

LM431

Adjustable Precision Zener Shunt Regulator

General Description

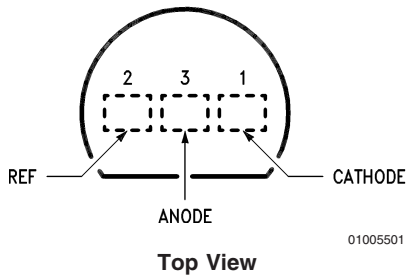
The LM431 is a 3-terminal adjustable shunt regulator with guaranteed temperature stability over the entire temperature range of operation. It is now available in a chip sized package (4-Bump micro SMD) using National's micro SMD package technology. The output voltage may be set at any level greater than 2.5V (V_{REF}) up to 36V merely by selecting two external resistors that act as a voltage divided network. Due to the sharp turn-on characteristics this device is an excellent replacement for many zener diode applications.

Features

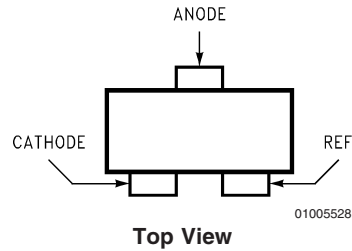
- Average temperature coefficient 50 ppm/°C
- Temperature compensated for operation over the full temperature range
- Programmable output voltage
- Fast turn-on response
- Low output noise
- LM431 in micro SMD package
- See AN-1112 for micro SMD considerations

Connection Diagrams

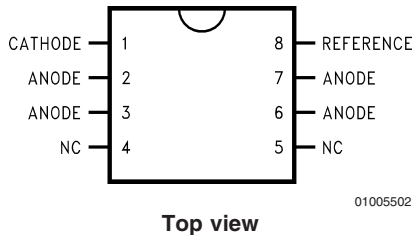
TO-92: Plastic Package



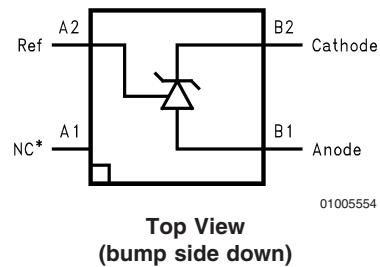
SOT-23: 3-Lead Small Outline



SO-8: 8-Pin Surface Mount



4-Bump micro SMD



Note: *NC = Not internally connected. Must be electrically isolated from the rest of the circuit for the microSMD package.

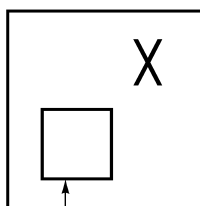
Ordering Information

Package	Typical Accuracy Order Number/Package Marking			Temperature Range	Transport Media	NSC Drawing
	0.5%	1%	2%			
TO-92	LM431CCZ/ LM431CCZ	LM431BCZ/ LM431BCZ	LM431ACZ/ LM431ACZ	0°C to +70°C	Rails	Z03A
	LM431CIZ/ LM431CIZ	LM431BIZ/ LM431BIZ	LM431AIZ/ LM431AIZ	-40°C to +85°C		
SO-8	LM431CCM/ 431CCM	LM431BCM/ 431BCM	LM431ACM/ LM431ACM	0°C to +70°C	Rails	M08A
	LM431CCMX/ 431CCM	LM431BCM/ 431BCM	LM431ACMX/ LM431ACM		Tape & Reel	
	LM431CIM/ 431CIM	LM431BIM/ 431BIM	LM431AIM/ LM431AIM	-40°C to +85°C	Rails	
	LM431CIMX/ 431CIM	LM431BIMX/ 431BIM	LM431AIMX/ LM431AIM		Tape & Reel	
SOT-23	LM431CCM3/ N1B	LM431BCM3/ N1D	LM431ACM3/ N1F	0°C to +70°C	Rails	MF03A
	LM431CCM3X/ N1B	LM431BCM3X/ N1D	LM431ACM3X/ N1F		Tape & Reel	
	LM431CIM3 N1A	LM431BIM3 N1C	LM431AIM3 N1E	-40°C to +85°C	Rails	
	LM431CIM3X N1A	LM431BIM3X N1C	LM431AIM3X N1E		Tape & Reel	
micro SMD	-	-	LM431AIBP LM431AIBPX (Note 1)	-40°C to +85°C	250 Units Tape and Reel 3k Units Tape and Reel	BPA04AFB

Note 1: The micro SMD package marking is a 1 digit manufacturing Date Code only

micro SMD Top View Marking Example

X = Date Code



Pin A1 Identifier

01005556

Absolute Maximum Ratings (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	
Industrial (LM431xl)	-40°C to +85°C
Commercial (LM431xC)	0°C to +70°C
Soldering Information	
Infrared or Convection (20 sec.)	235°C
Wave Soldering (10 sec.)	260°C (lead temp.)
Cathode Voltage	37V
Continuous Cathode Current	-10 mA to +150 mA

Reference Voltage	-0.5V
Reference Input Current	10 mA
Internal Power Dissipation (Notes 3, 4)	
TO-92 Package	0.78W
SO-8 Package	0.81W
SOT-23 Package	0.28W
micro SMD Package	0.30W

Operating Conditions

	Min	Max
Cathode Voltage	V_{REF}	37V
Cathode Current	1.0 mA	100 mA

LM431

Electrical Characteristics

$T_A = 25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{REF}	Reference Voltage	$V_Z = V_{REF}$, $I_I = 10\text{ mA}$ LM431A (Figure 1)	2.440	2.495	2.550	V
		$V_Z = V_{REF}$, $I_I = 10\text{ mA}$ LM431B (Figure 1)	2.470	2.495	2.520	V
		$V_Z = V_{REF}$, $I_I = 10\text{ mA}$ LM431C (Figure 1)	2.485	2.500	2.510	V
V_{DEV}	Deviation of Reference Input Voltage Over Temperature (Note 5)	$V_Z = V_{REF}$, $I_I = 10\text{ mA}$, $T_A = \text{Full Range}$ (Figure 1)		8.0	17	mV
$\frac{\Delta V_{REF}}{\Delta V_Z}$	Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	$I_Z = 10\text{ mA}$ (Figure 2)	V_Z from V_{REF} to 10V	-1.4	-2.7	mV/V
			V_Z from 10V to 36V	-1.0	-2.0	
I_{REF}	Reference Input Current	$R_1 = 10\text{ k}\Omega$, $R_2 = \infty$, $I_I = 10\text{ mA}$ (Figure 2)		2.0	4.0	μA
∞I_{REF}	Deviation of Reference Input Current over Temperature	$R_1 = 10\text{ k}\Omega$, $R_2 = \infty$, $I_I = 10\text{ mA}$, $T_A = \text{Full Range}$ (Figure 2)		0.4	1.2	μA
$I_{Z(MIN)}$	Minimum Cathode Current for Regulation	$V_Z = V_{REF}$ (Figure 1)		0.4	1.0	mA
$I_{Z(OFF)}$	Off-State Current	$V_Z = 36\text{V}$, $V_{REF} = 0\text{V}$ (Figure *NO TARGET FOR fi*)		0.3	1.0	μA
r_Z	Dynamic Output Impedance (Note 6)	$V_Z = V_{REF}$, LM431A, Frequency = 0 Hz (Figure 1)			0.75	Ω
		$V_Z = V_{REF}$, LM431B, LM431C Frequency = 0 Hz (Figure 1)			0.50	Ω

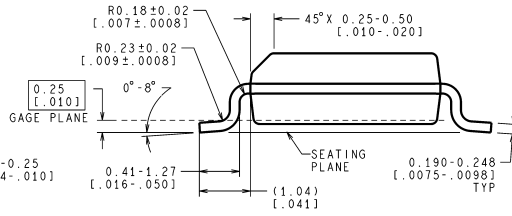
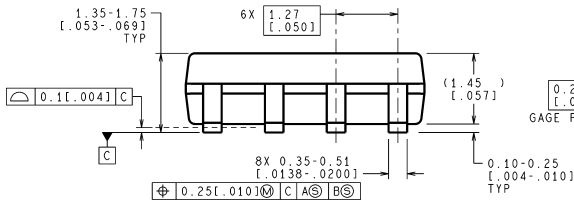
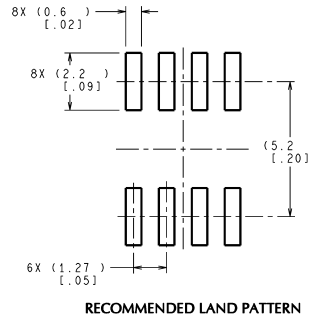
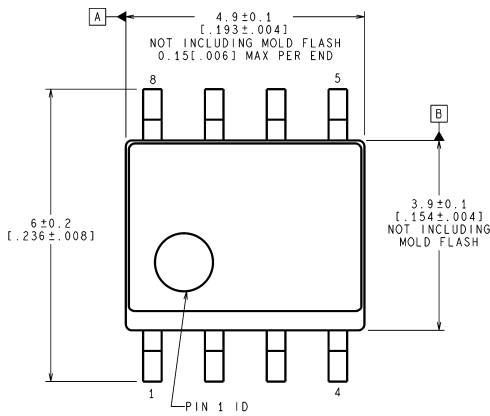
Note 2: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device beyond its rated operating conditions.

Note 3: $T_{J\text{ Max}} = 150^\circ\text{C}$.

Note 4: Ratings apply to ambient temperature at 25°C. Above this temperature, derate the TO-92 at 6.2 mW/°C, the SO-8 at 6.5 mW/°C, the SOT-23 at 2.2 mW/°C and the micro SMD at 3mW/°C.

Note 5: Deviation of reference input voltage, V_{DEV} , is defined as the maximum variation of the reference input voltage over the full temperature range.

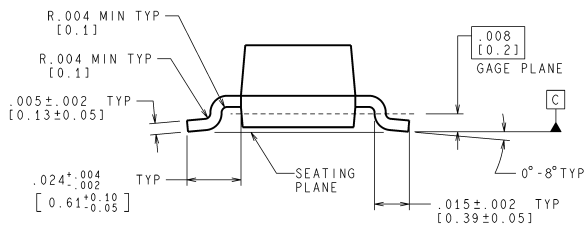
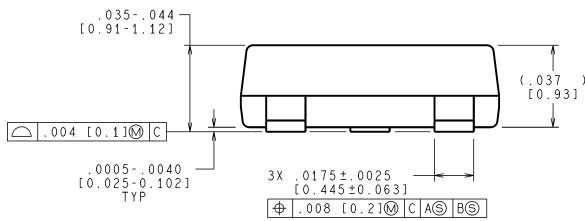
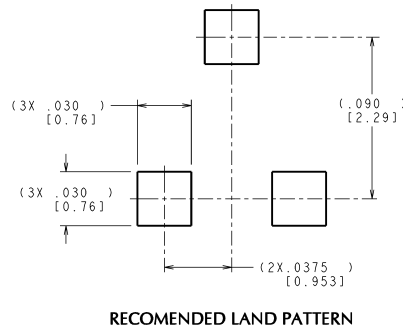
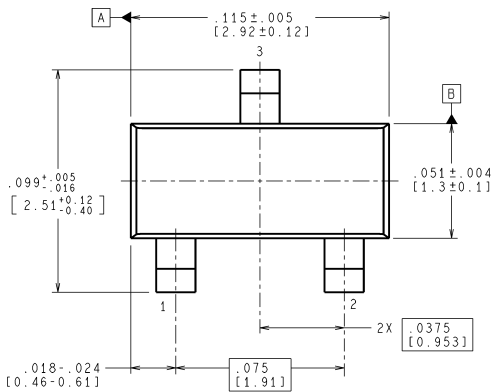
Physical Dimensions inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS MILLIMETER
VALUES IN [] ARE INCHES
DIMENSIONS IN () FOR REFERENCE ONLY

M08A (Rev K)

**8-Pin SOIC
NS Package Number M08A**



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS

MF03A (Rev B)

**SOT-23 Molded Small Outline Transistor Package (M3)
NS Package Number MF03A**