FAIRCHILD SEMICONDUCTOR®

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LM431A/LM431B/LM431C

Programmable Shunt Regulator

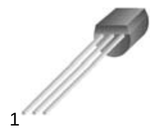
Features

- Programmable Output Voltage to 36 Volts
- Low Dynamic Output Impedance 0.2Ω 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

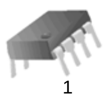
The LM431A/LM431B/LM431C are three terminal output adjustable regulators with thermal stability over operating temperature range. The output voltage can be set any value between V_{REF} (approximately 2.5 volts) and 36 volts with two external resistors. These devices have a typical dynamic output impedance of 0.2Ω. Active output circuit provides a sharp turn-on characteristic, making these devices excellent replacement for Zener Diodes in many applications.

TO-92



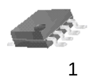
1. Ref 2. Anode 3. Cathode

8-DIP



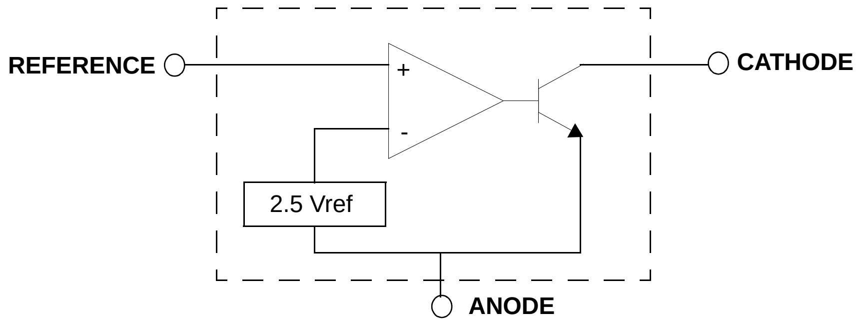
1.Cathode 2.3.4.5.7.NC
6.Anode 8.Ref

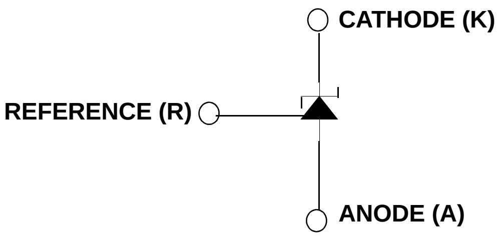
8-SOP



1.Cathode 2.3.6.7.Anode
4.5.NC 8.Ref

Internal Block Diagram





Rev. 1.0.8

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 M, Z Suffix Package N Suffix Package	P_D	 770 1000	mW
Operating Temperature Range			
LM431xC	T_{OPR}	-25 ~ +85	°C
LM431xI		-40 ~ +85	°C
Junction Temperature	T_J	150	°C
Storage Temperature Range	T_{STG}	-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	LM431A			LM431B			LM431C			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Reference Input Voltage	V_{REF}	$V_{KA} = V_{REF}$, I_{KA} =10mA	2.450	2.500	2.550	2.470	2.495	2.520	2.482	2.495	2.508	V
Deviation of Reference Input Voltage Over-Temperature	$\Delta V_{REF}/\Delta T$	$V_{KA}=V_{REF}$, I_{KA}=10mA $T_{MIN} \le T_A \le T_{MAX}$	-	4.5	17	-	4.5	17	-	4.5	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	I_{KA} =10mA, ΔV_{KA}=10V-V_{REF}	-	-1.0	-2.7	-	-1.0	-2.7	-	-1.0	-2.7	mV/V
		I_{KA} =10mA, ΔV_{KA}=36V-10V	-	-0.5	-2.0	-	-0.5	-2.0	-	-0.5	-2.0	mV/V
Reference Input Current	I_{REF}	I_{KA}=10mA, R_1=10kΩ,$R_2=\infty$	-	1.5	4	-	1.5	4	-	1.5	4	μA
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	I_{KA}=10mA, R_1=10kΩ,$R_2=\infty$ 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	Z_{KA}	$V_{KA}=V_{REF}$, I_{KA}=1 to 100mA f ≥1.0kHz	-	0.15	0.5	-	0.15	0.5	-	0.15	0.5	Ω

Note1

- LM431XC : T_{MIN} = -25 °C, T_{MAX} = +85°C
- LM431XI : T_{MIN} = -40°C, T_{MAX} = +85°C

Test Circuits

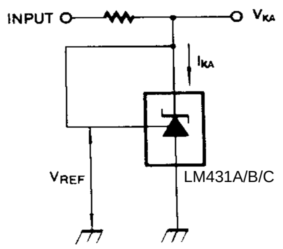


Figure 1. Test Circuit for V_{KA}=V_{REF}

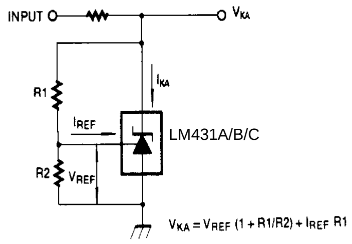


Figure 2. Test Circuit for V_{KA}≥V_{REF}

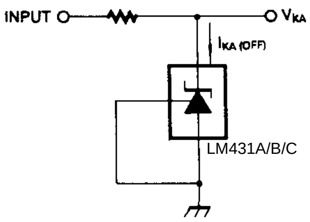


Figure 3. Test Circuit for $I_{KA(OFF)}$

Typical Performance Characteristics

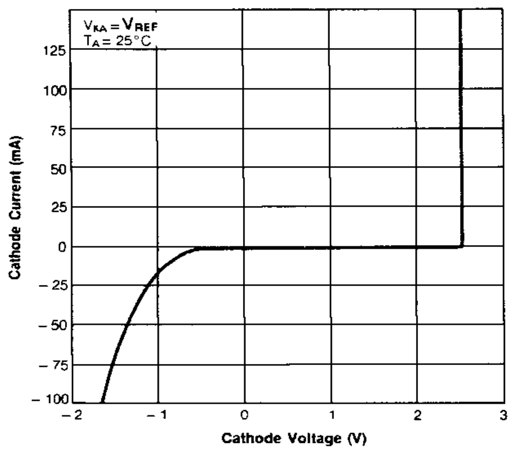


Figure 4. Cathode Current vs. Cathode Voltage

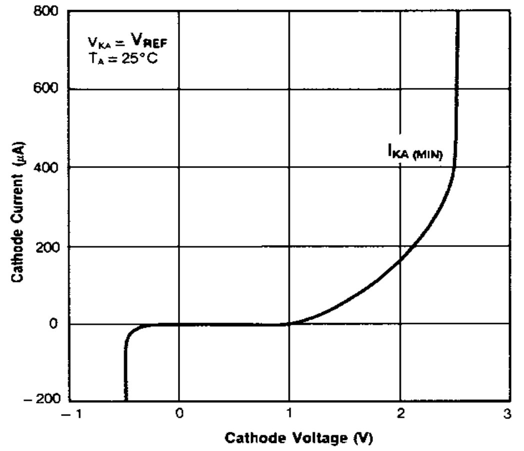


Figure 5. Cathode Current vs. Cathode Voltage

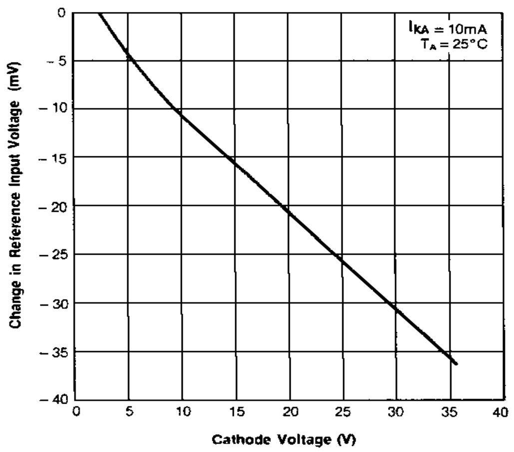


Figure 6. Change In Reference Input Voltage vs. Cathode Voltage

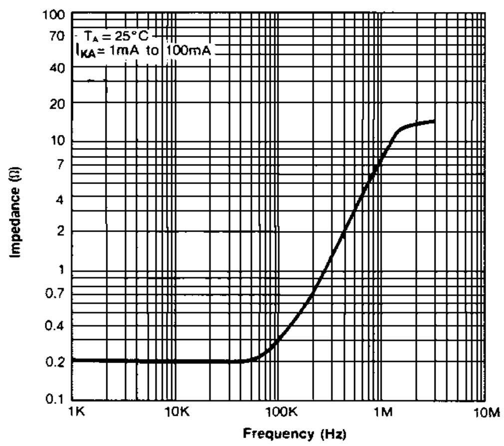


Figure7. Dynamic Impedance Frequency

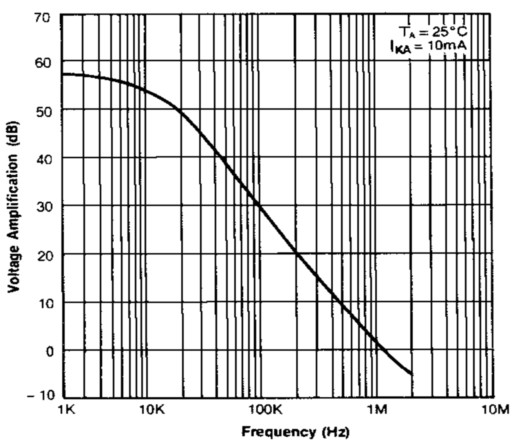


Figure 8. Small Signal Voltage Amplification vs. Frequency

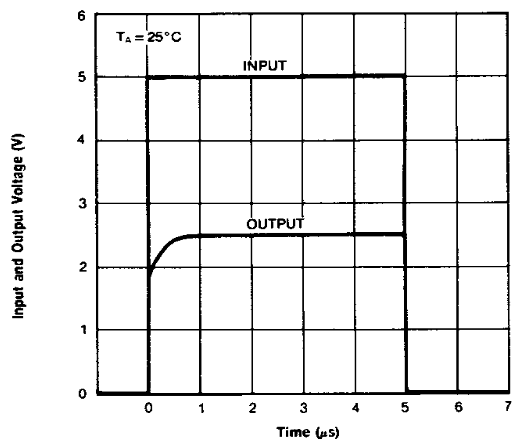


Figure 9. Pulse Response

Typical Performance Characteristics (Continued)

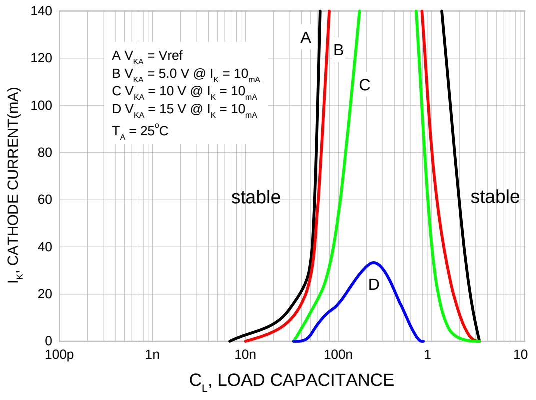


Figure 10. Stability Boundary Conditions

Typical Application

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

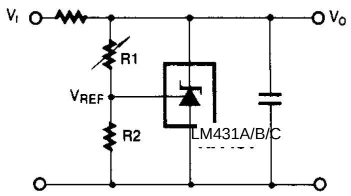


Figure 11. Shunt Regulator

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

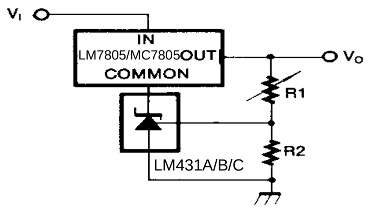


Figure 12. Output Control for Three–Terminal Fixed Regulator

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

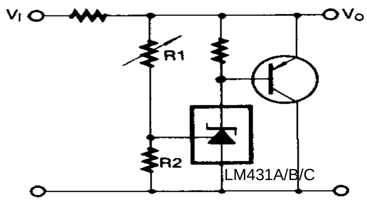


Figure 13. High Current Shunt Regulator

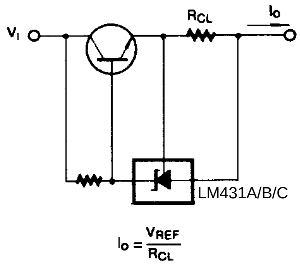


Figure 14. Current Limit or Current Source

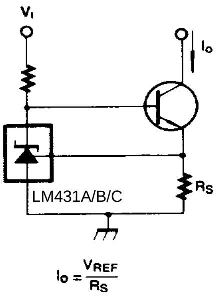


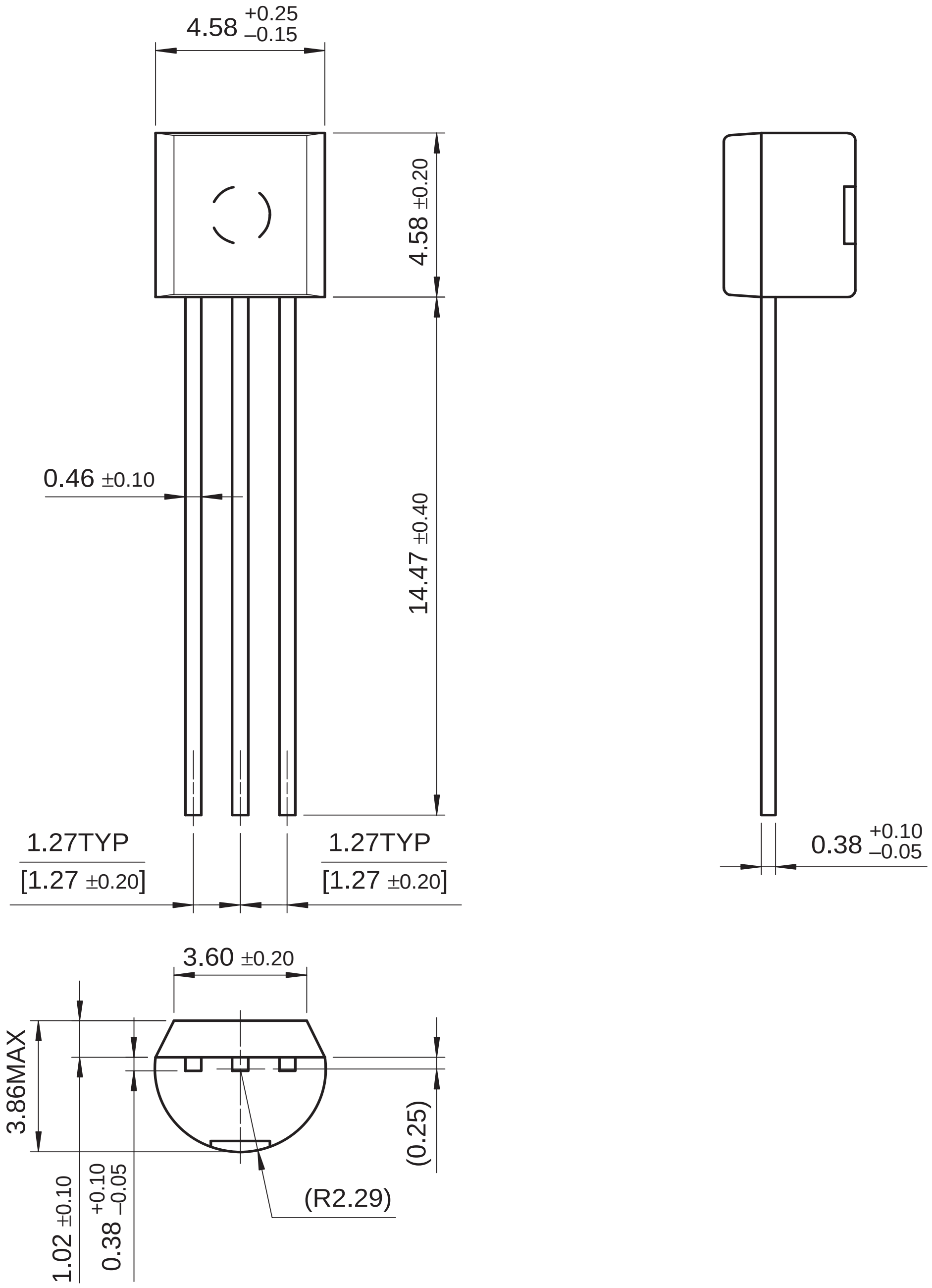
Figure 15. Constant-Current Sink

Mechanical Dimensions

Package

Dimensions in millimeters

TO-92

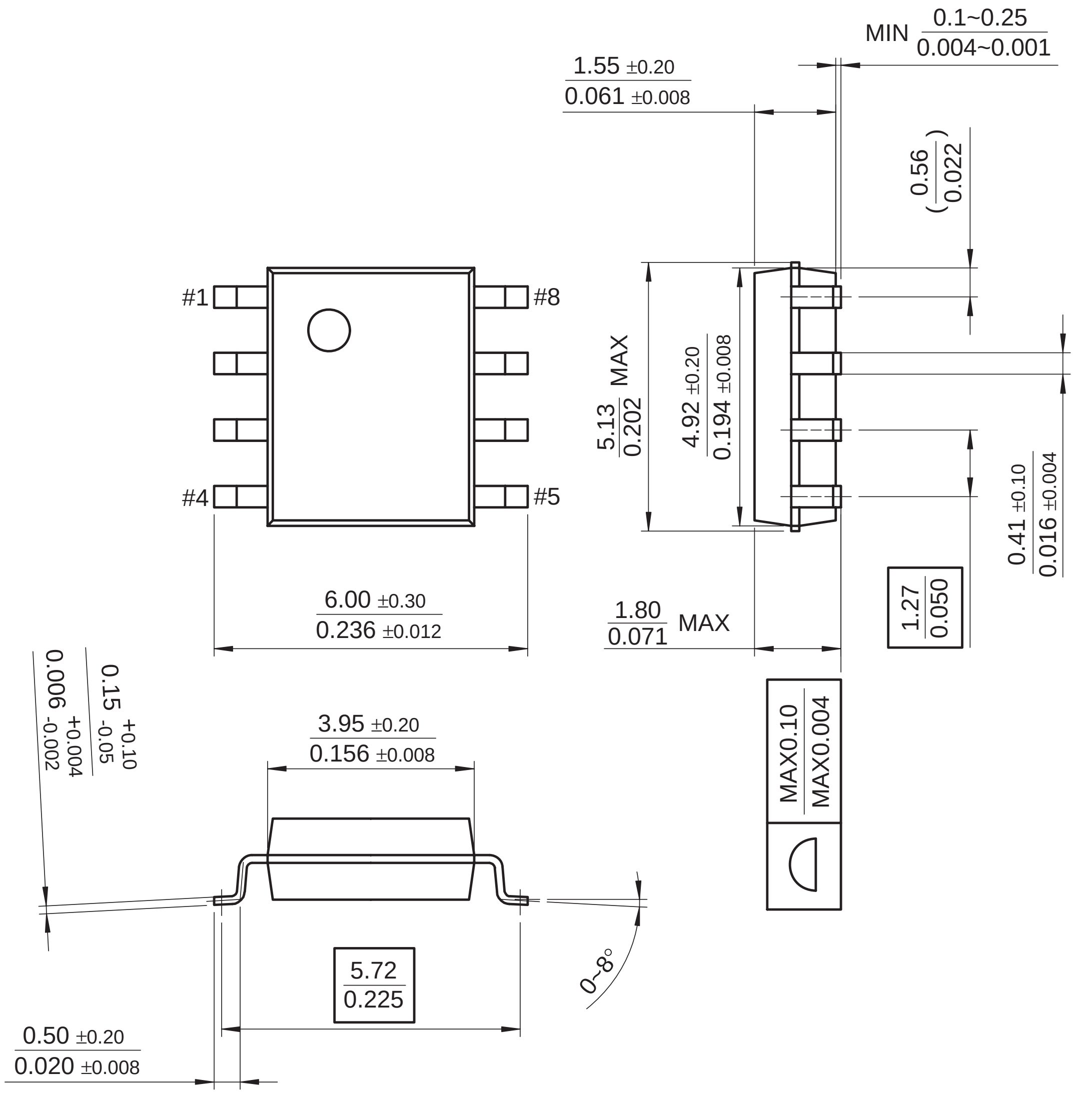


Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

8-SOP

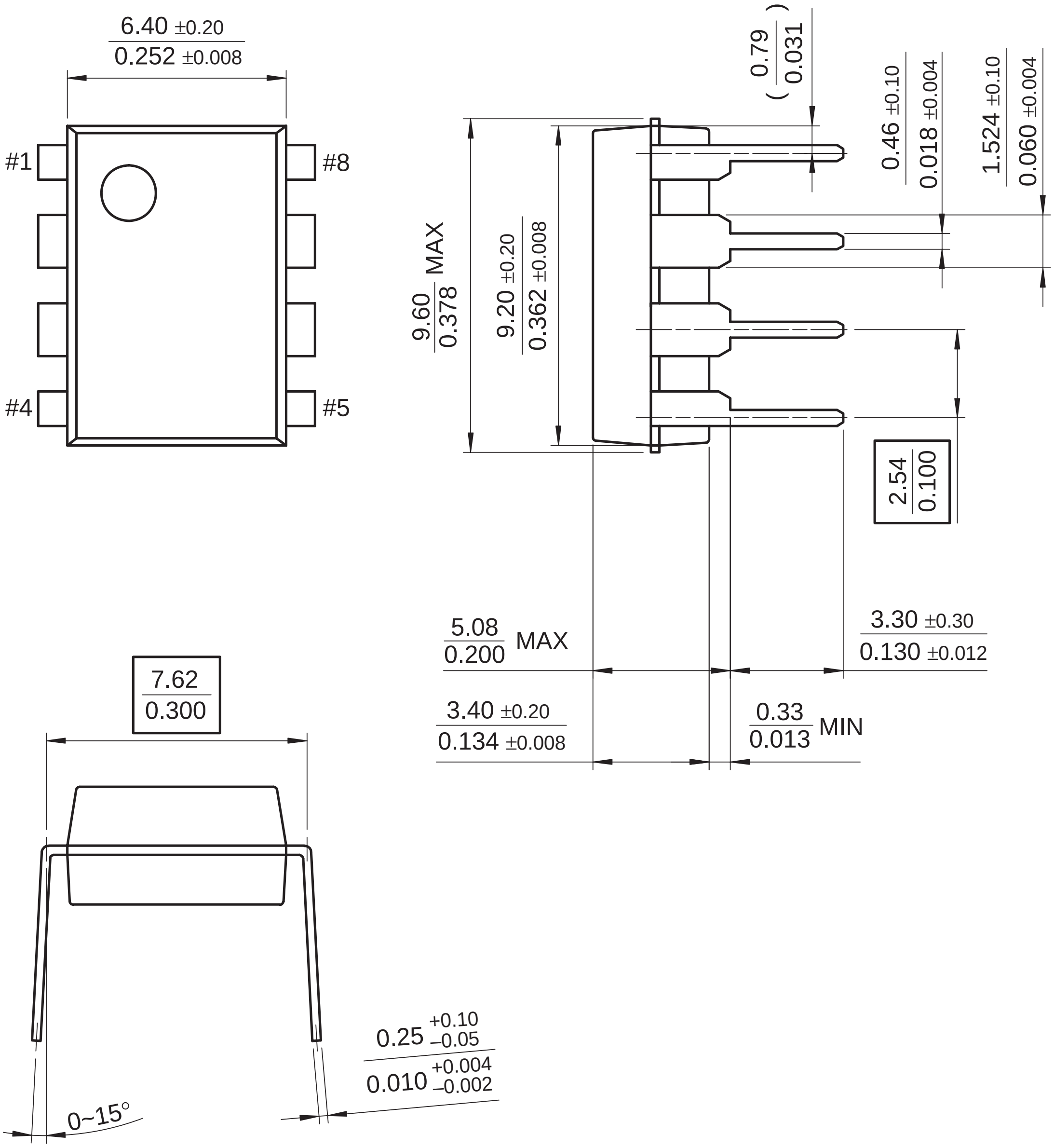


Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

8-DIP



Ordering Information

Product Number	Output Voltage Tolerance	Package	Operating Temperature
LM431CCZ	0.5%	TO-92	-25 ~ +85°C
LM431CCM		8-SOP	
LM431BCZ	1%	TO-92	
LM431BCM		8-SOP	
LM431ACN	2%	8-DIP	
LM431ACZ		TO-92	
LM431ACM		8-SOP	
LM431CIZ	0.5%	TO-92	-40 ~ +85°C
LM431CIM		8-SOP	
LM431BIZ	1%	TO-92	
LM431BIM		8-SOP	
LM431AIZ	2%	TO-92	
LM431AIM		8-SOP	

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