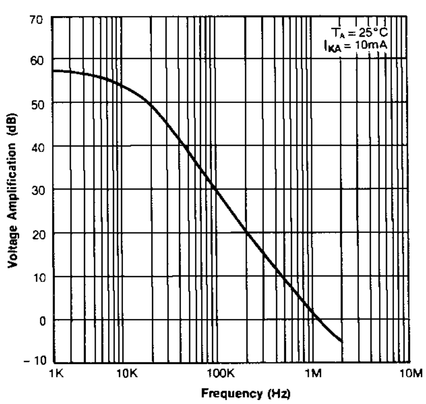
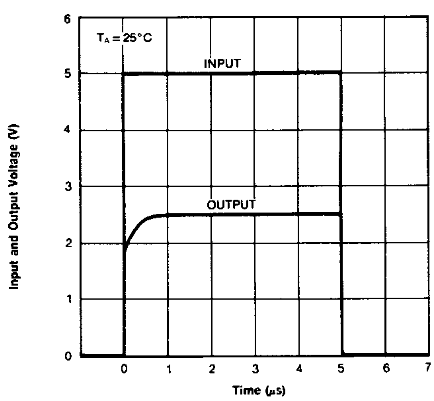
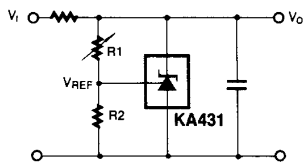


Fig. 9 Pulse Response



TYPICAL APPLICATIONS

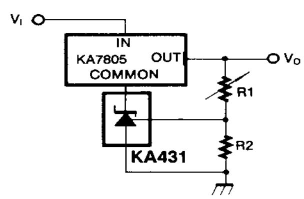
Fig. 10 Shunt Regulator



$V_O = (1 + \quad) V_{REF}$

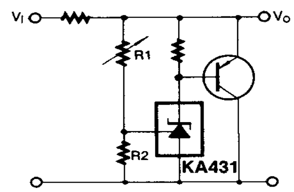
$V_O = V_{REF} (1 + \quad)$

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



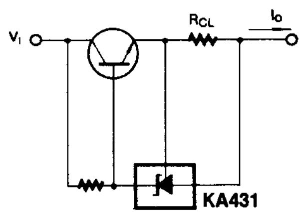
$V_O = (1 + \quad))V_{REF} \frac{R1}{R2}$

Fig.12 High Current Shunt Regulator



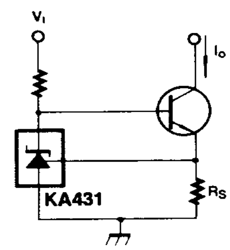
$\frac{R1}{R2}$

Fig. 13 Current Limit or Current Source



$I_O = \frac{V_{REF}}{R_{CL}}$

Fig. 14 Constant-Current Sink



$I_O = \frac{V_{REF}}{R_S}$

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