LM431A/LM431B/LM431C

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 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

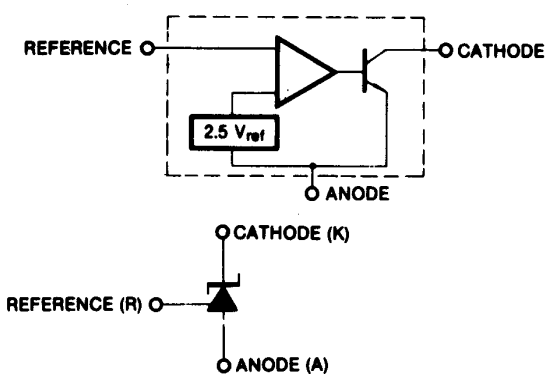
SOT-89

1. Ref 2. Anode 3. Cathode

SOT-23F

1. Cathode 2. Ref 3. Anode

Internal Block Diagram



Rev. 1.0.4

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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	P_D	770	mW
Operating Temperature Range			
LM431xC	T_{OPR}	-25 ~ + 85	^oC
LM431xI		-40 ~ + 85	^oC
Storage Temperature Range	T_{STG}	-65 ~ + 150	^oC

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}	-	- 10	- 2.7	-	- 1.0	- 2.7	-	- 1.0	- 2.7	mV/V
			ΔV_{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	$\Delta I_{REF}/\Delta T$	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	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

- LM431$_X$C : T_{MIN}= -25 °C, T_{MAX}= +85 °C
- LM431$_X$I : T_{MIN}= -40 °C, T_{MAX}= +85 °C

Test Circuits

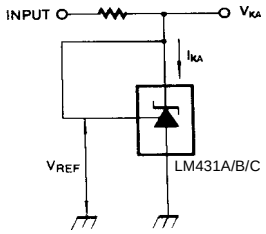


Figure 1. Test Circuit for $V_{KA}=V_{REF}$

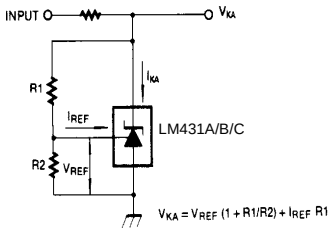


Figure 2. Test Circuit for $V_{KA} \geq V_{REF}$

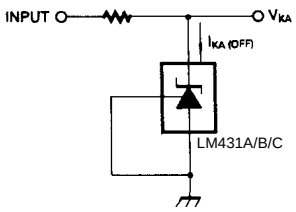


Figure 3. Test Circuit for $I_{KA(OFF)}$

Typical Perfomance Characteristics

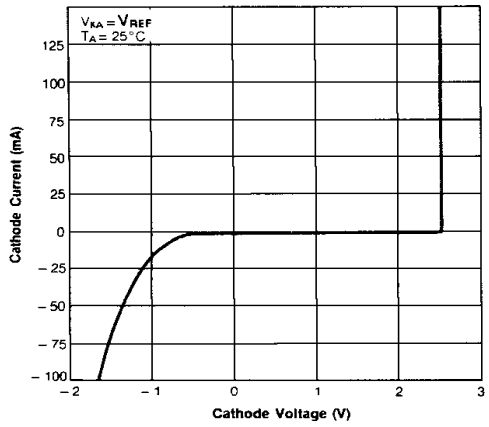


Figure 1. Cathode Current vs. Cathode Voltage

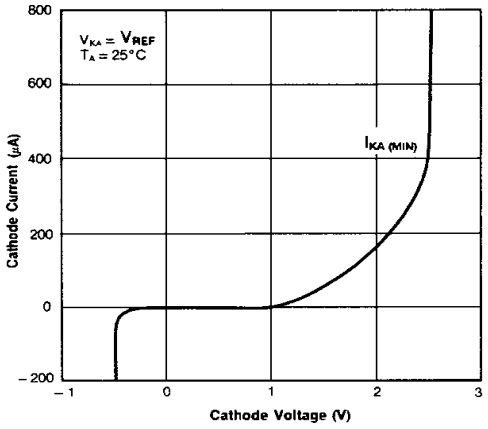


Figure 2. Cathode Current vs. Cathode Voltage

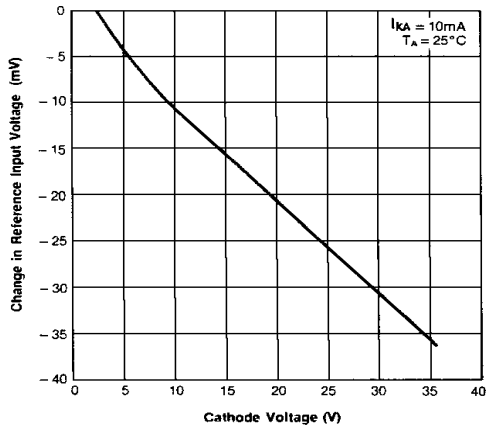


Figure 3. Change In Reference Input Voltage vs. Cathode Voltage

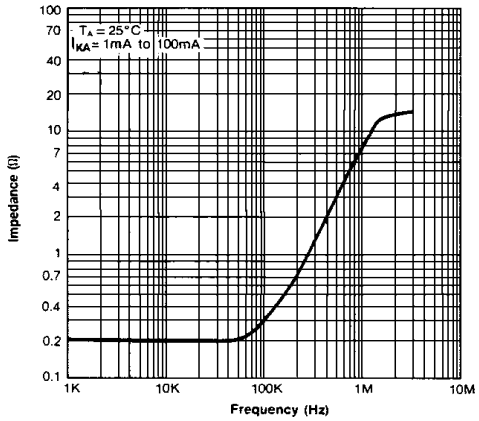


Figure 4. Dynamic Impedance Frequency

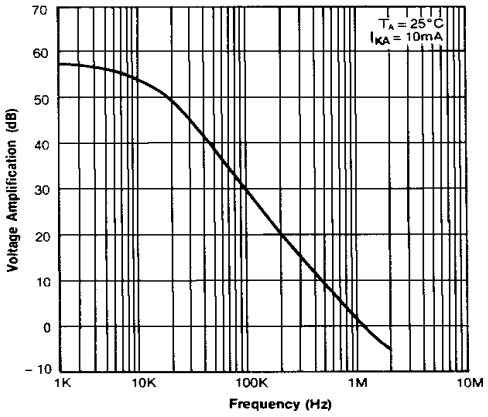


Figure 5. Small Signal Voltage Amplification vs. Frequency

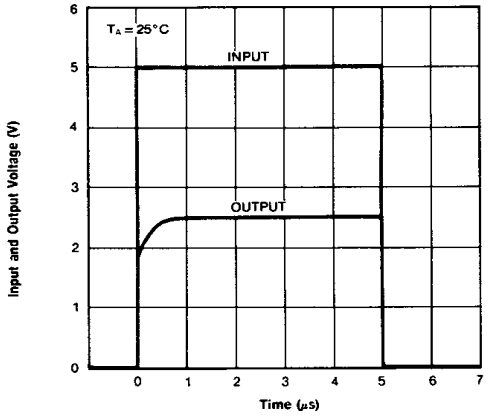


Figure 6. Pulse Response

Typical Application

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

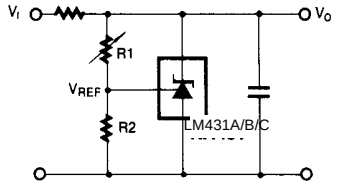


Figure 10. Shunt Regulator

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

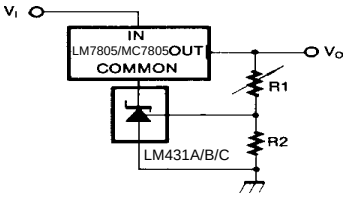


Figure 11. Output Control for Three-Termianl Fixed Regulator

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

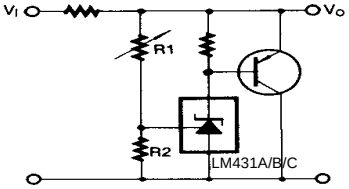


Figure 12. High Current Shunt Regulator

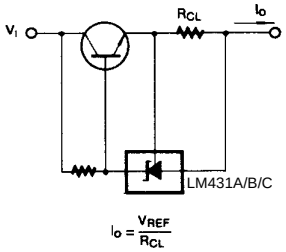


Figure 13. Current Limit or Current Source

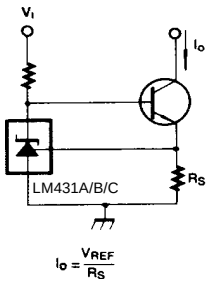
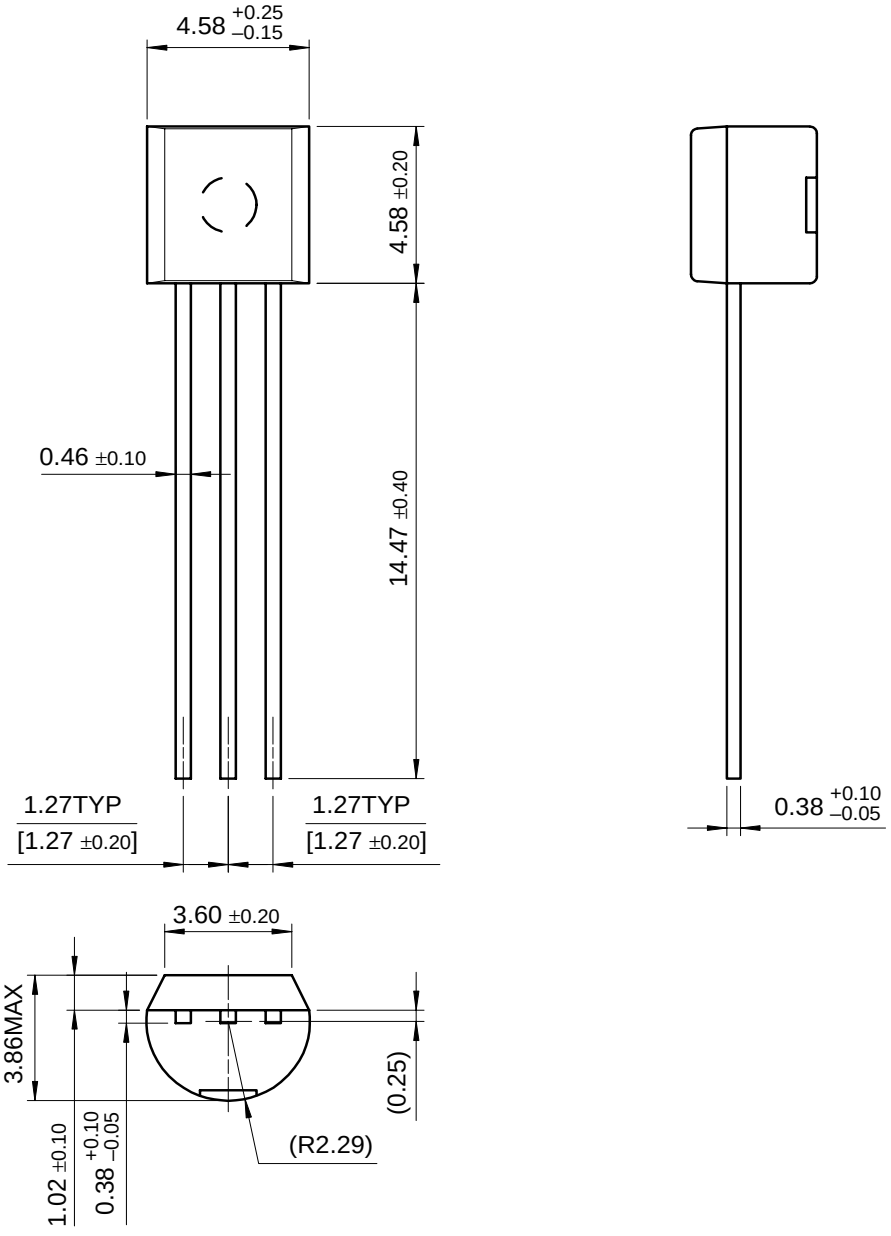


Figure 14. Constant-Current Sink

Mechanical Dimensions

Package

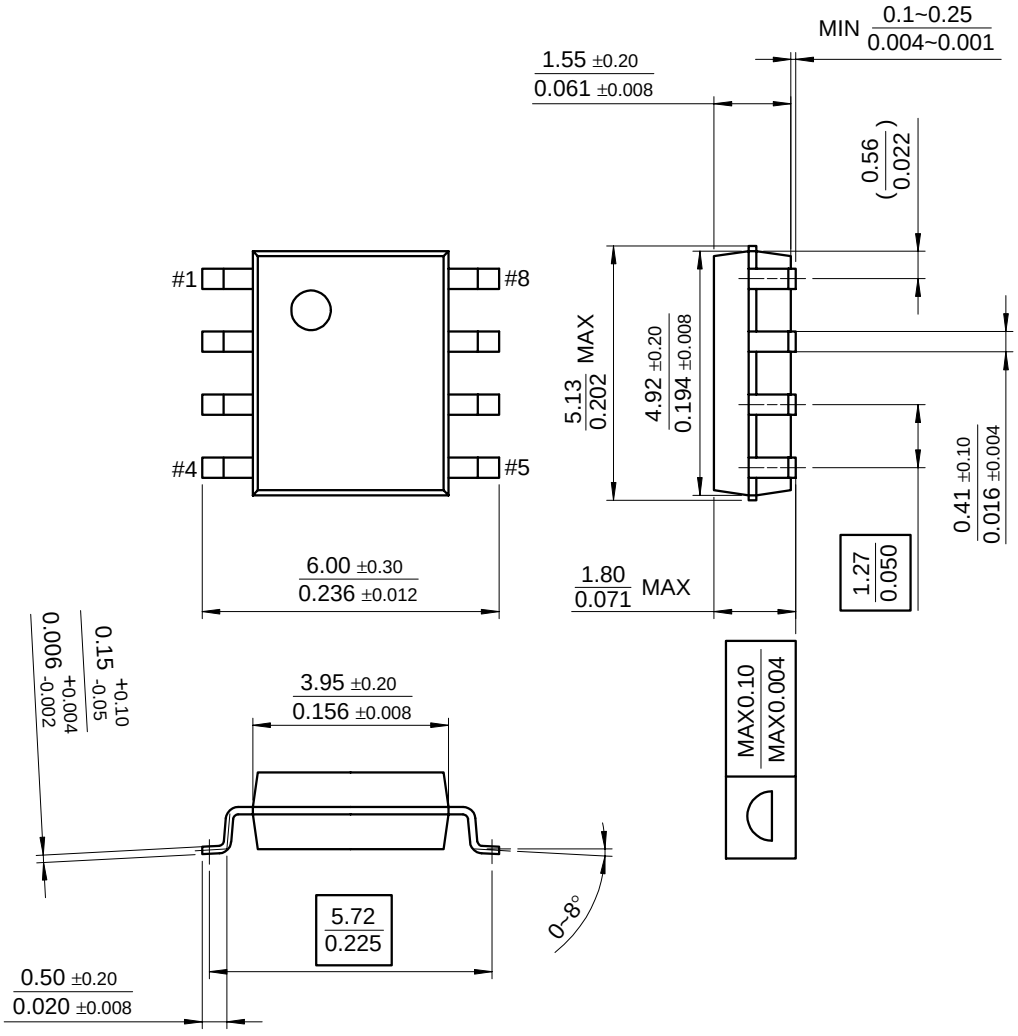
TO-92



Mechanical Dimensions (Continued)

Package

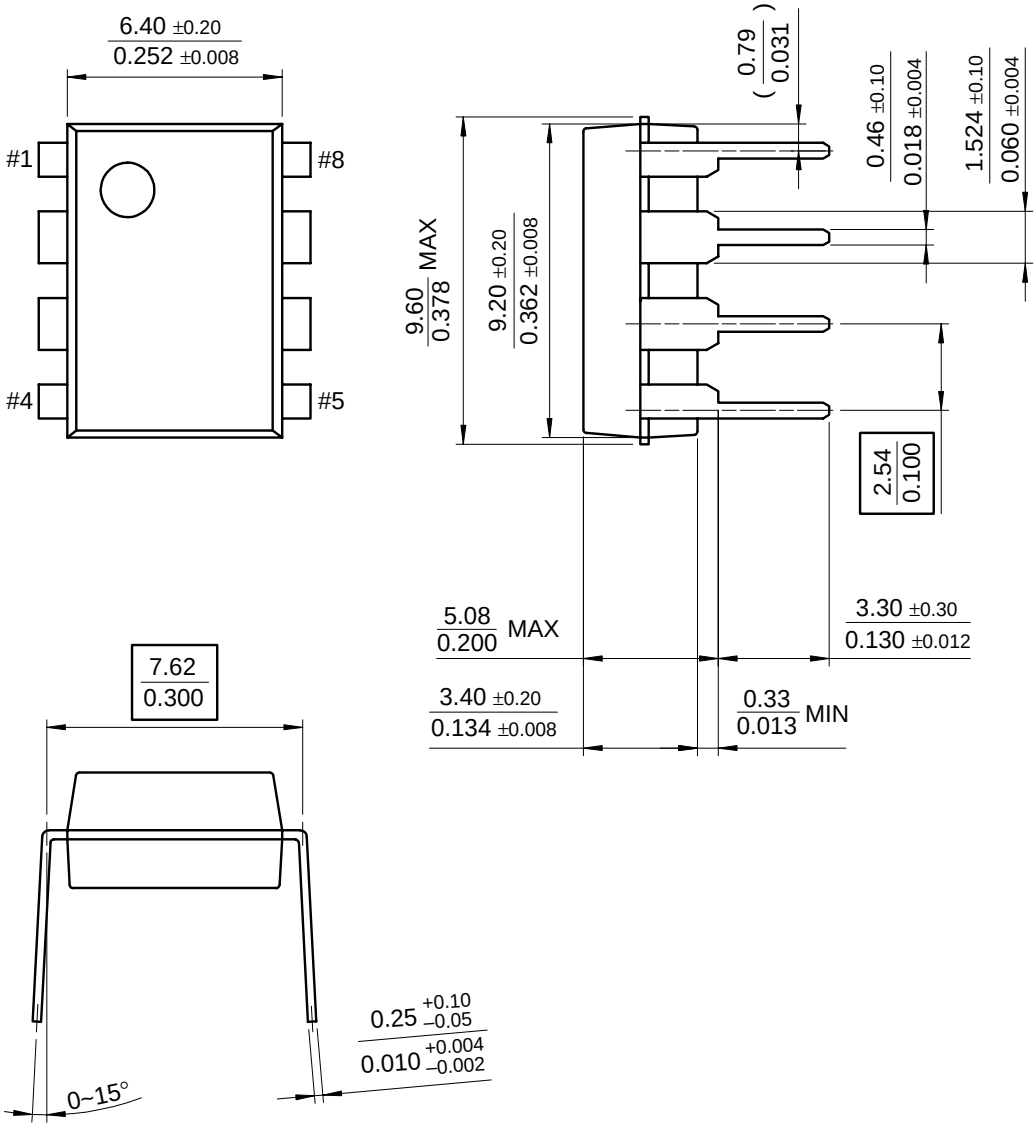
8-SOP



Mechanical Dimensions (Continued)

Package

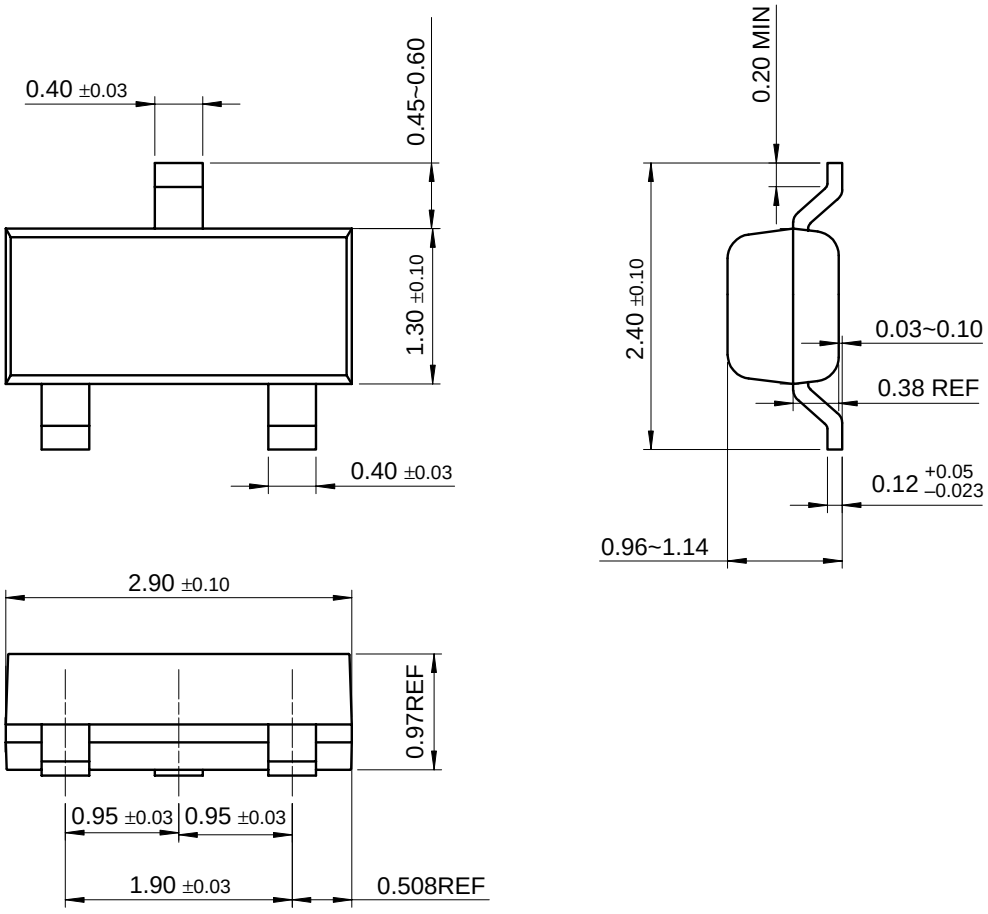
8-DIP



Mechanical Dimensions (Continued)

Package

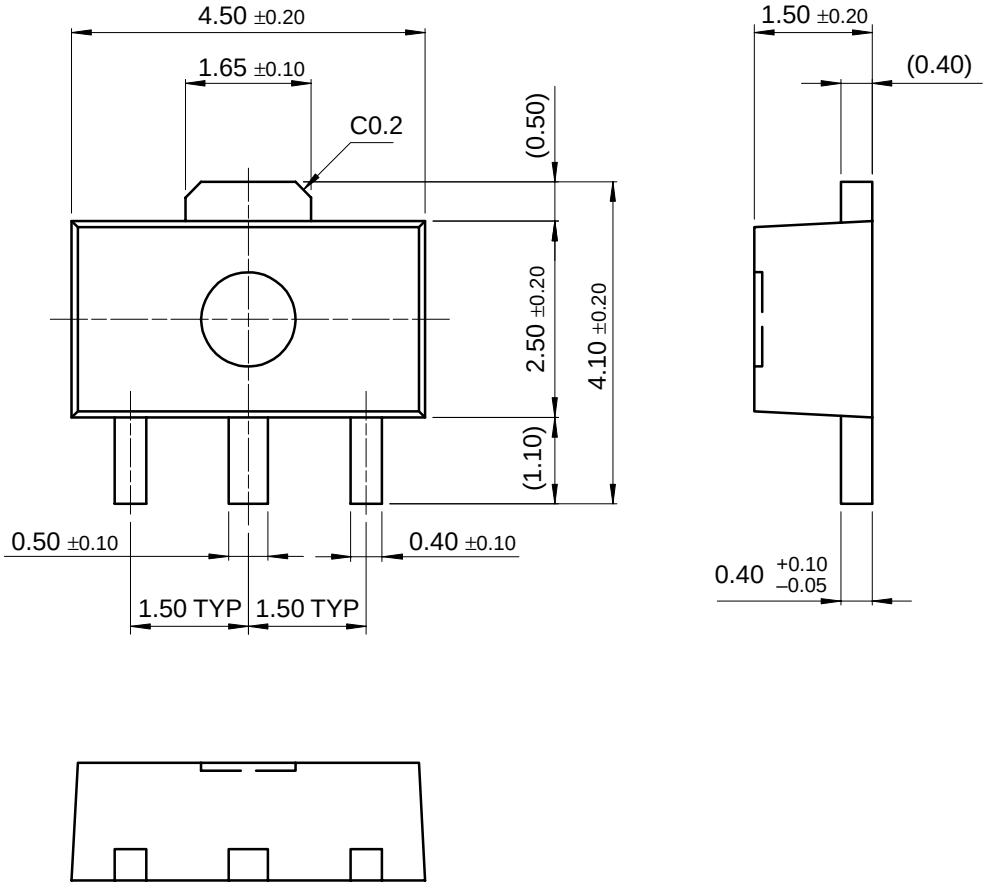
SOT-23F



Mechanical Dimensions (Continued)

Package

SOT-89



Ordering Information

Product Number	Output Voltage Tolerance	Package	Operating Temperature
LM431CCZ	0.5%	TO-92	-25 ~ + 85 °C
LM431CCM		8-SOP	
LM431CCML		SOT-89	
LM431CCMF		SOT-23F	
LM431BCZ	1%	TO-92	
LM431BCM		8-SOP	
LM431BCML		SOT-89	
LM431BCMF		SOT-23F	
LM431ACN	2%	8-DIP	
LM431ACZ		TO-92	
LM431ACM		8-SOP	
LM431ACML		SOT-89	
LM431ACMF		SOT-23F	
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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