

# LM431A/LM431B/LM431C

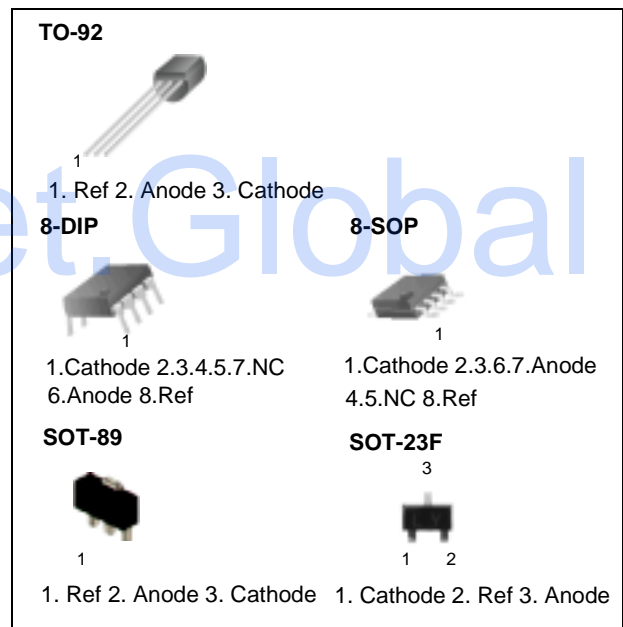
## Programmable Shunt Regulator

### Features

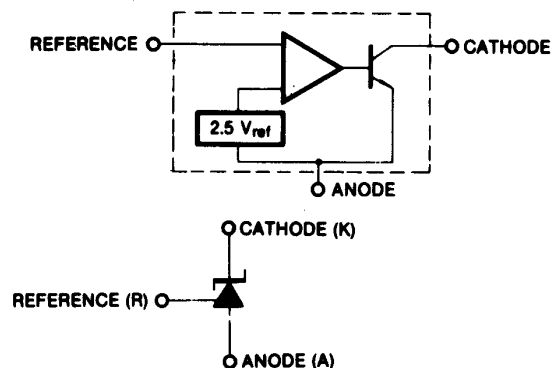
- Programmable output voltage to 36 volts
- Low dynamic output impedance 0.20 typical
- Sink current capability of 1.0 to 100mA
- Equivalent full-range temperature coefficient of 50ppm/°C typical
- Temperature compensated for operation over full rated operating temperature range
- Low output noise voltage
- 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  $0.2\Omega$ . Active output circuit provides a 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 <sub>KA</sub>	37	V
Cathode current Range (Continuous)	I <sub>KA</sub>	-100~ + 150	mA
Reference Input Current Range	I <sub>REF</sub>	0.05~ + 10	mA
Power Dissipation M, Z Suffix Package	P <sub>D</sub>	770	mW
<b>Operating Temperature Range</b>			
LM431xC	T <sub>OPR</sub>	-25 ~ + 85	°C
LM431xI		-40 ~ + 85	°C
Storage Temperature Range	T <sub>STG</sub>	-65 ~ + 150	°C

## Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Cathode Voltage	V <sub>KA</sub>	V <sub>REF</sub>	-	36	V
Cathode Current	I <sub>KA</sub>	1.0	-	100	mA

## Electrical Characteristics

(T<sub>A</sub> = +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 <sub>REF</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =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 <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =10mA T <sub>MIN</sub> ≤ T <sub>A</sub> ≤ T <sub>MAX</sub>		-	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 <sub>KA</sub> =10mA	ΔV <sub>KA</sub> =10V-V <sub>REF</sub>	-	-10	-2.7	-	-1.0	-2.7	-	-1.0	-2.7	mV/V
			ΔV <sub>KA</sub> =36V-10V	-	-0.5	-2.0	-	-0.5	-2.0	-	-0.5	-2.0	
Reference Input Current	I <sub>REF</sub>	I <sub>KA</sub> =10mA, R <sub>1</sub> =10KΩ, R <sub>2</sub> =∞		-	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 <sub>KA</sub> =10mA, R <sub>1</sub> =10KΩ, R <sub>2</sub> =∞ T <sub>A</sub> = Full Range		-	0.4	1.2	-	0.4	1.2	-	0.4	1.2	μA
Minimum Cathode Current for Regulation	I <sub>KA(MIN)</sub>	V <sub>KA</sub> =V <sub>REF</sub>		-	0.45	1.0	-	0.45	1.0	-	0.45	1.0	mA
Off - Stage Cathode Current	I <sub>KA(OFF)</sub>	V <sub>KA</sub> =36V, V <sub>REF</sub> =0		-	0.05	1.0	-	0.05	1.0	-	0.05	1.0	μA
Dynamic Impedance	Z <sub>KA</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =1 to 100mA f ≥ 1.0KHz		-	0.15	0.5	-	0.15	0.5	-	0.15	0.5	Ω

### Note1

- LM431XC : T<sub>MIN</sub>= -25 °C, T<sub>MAX</sub>= +85 °C
- LM431XI : T<sub>MIN</sub>= -40 °C, T<sub>MAX</sub>= +85 °C

## Test Circuits

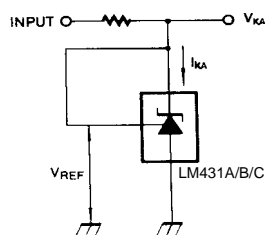


Figure 1. Test Circuit for  $V_{KA}=V_{REF}$

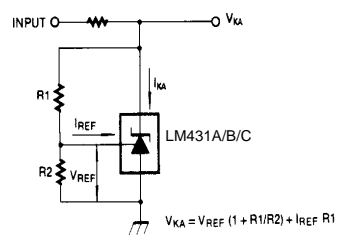


Figure 2. Test Circuit for  $V_{KA} \geq V_{REF}$

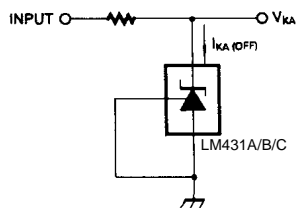


Figure 3. Test Circuit for  $I_{KA}(OFF)$

## Typical Performance Characteristics

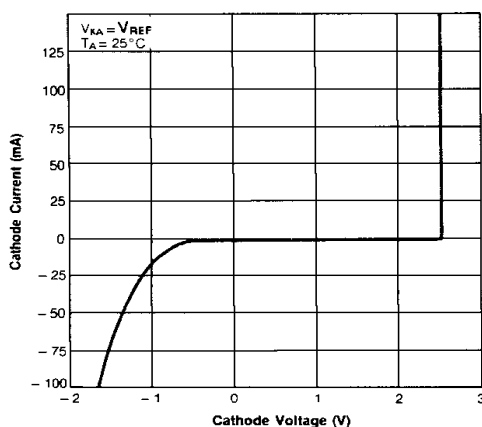


Figure 1. Cathode Current vs. Cathode Voltage

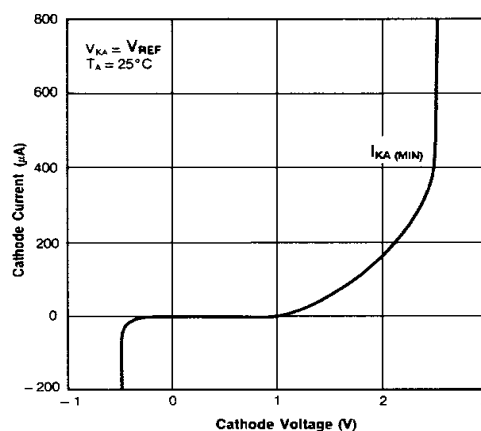


Figure 2. Cathode Current vs. Cathode Voltage

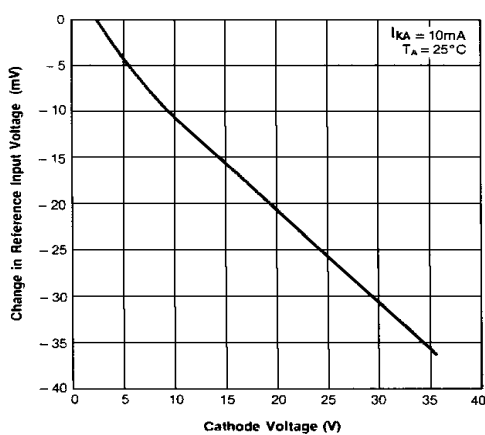


Figure 3. Change In Reference Input Voltage vs. Cathode Voltage

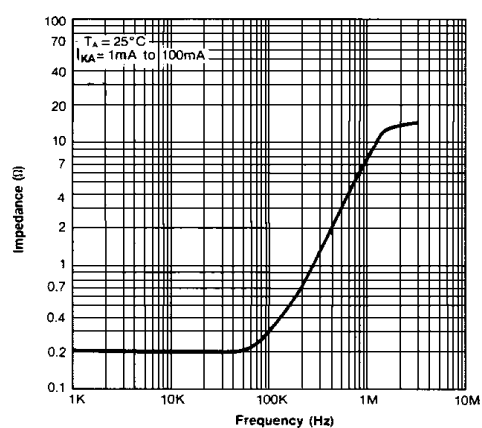


Figure 4. Dynamic Impedance Frequency

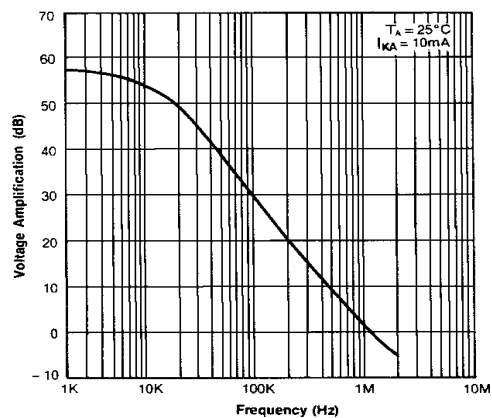


Figure 5. Small Signal Voltage Amplification vs. Frequency

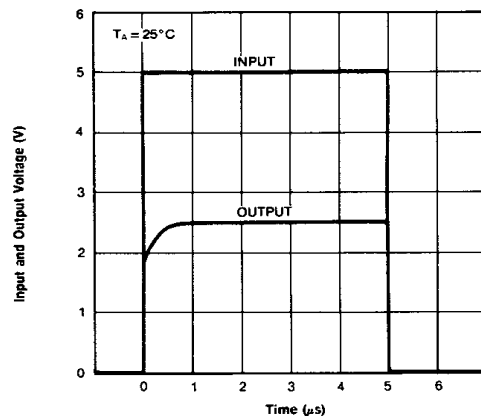


Figure 6. Pulse Response

## Typical Application

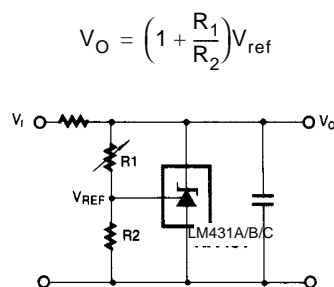


Figure 10. Shunt Regulator

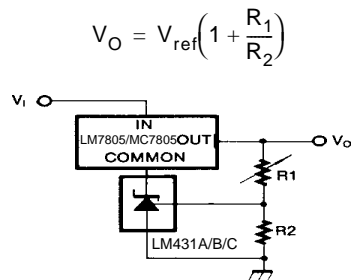


Figure 11. Output Control for Three-Terminal Fixed Regulator

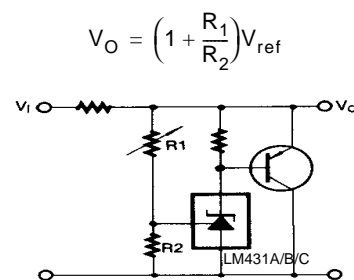


Figure 12. High Current Shunt Regulator

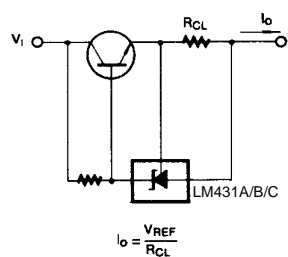


Figure 13. Current Limit or Current Source

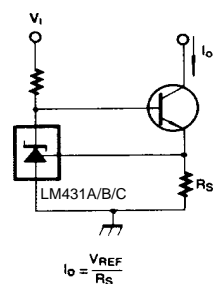
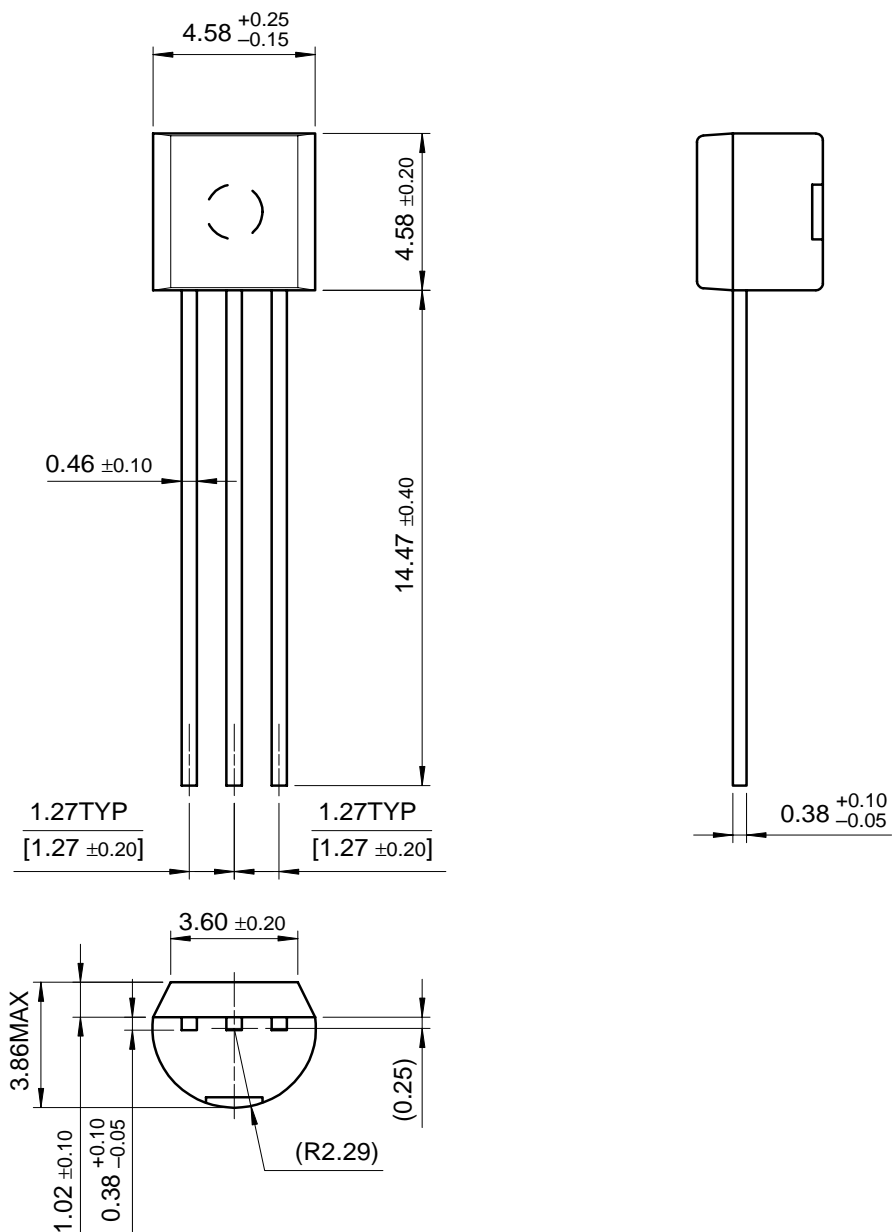


Figure 14. Constant-Current Sink

## Mechanical Dimensions

### Package

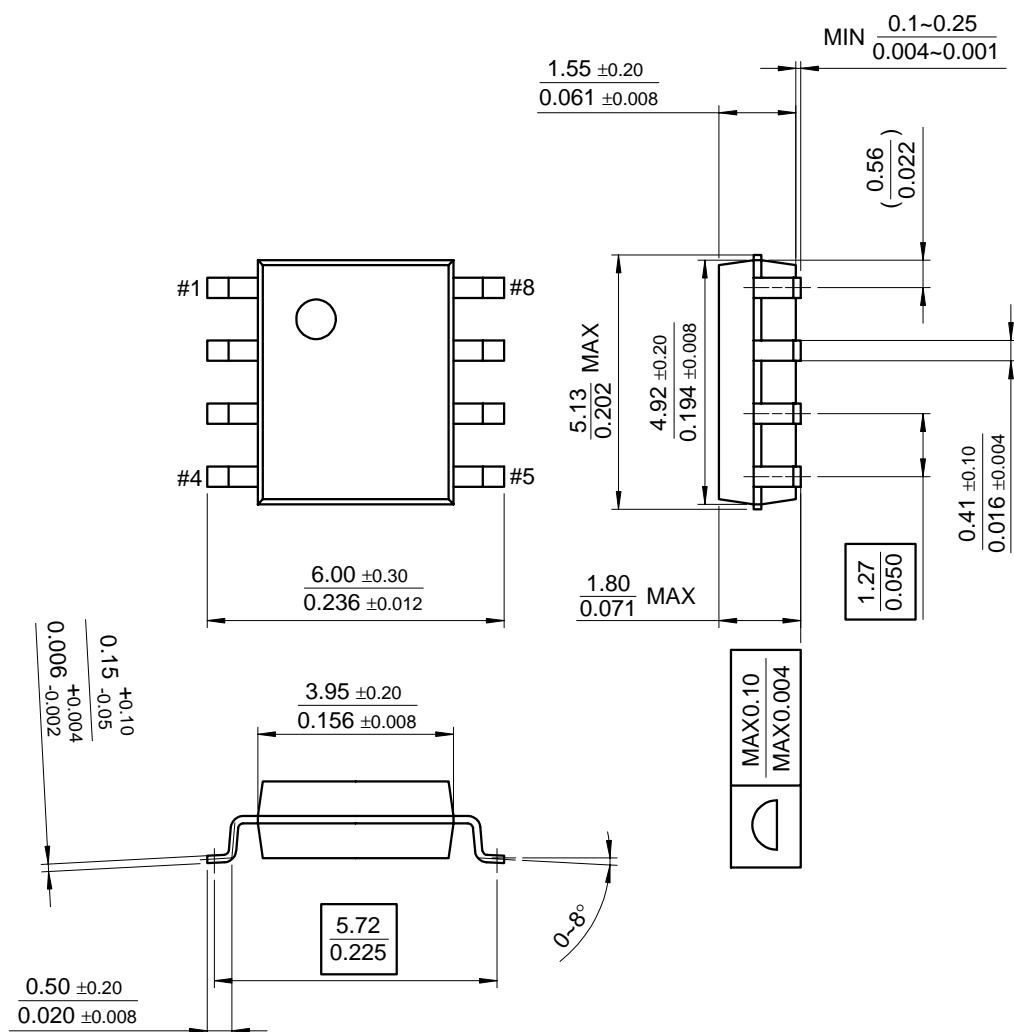
## TO-92



# Mechanical Dimensions (Continued)

## Package

### 8-SOP

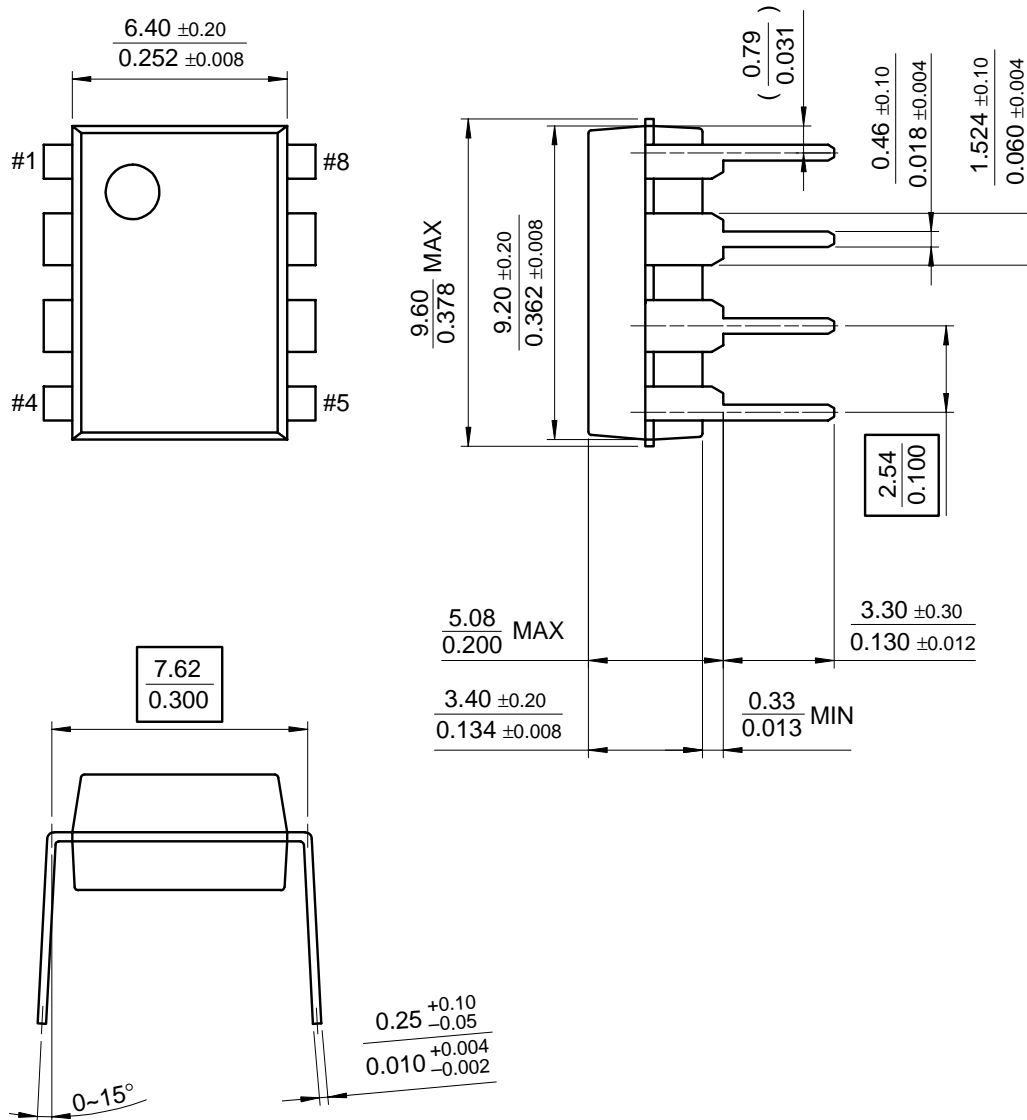


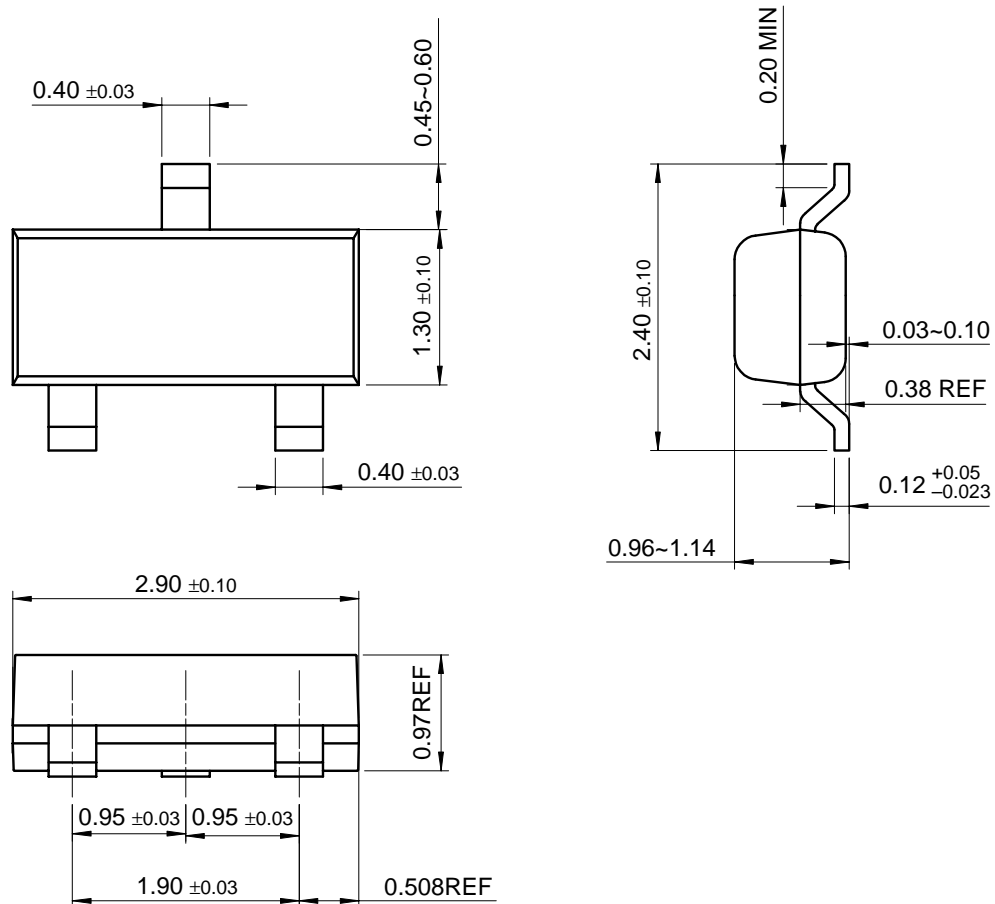


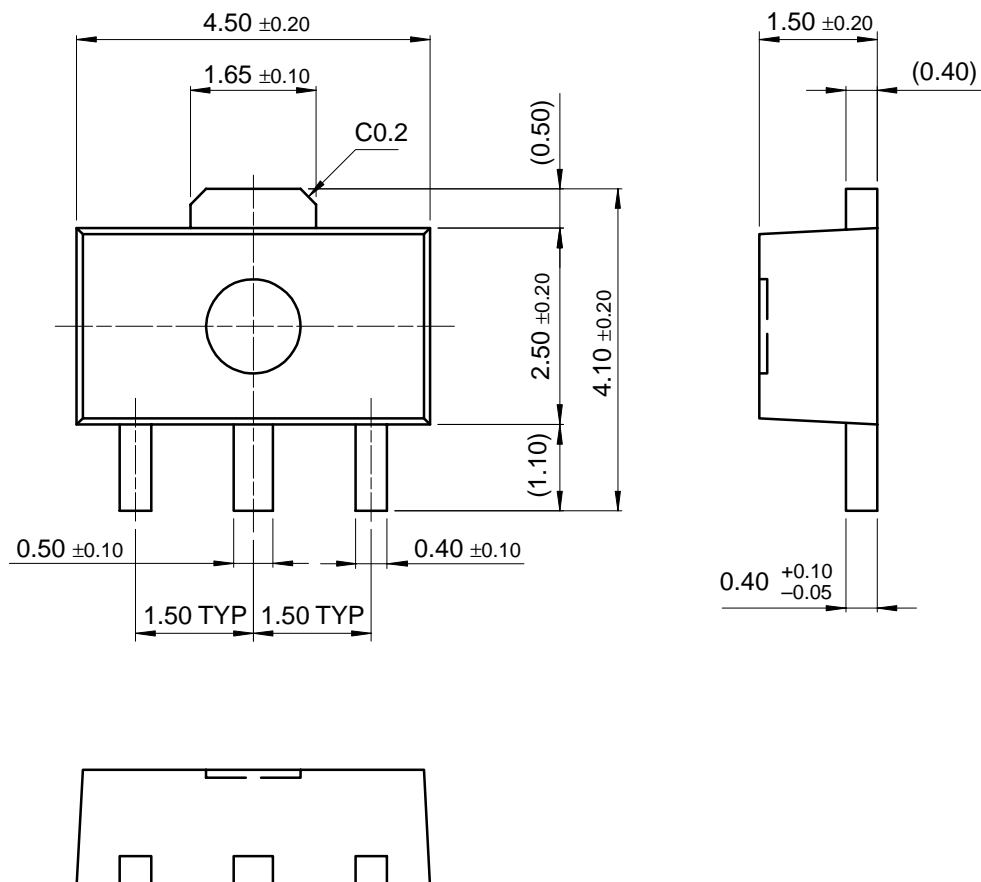
# Mechanical Dimensions (Continued)

## 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	-40 ~ + 85 °C
LM431ACZ		TO-92	
LM431ACM		8-SOP	
LM431ACMF		SOT-23F	
LM431CIZ	0.5%	TO-92	
LM431CIM		8-SOP	
LM431BIZ	1%	TO-92	
LM431BIM		8-SOP	
LM431AIZ	2%	TO-92	
LM431AIM		8-SOP	

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