

TL431/TL431A

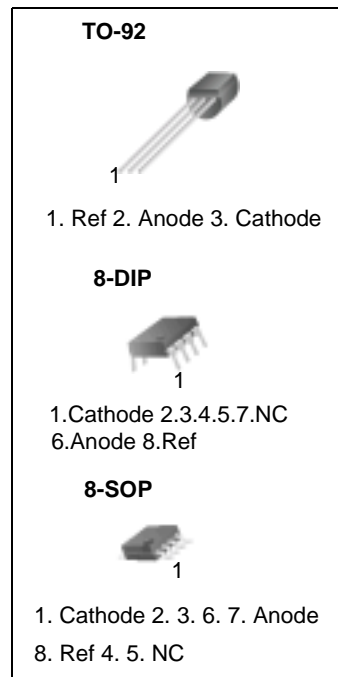
Programmable Shunt Regulator

Features

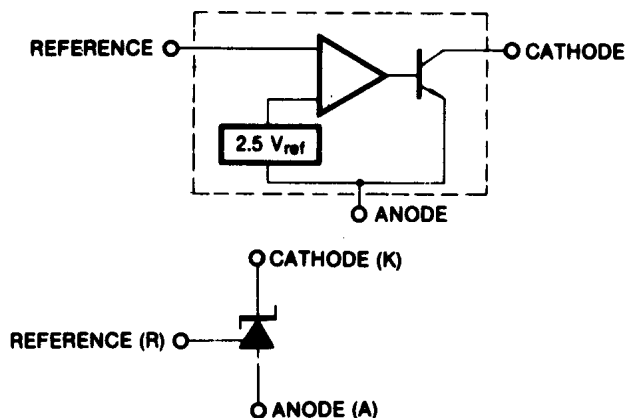
- Programmable Output Voltage to 36 Volts
- Low Dynamic Output Impedance 0.20 Typical
- Sink Current Capability of 1.0 to 100mA
- Equivalent Full-Range Temperature Coefficient of 50ppm/°C Typical
- Temperature Compensated For Operation Over Full Rated Operating Temperature Range
- Low Output Noise Voltage
- Fast Turn-on Response

Description

The TL431/TL431A 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 0.2W. Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications.



Internal Block Diagram



Absolute Maximum Ratings

(Operating temperature range applies unless otherwise specified.)

Parameter	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, LP Suffix Package P Suffix Package	PD	770 1000	mW mW
Operating Temperature Range	TOPR	-25 ~ +85	°C
Storage Temperature Range	TSTG	-65 ~ +150	°C

Recommended Operating Conditions

Parameter	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)

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

- T_{MIN}= -25 °C, T_{MAX}= +85 °C

Test Circuits

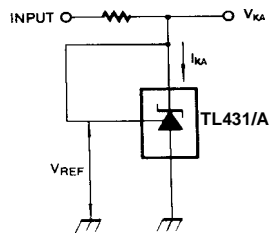


Figure 1. Test Circuit for $V_{KA} = V_{REF}$

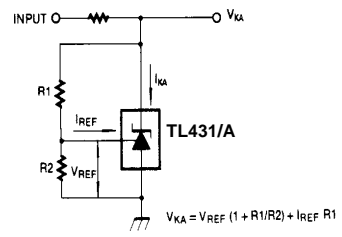


Figure 2. Test Circuit for $V_{KA} \geq V_{REF}$

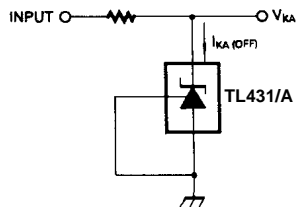


Figure 3. Test Circuit for $I_{KA(OFF)}$

Typical Performance Characteristics

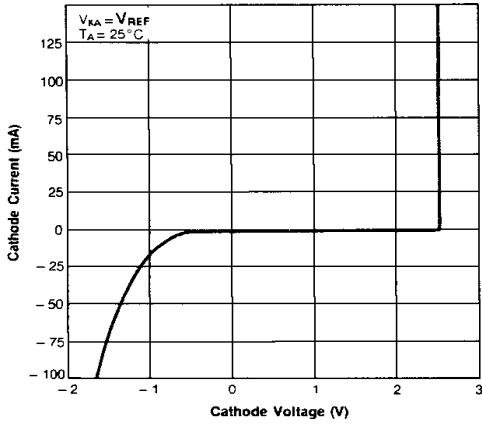


Figure 1. Cathode Current vs. Cathode Voltage

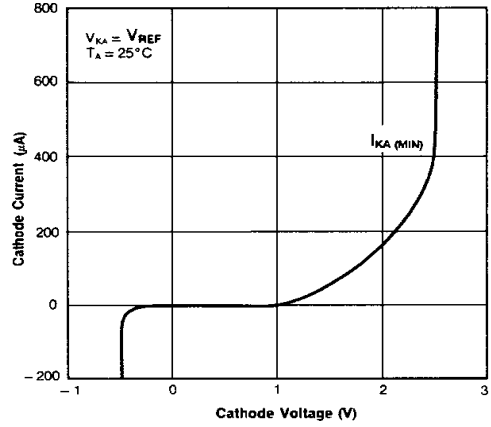


Figure 2. Cathode Current vs. Cathode Voltage

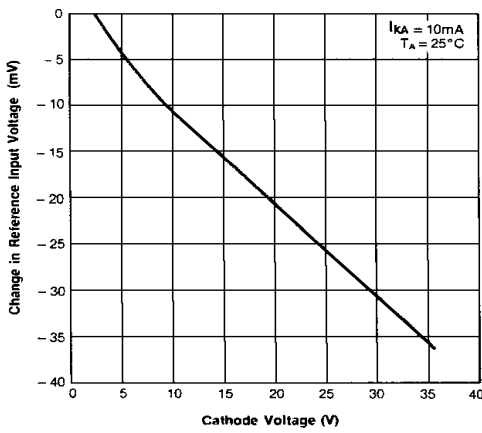


Figure 3. Change In Reference Input Voltage vs. Cathode Voltage

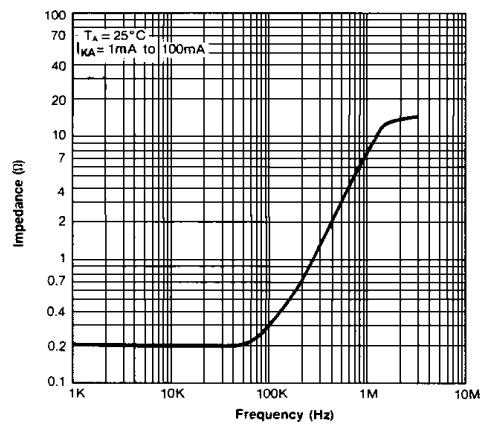


Figure 4. Dynamic Impedance Frequency

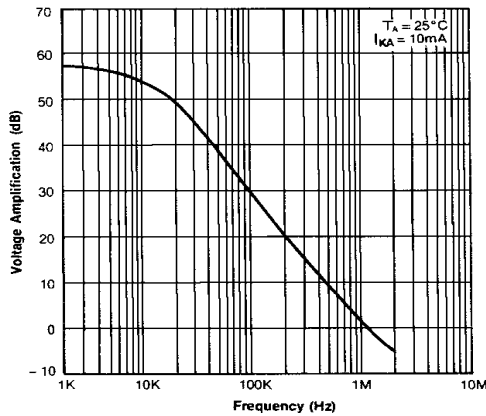


Figure 5. Small Signal Voltage Amplification vs. Frequency

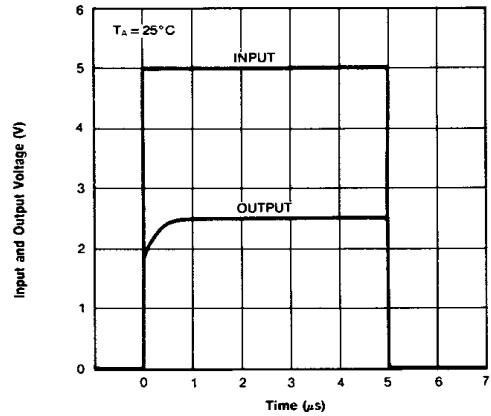


Figure 6. Pulse Response

Typical Application

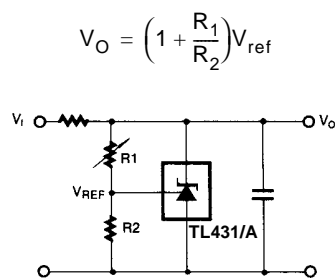


Figure 10. Shunt Regulator

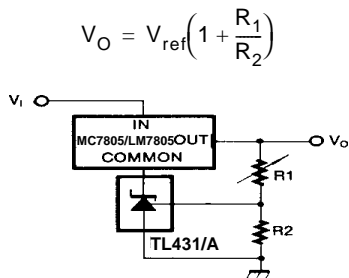


Figure 11. Output Control for Three-Termianl Fixed Regulator

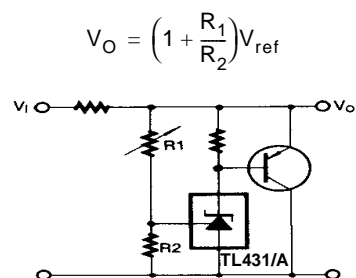


Figure 12. High Current Shunt Regulator

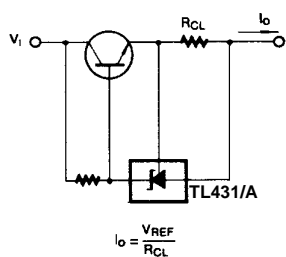


Figure 13. Current Limit or Current Source

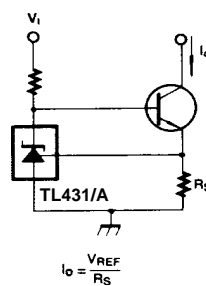
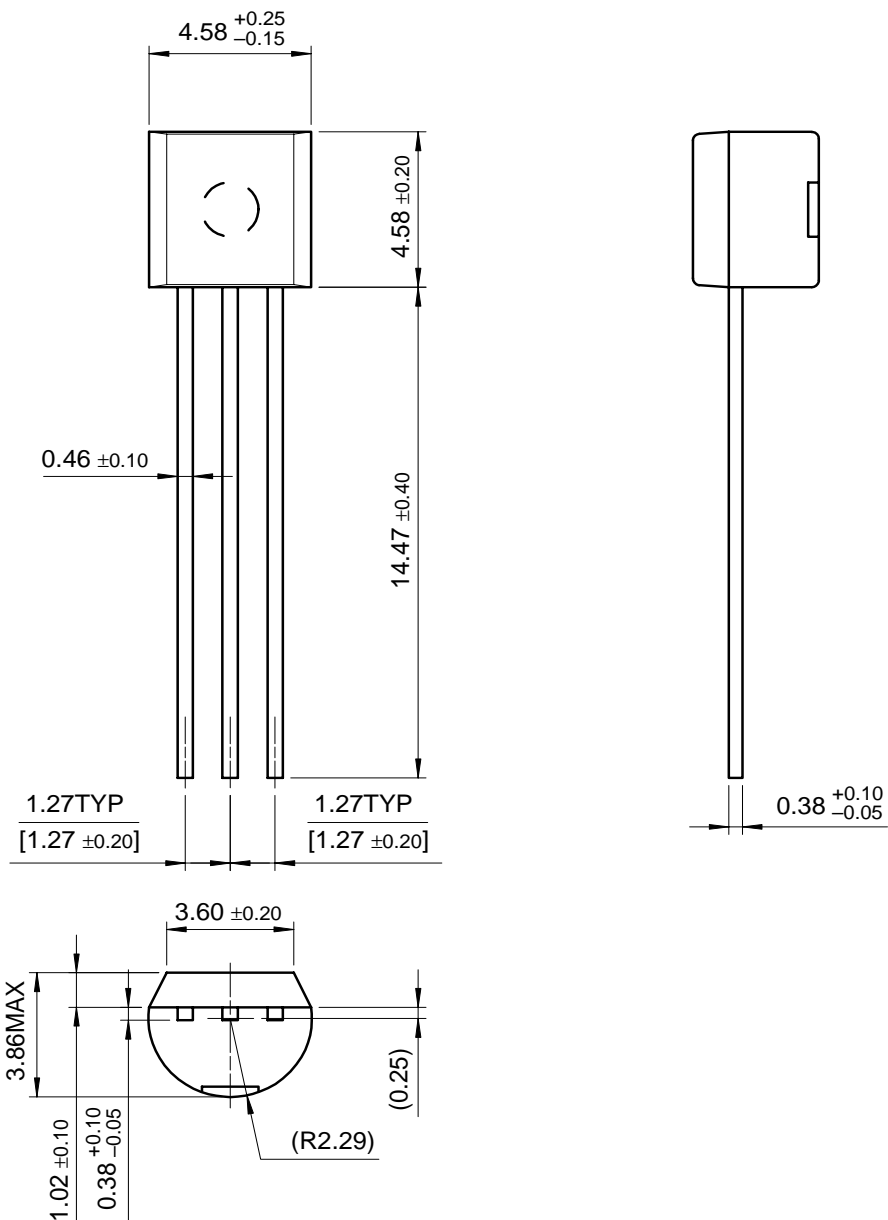


Figure 14. Constant-Current Sink

Mechanical Dimensions

Package

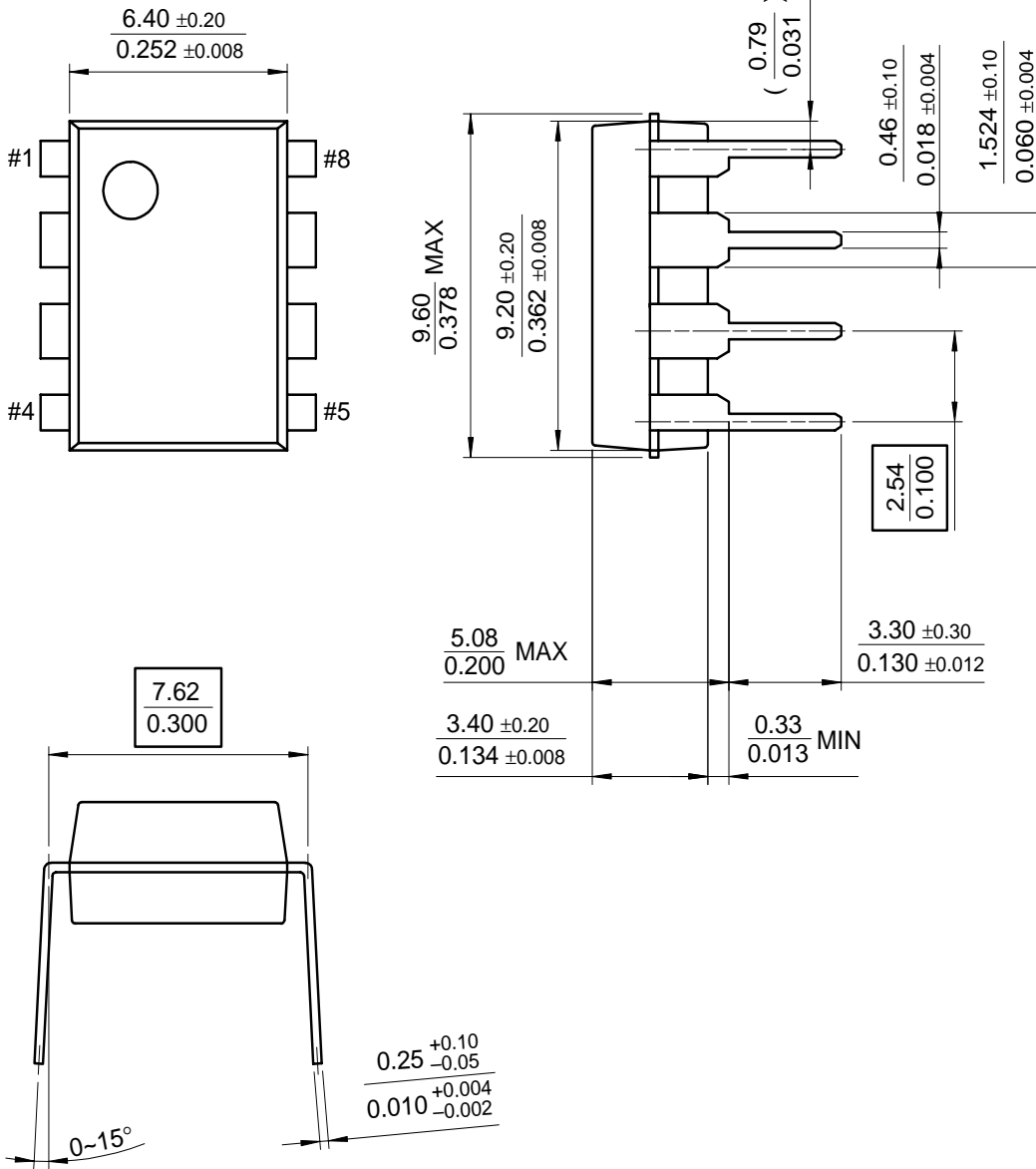
TO-92



Mechanical Dimensions (Continued)

Package

8-DIP



Ordering Information

Product Number	Output Voltage Tolerance	Package	Operating Temperature
TL431ACLP	1%	TO-92	-25 ~ + 85°C
TL431ACD		8-SOP	
TL431CLP	2%	TO-92	
TL431CP		8-DIP	
TL431CD		8-SOP	

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TL431A

Adjustable/2.5V, 1% Tolerance Shunt
Regulator

Contents

[General description](#) | [Features](#) | [Product
status/pricing/packaging](#) | [Application notes](#)

General description

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[back to top](#)

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[back to top](#)

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Product status/pricing/packaging

Product	Product status	Package type	Leads	Packing method
TL431ACZX	Full Production	TO-92	3	TAPE REEL
TL431ACZ	Full Production	TO-92	3	BULK
TL431ACD	Not recommended for new designs	SOIC	8	RAIL
TL431ACLP	Full Production	TO-92	3	BULK
TL431ACLPX	Full Production	TO-92	3	TAPE REEL

[back to top](#)

Application notes

[AN-9018-3: AN-9018-3 \(Part 3 of 3\) Smart Power Module User's Guide](#)

(544 K) Jul 19, 2002

[AN-9019: AN-9019 Motor Drive System Using SPM Inverter](#) (260 K) Jul

19, 2002

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