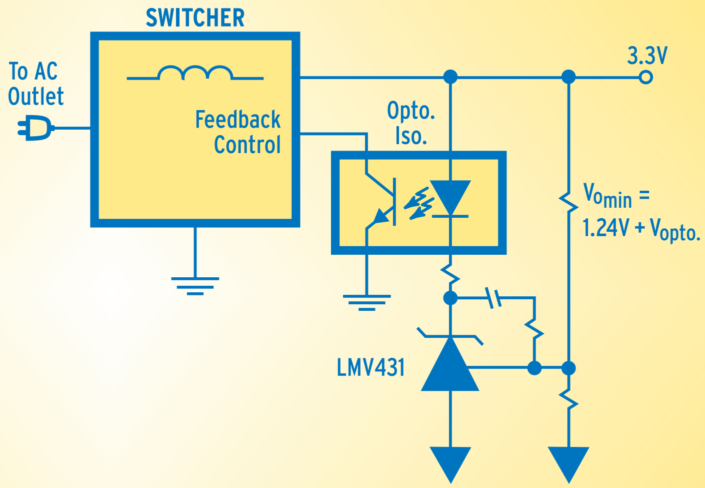
NATIONAL'S INDUSTRY STANDARD

LMV431

QUALIFICATION PACKAGE

LOW-VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR

3.3V Off-line Switching Regulator



- LOW VOLTAGE: 1.24V
- WIDE ADJUSTABLE OUTPUT RANGE: 1.24V TO 30V
- 1% AND 1.5% REFERENCE VOLTAGE TOLERANCES
- LOW OUTPUT IMPEDANCE: 0.25Ω
- FAST TURN-ON CHARACTERISTICS
- TO-92 AND SPACE SAVING SOT23-5 PACKAGES
- LOW PRICE
- INDUSTRIAL AND COMMERCIAL TEMP RANGE

National Semiconductor

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LMV431
QUALIFICATION PACKAGE

Summer 1999

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1.0 INTRODUCTION

1.1 General Product Description

This qualification packet covers the LMV431 low-voltage adjustable precision shunt regulator. It features low-voltage operation, down to 1.24V, and a wide adjustable range, up to 30V. Offered in 1% or 1.5% reference voltage tolerance versions, it is available in the TO-92 or SOT23-5 packages in both industrial and commercial temperature ranges.

1.2 Technical Product Description

The LMV431 uses a 1.24 band-gap reference instead of zener diode to overcome the shortcomings of low voltage zeners. Zener voltages below 6V tend to suffer in performance. The LMV431 provides a sharp turn-on voltage, a precision tolerance, a low temperature coefficient and a low bias current operation.

The band-gap reference is in essence a temperature compensated circuit. It sums the negative temperature coefficient (TC) of a transistor with a positive TC of equal and opposite slope. When summed, these slopes cancel each other out, resulting in a relatively flat TC.

The positive TC is generated by taking the difference between base-emitter voltages of two transistors running at different current densities. Current density is directly related to transistor saturation current (Is). Using the Ebers-Moll transistor model, the difference between two base-emitter voltages at different current densities results in the following: $\Delta V_{be} = V_t \ln (I_{S2}/I_{S1})$. The LMV431 uses a ratio of 10, causing the equation to become $\Delta V_{be} = V_t \ln (10\ I_{S1}/\ I_{S1})$. The effect of saturation current cancels out and the TC becomes positive. The gain of the ΔV_{be} circuit is precisely trimmed to provide a positive TC slope that is equal in magnitude to the negative TC that it is summed with.

The LMV431 is adjustable by means of negative feedback. Refer to functional diagram in the datasheet. The LMV431 can be functionally viewed as a band-gap reference tied to the inverting input of an op amp whose output drives base of an NPN shunt transistor. When the collector/cathode is tied to the non-inverting input of the op amp, negative feedback results. This is because the shunt transistor inverts the op amp's output at its collector. If the collector is tied directly to the non-inverting input, the shunt transistor sinks the necessary to maintain the cathode at 1.24V. This voltage can be gained up by using a resistive divider terminated at the op amp's non-inverting input. (See datasheet).

1.3 Reliability/Qualification Overview

The LMV431 is fabricated with the LB300 process. This device is the first LB300 product to be packaged in 5L SOT-23 and 3L TO-92. Therefore, the qualification plan also included package qualifications for each of these package combinations. The LMV431 was qualified with static operating life testing on the 3L TO-92 packaged version, along with autoclave, temperature cycle, and temperature humidity bias test on each of the package types. All tests were successfully completed. Please refer to the reliability report included in this booklet for more details.

1.4 Technical Assistance

Americas
Tel: 1-800-272-9959
Fax: 1-800-737-7018
Email: support@nsc.com

Europe
Fax: +49 (0) 1 80 5 30 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 1 80 5 30 85 85
English Tel: +49 (0) 1 80 5 32 78 32

Japan
Tel: 81-3-5639-7560
Fax: 81-3-5639-7507

Asia Pacific
Fax: 65-2504466
Email: sea.support@nsc.com
Tel: 65-2544466
(IDD telephone charge to be paid by caller)

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2.0 DEVICE INFORMATION

2.1 Datasheet

National Semiconductor

April 1999

LMV431/LMV431A
Low-Voltage (1.24V) Adjustable Precision Shunt Regulators

General Description

The LMV431and LMV431A are precision 1.24V shunt regulators capable of adjustment to 30V. Negative feedback from the cathode to the adjust pin controls the cathode voltage, much like a non-inverting op amp configuration (Refer to Symbol and Functional diagrams). A two resistor voltage divider terminated at the adjust pin controls the gain of a 1.24V band-gap reference. Shorting the cathode to the adjust pin (voltage follower) provides a cathode voltage of a 1.24V.

The LMV431 and LMV431A have respective initial tolerances of 1.5% and 1%. Both grades are available in commercial and Industrial temperature ranges.

The LMV431 and LMV431A functionally lends themselves to several applications that require zener diode type performance at low voltages. Applications include a 3V to 2.7V low drop-out regulator, an error amplifier in a 3V off-line switching regulator and even as a voltage detector. The part is typically stable with capacitive loads greater than 10nF and less than 50 pF.

The LMV431 and LMV431A provide performance at a competitive price.

Features

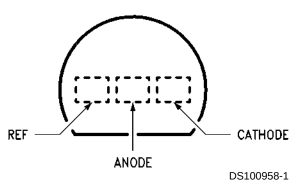
- Low Voltage Operation/Wide Adjust Range (1.24V/30V)
- 1% Initial Tolerance (LMV431A)
- Temperature Compensated for Industrial Temperature Range (39 PPM/˚C for the LMV431AI)
- Low Operation Current (55µA)
- Low Output Impedance (0.25Ω)
- Fast Turn-On Response
- Low Cost

Applications

- Shunt Regulator
- Series Regulator
- Current Source or Sink
- Voltage Monitor
- Error Amplifier
- 3V Off-Line Switching Regulator
- Low Dropout N-Channel Series Regulator

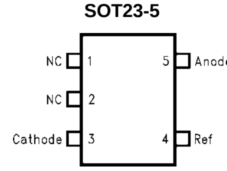
Connection Diagrams

TO92: Plastic Package



Top View
Order Number LMV431AIZ, LMV431IZ, LMV431ACZ, LMV431CZ

SOT23-5



Top View
Order Number LMV431AIM5, LMV431IM5, LMV431ACM5, LMV431CM5

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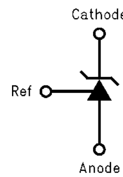
Symbol and Functional Diagrams



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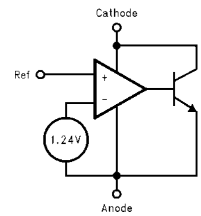

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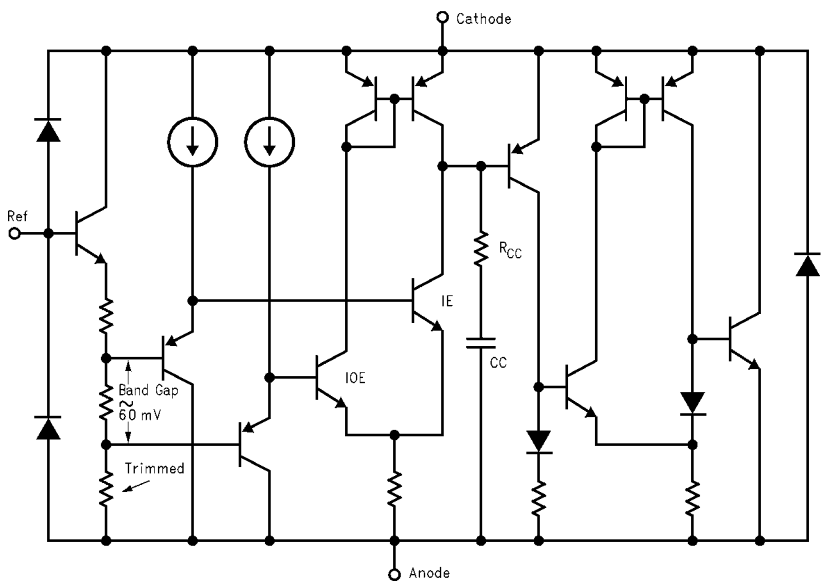
Simplified Schematic



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Ordering Information

Package	Temperature Range	Voltage Tolerance	Part Number	Package Marking	Drawing Number
TO92	Industrial Range −40˚C to +85˚C	1%	LMV431AIZ	LMV431AIZ	Z03A
		1.5%	LMV431IZ	LMV431IZ	
	Commerial Range 0˚C to + 70˚C	1%	LMV431ACZ	LMV431ACZ	
		1.5%	LMV431CZ	LMV431CZ	
SOT23-5	Industrial Range −40˚C to +80˚C	1%	LMV431AIM5	N08A	MA05A
		1%	LMV431AIM5X	N08A	
		1.5%	LMV431IM5	N08B	
		1.5%	LMV431IM5X	N08B	
	Commercial Range 0˚C to + 70˚C	1%	LMV431ACM5	N09A	
		1%	LMV431ACM5X	N09A	
		1.5%	LMV431CM5	N09B	
		1.5%	LMV431CM5X	N09B	

DC/AC Test Circuits for Table and Curves

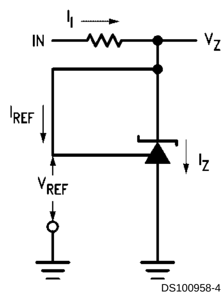
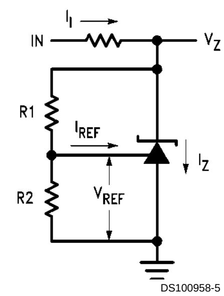


FIGURE 1. Test Circuit for $V_Z = V_{REF}$



Note: $V_Z = V_{REF} (1 + R1/R2) + I_{REF} \bullet R1$

FIGURE 2. Test Circuit for $V_Z > V_{REF}$

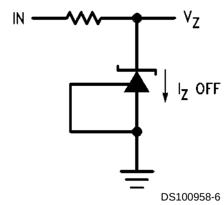


FIGURE 3. Test Circuit for Off-State Current

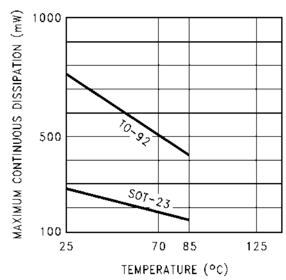
Absolute Maximum Ratings (Note 1)

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 (LMV431AI, LMV431I)	−40˚C to +85˚C
Commercial (LMV431AC, LMV431C)	0˚C to +70˚C
Lead Temperature	
TO92 Package/SOT23 -5Package	
(Soldering, 10 sec.)	265˚C
Internal Power Dissipation (Note 2) TO92	0.78W
SOT23-5 Package	0.28W
Cathode Voltage	35V
Continuous Cathode Current	−30 mA to +30 mA
Reference Input Current range	−.05mA to 3 mA

Operating Conditions

Cathode Voltage	V_{REF} to 30V
Cathode Current	0.1 mA to 15mA
Temperature range	
LMV431AI	−40˚C ≤ T_A ≤ 85˚C
Thermal Resistance (θ_{JA})(Note 3)	
SOT23-5 Package	455 ˚C/W
TO-92 Package	161 ˚C/W
Derating Curve (Slope = −1/θ_{JA})	



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LMV431C Electrical Characteristics

T_A = 25˚C unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{REF}	Reference Voltage	V_Z=V_{REF}, I_Z=10 mA *(See Figure 1)*	T_A = 25˚C	1.222	1.24	1.258	
			T_A = Full Range	1.21		1.27	V
V_{DEV}	Deviation of Reference Input Voltage Over Temperature (Note 4)	V_Z= V_{REF}, I_Z=10mA, T_A=Full Range *(See Figure 1)*			4	12	mV
$\frac{\Delta V_{REF}}{\Delta V_Z}$	Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	I_Z = 10 mA *(see Figure 2)* V_Z from V_{REF} to 6V R_1 = 10k, R_2 = ∞ and 2.6K			−1.5	−2.7	mV/V
I_{REF}	Reference Input Current	R_1 = 10 kΩ, R_2 = ∞ I_I = 10 mA *(see Figure 2)*			0.15	0.5	µA
∝I_{REF}	Deviation of Reference Input Current over Temperature	R_1 = 10 kΩ, R_2 = ∞, I_I = 10 mA, T_A = Full Range *(see Figure 2)*			0.05	0.3	µA
$I_{Z(MIN)}$	Minimum Cathode Current for Regulation	V_Z = V_{REF} *(see Figure 1)*			55	80	µA
$I_{Z(OFF)}$	Off-State Current	V_Z=6V, V_{REF} = 0V *(see Figure 3)*			0.001	0.1	µA
r_Z	Dynamic Output Impedance (Note 5)	V_Z = V_{REF}, I_Z = 0.1mA to 15mA Frequency = 0 Hz *(see Figure 1)*			0.25	0.4	Ω

LMV431I Electrical Characteristics

T_A = 25˚C unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{REF}	Reference Voltage	V_Z=V_{REF}, I_Z=10 mA *(See Figure 1)*	T_A = 25˚C	1.222	1.24	1.258	V
			T_A = Full Range	1.202		1.278	
V_{DEV}	Deviation of Reference Input Voltage Over Temperature (Note 4)	V_Z= V_{REF}, I_Z=10mA, T_A=Full Range *(See Figure 1)*			6	20	mV
$\frac{\Delta V_{REF}}{\Delta V_Z}$	Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	I_Z = 10 mA *(see Figure 2)* V_Z from V_{REF} to 6V R_1 = 10k, R_2 = ∞ and 2.6K			−1.5	−2.7	mV/V
I_{REF}	Reference Input Current	R_1 = 10 kΩ, R_2 = ∞ I_I = 10 mA *(see Figure 2)*			0.15	0.5	µA
$\propto I_{REF}$	Deviation of Reference Input Current over Temperature	R_1 = 10 kΩ, R_2 = ∞, I_I = 10 mA, T_A = Full Range *(see Figure 2)*			0.1	0.4	µA
$I_{Z(MIN)}$	Minimum Cathode Current for Regulation	V_Z = V_{REF} *(see Figure 1)*			55	80	µA
$I_{Z(OFF)}$	Off-State Current	V_Z=6V, V_{REF} = 0V *(see Figure 3)*			0.001	0.1	µA
r_Z	Dynamic Output Impedance (Note 5)	V_Z = V_{REF}, I_Z = 0.1mA to 15mA Frequency = 0 Hz *(see Figure 1)*			0.25	0.4	Ω

LMV431AC Electrical Characteristics

T_A = 25˚C unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{REF}	Reference Voltage	V_Z=V_{REF}, I_Z=10 mA *(See Figure 1)*	T_A = 25˚C	1.228	1.24	1.252	V
			T_A = Full Range	1.221		1.259	
V_{DEV}	Deviation of Reference Input Voltage Over Temperature (Note 4)	V_Z= V_{REF}, I_Z=10mA, T_A=Full Range *(See Figure 1)*			4	12	mV
$\frac{\Delta V_{REF}}{\Delta V_Z}$	Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	I_Z = 10 mA *(see Figure 2)* V_Z from V_{REF} to 6V R_1 = 10k, R_2 = ∞ and 2.6K			−1.5	−2.7	mV/V
I_{REF}	Reference Input Current	R_1 = 10 kΩ, R_2 = ∞ I_I = 10 mA *(see Figure 2)*			0.15	0.50	µA
$\propto I_{REF}$	Deviation of Reference Input Current over Temperature	R_1 = 10 kΩ, R_2 = ∞, I_I = 10 mA, T_A = Full Range *(see Figure 2)*			0.05	0.3	µA
$I_{Z(MIN)}$	Minimum Cathode Current for Regulation	V_Z = V_{REF} *(see Figure 1)*			55	80	µA
$I_{Z(OFF)}$	Off-State Current	V_Z=6V, V_{REF} = 0V *(see Figure 3)*			0.001	0.1	µA
r_Z	Dynamic Output Impedance (Note 5)	V_Z = V_{REF}, I_Z = 0.1mA to 15mA Frequency = 0 Hz *(see Figure 1)*			0.25	0.4	Ω

LMV431AI Electrical Characteristics

T_A = 25˚C unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{REF}	Reference Voltage	V_Z=V_{REF}, I_Z=10 mA *(See Figure 1)*	T_A = 25˚C	1.228	1.24	1.252	V
			T_A = Full Range	1.215		1.265	
V_{DEV}	Deviation of Reference Input Voltage Over Temperature (Note 4)	V_Z= V_{REF}, I_Z=10mA, T_A=Full Range *(See Figure 1)*			6	20	mV
$\frac{\Delta V_{REF}}{\Delta V_Z}$	Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	I_Z = 10 mA *(see Figure 2)* V_Z from V_{REF} to 6V R_1 = 10k, R_2 = ∞ and 2.6K			−1.5	−2.7	mV/V
I_{REF}	Reference Input Current	R_1 = 10 kΩ, R_2 = ∞ I_I = 10 mA *(see Figure 2)*			0.15	0.5	µA
∝I_{REF}	Deviation of Reference Input Current over Temperature	R_1 = 10 kΩ, R_2 = ∞, I_I = 10 mA, T_A = Full Range *(see Figure 2)*			0.1	0.4	µA
$I_{Z(MIN)}$	Minimum Cathode Current for Regulation	V_Z = V_{REF} *(see Figure 1)*			55	80	µA
$I_{Z(OFF)}$	Off-State Current	V_Z=6V, V_{REF} = 0V *(see Figure 3)*			0.001	0.1	µA
r_Z	Dynamic Output Impedance (Note 5)	V_Z = V_{REF}, I_Z = 0.1mA to 15mA Frequency = 0 Hz *(see Figure 1)*			0.25	0.4	Ω

Note 1: 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.

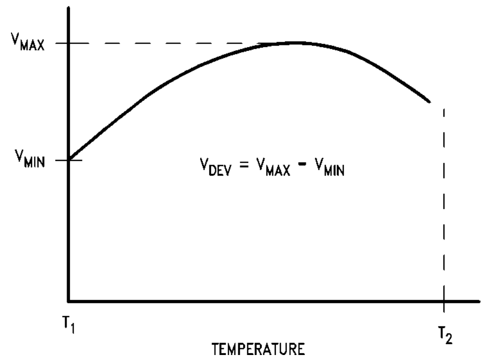
Note 2: Ratings apply to ambient temperature at 25˚C. Above this temperature, derate the TO92 at 6.2 mW/˚C, and the SOT23-5 at 2.2 mW/˚C. See derating curve in Operating Condition section..

Note 3: $T_{J\ Max}$ = 150˚C, T_J = T_A+ (θ_{JA} P_D), where P_D is the operating power of the device.

Note 4: Deviation of reference input voltage, V_{DEV}, is defined as the maximum variation of the reference input voltage over the full temperature range.

See following:

LMV431AI Electrical Characteristics (Continued)



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The average temperature coefficient of the reference input voltage, $\propto V_{REF}$, is defined as:

$$\propto V_{REF}\,\frac{ppm}{°C} = \frac{\pm\left[\frac{V_{Max} - V_{Min}}{V_{REF}\text{ (at 25°C)}}\right]10^6}{T_2 - T_1} = \frac{\pm\left[\frac{V_{DEV}}{V_{REF}\text{ (at 25°C)}}\right]10^6}{T_2 - T_1}$$

Where:

$T_2 - T_1$ = full temperature change.

$\propto V_{REF}$ can be positive or negative depending on whether the slope is positive or negative.

Example: V_{DEV} = 6.0mV, $_{REF}$ = 1240mV, $T_2 - T_1$ = 125˚C.

$$\propto V_{REF} = \frac{\left[\frac{6.0\text{ mV}}{1240\text{ mV}}\right]10^6}{125°C} = +39\text{ ppm/°C}$$

Note 5: The dynamic output impedance, r_Z, is defined as:

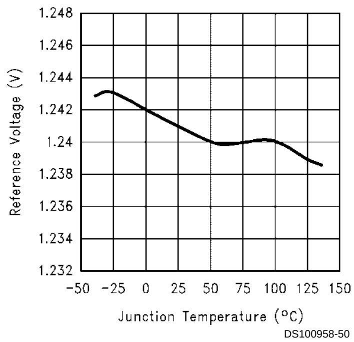
$$r_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

When the device is programmed with two external resistors, R1 and R2, (see *Figure 2*), the dynamic output impedance of the overall circuit, r_Z, is defined as:

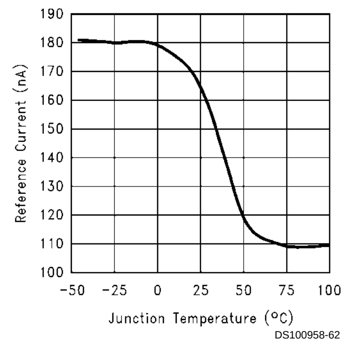
$$r_Z = \frac{\Delta V_Z}{\Delta I_Z} \sim \left[r_Z\left(1 + \frac{R1}{R2}\right)\right]$$

Typical Performance Characteristics

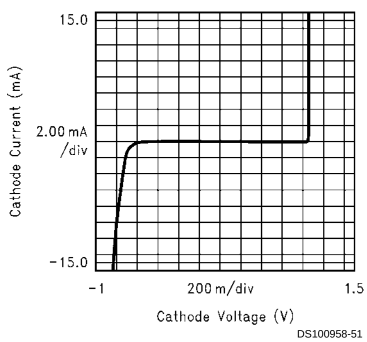
Reference Voltage vs Junction Temperature



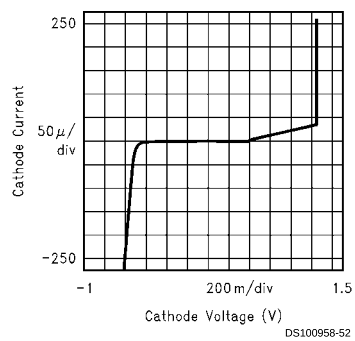
Reference Input Current vs Junction Temperature



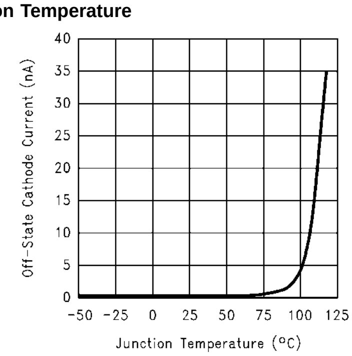
Cathode Current vs Cathode Voltage 1



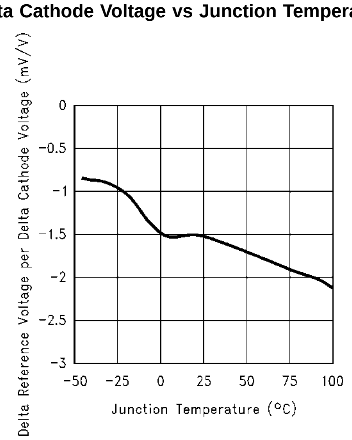
Cathode Current vs Cathode Voltage 2



Off-State Cathode Current vs Junction Temperature

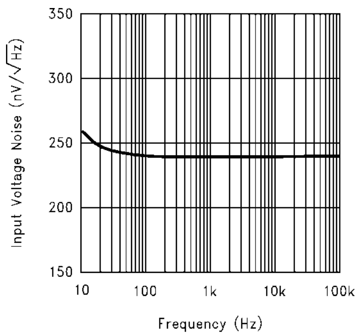


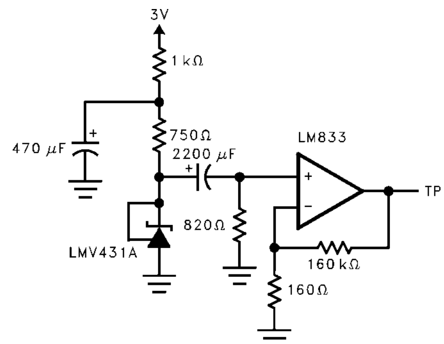
Delta Reference Voltage Per Delta Cathode Voltage vs Junction Temperature



Typical Performance Characteristics (Continued)

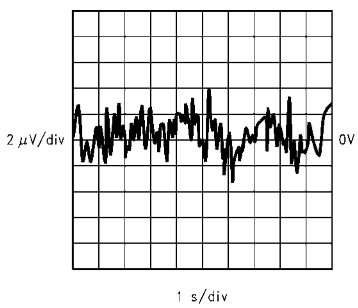
Input Voltage Noise vs Frequency

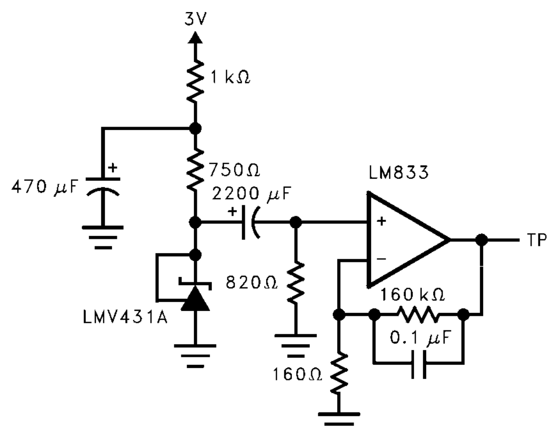




Test Circuit for Input Voltage Noise vs Frequency

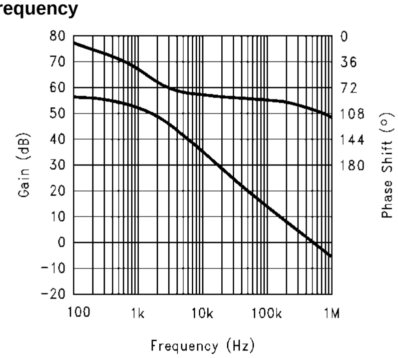
Low Frequency Peak to Peak Noise

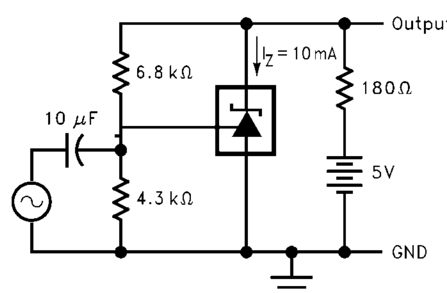




Test Circuit for Peak to Peak Noise (BW= 0.1Hz to 10Hz)

Small Signal Voltage Gain and Phase Shift vs Frequency

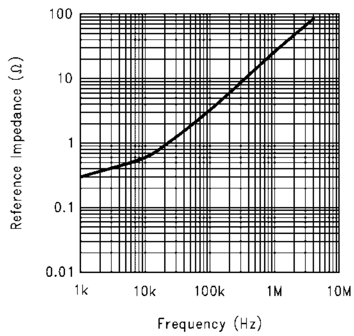




Test Circuit For Voltage Gain and Phase Shift vs Frequency

Typical Performance Characteristics (Continued)

Reference Impedance vs Frequency



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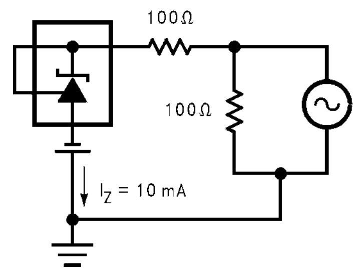

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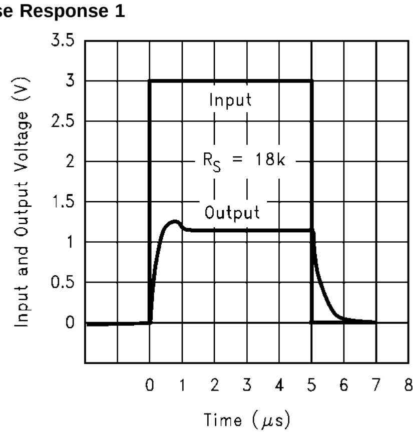
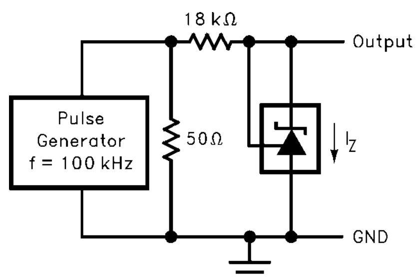
Test Circuit For Reference Impedance vs Frequency

Pulse Response 1



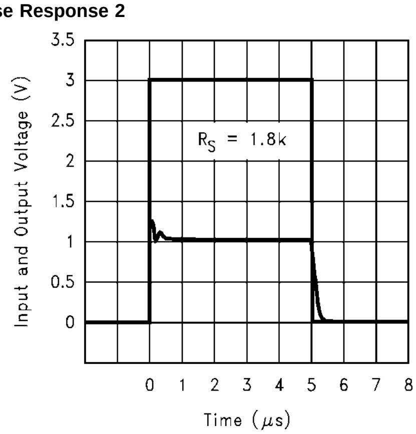
DS100958-57



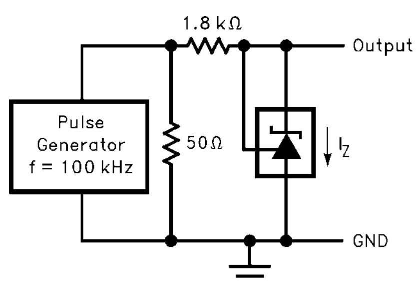
DS100958-48

Test Circuit for Pulse Response 1

Pulse Response 2



DS100958-58

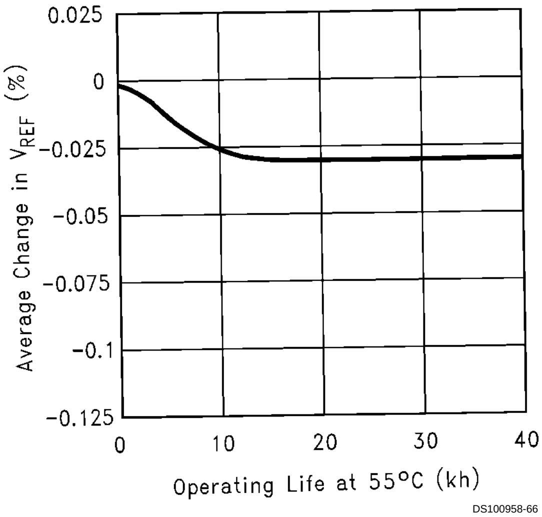


DS100958-49

Test Circuit for Pulse Response 2

Typical Performance Characteristics (Continued)

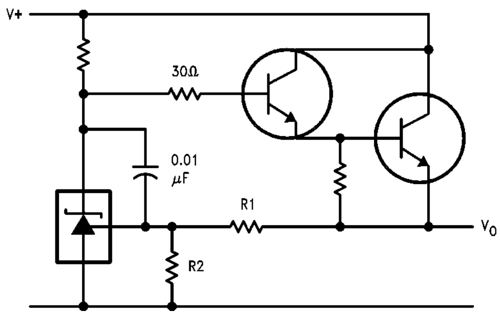
Percentage Change in V_{REF} vs Operating Life at 55˚C



Extrapolated from life-test data taken at 125˚C; the activation energy assumed is 0.7eV.

Typical Applications

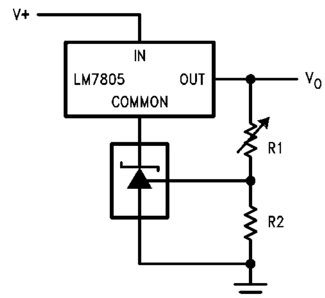
Series Regulator



DS100958-16

$$V_O \approx \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Output Control of a Three Terminal Fixed Regulator

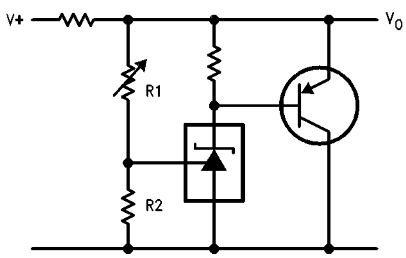


DS100958-17

$$V_O = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

$$V_{O\ MIN} = V_{REF} + 5V$$

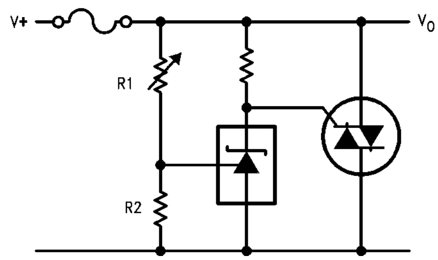
Higher Current Shunt Regulator



DS100958-18

$$V_O \approx \left(1 + \frac{R1}{R2}\right) V_{REF}$$

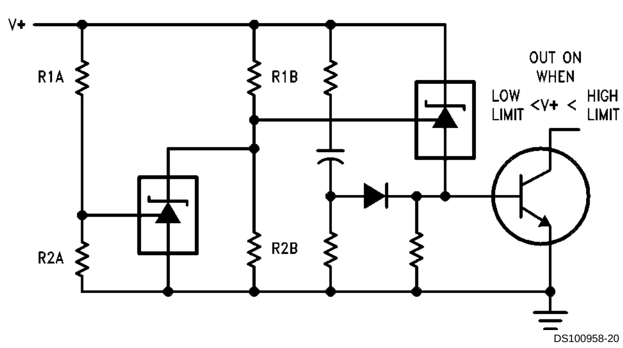
Crow Bar



DS100958-19

$$V_{LIMIT} \approx \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Over Voltage/Under Voltage Protection Circuit



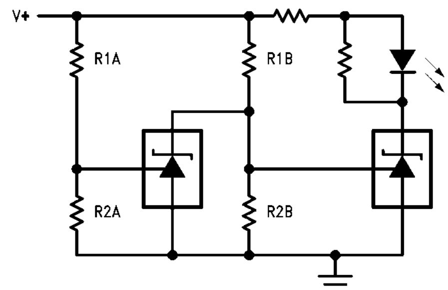
DS100958-20

$$\text{LOW LIMIT} \approx V_{REF}\left(1 + \frac{R1B}{R2B}\right) + V_{BE}$$

$$\text{HIGH LIMIT} \approx V_{REF}\left(1 + \frac{R1A}{R2A}\right)$$

Typical Applications (Continued)

Voltage Monitor



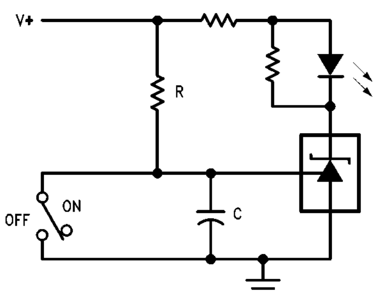
DS100958-21

$$\text{LOW LIMIT} \approx V_{REF}\left(1 + \frac{R1B}{R2B}\right)$$

LED ON WHEN LOW LIMIT $< V^{+} <$ HIGH LIMIT

$$\text{HIGH LIMIT} \approx V_{REF}\left(1 + \frac{R1A}{R2A}\right)$$

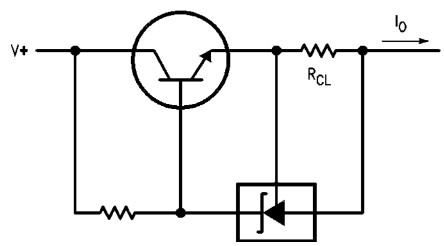
Delay Timer



DS100958-22

$$\text{DELAY} = R \bullet C \bullet \ell n \frac{V+}{(V^{+}) - V_{REF}}$$

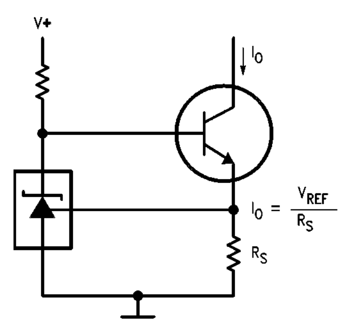
Current Limiter or Current Source



DS100958-23

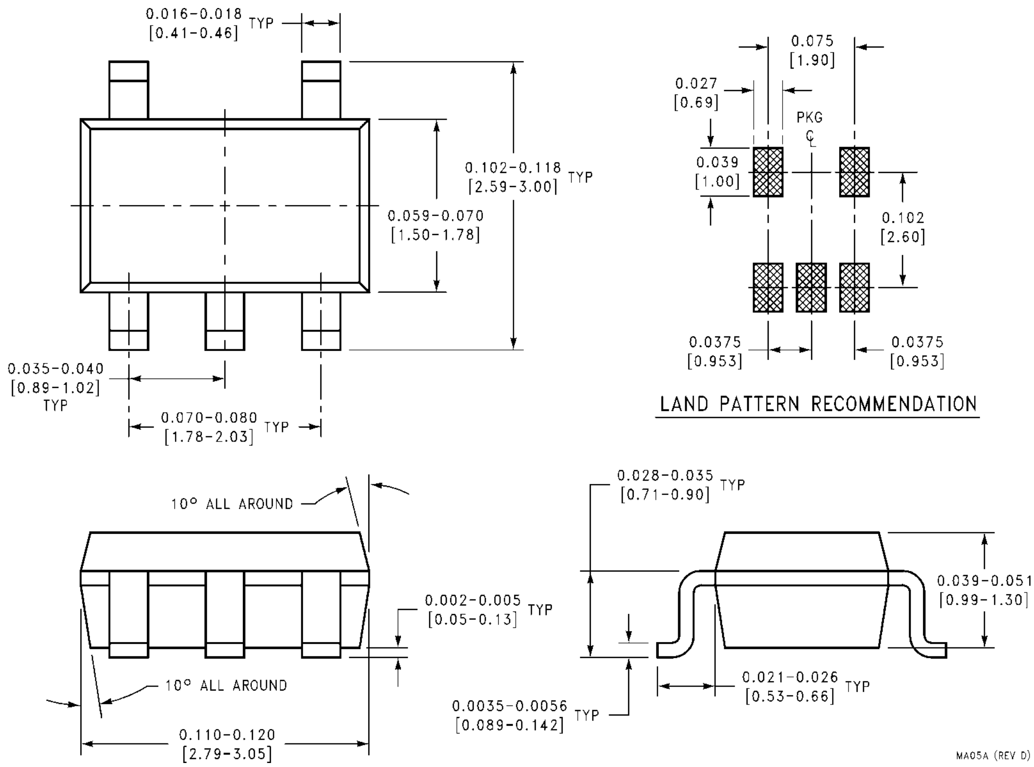
$$I_O = \frac{V_{REF}}{R_{CL}}$$

Constant Current Sink



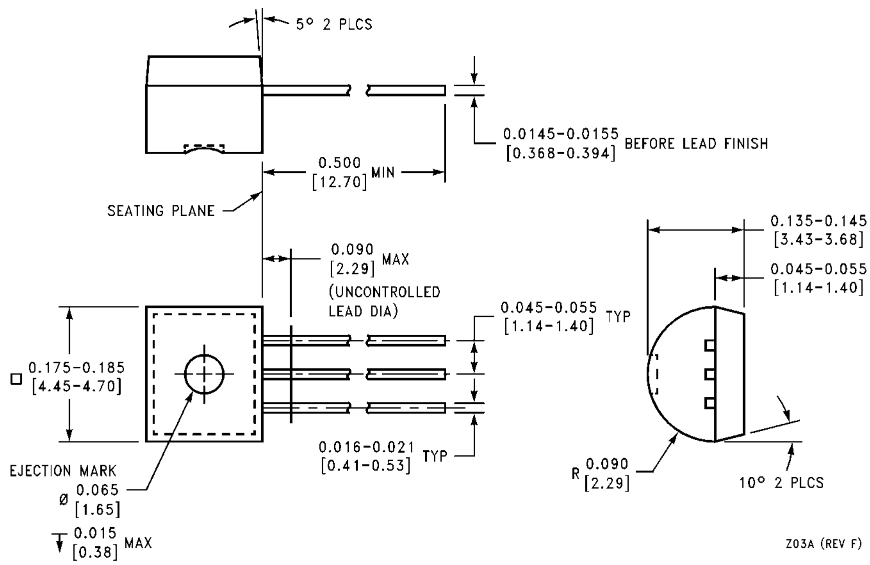
DS100958-24

Physical Dimensions inches (millimeters) unless otherwise noted



SOT23-5 Molded Small Outline Transistor Package (M5)
Order Number LMV431AIM5, LMV431AIM5X,
NS Package Number MA05A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



Order Number LMV431AIZ, LMV431AIZX,
NS Package Number Z03A

National Semiconductor Corporation
Americas
Tel: 1-800-272-9959
Fax: 1-800-737-7018
Email: support@nsc.com

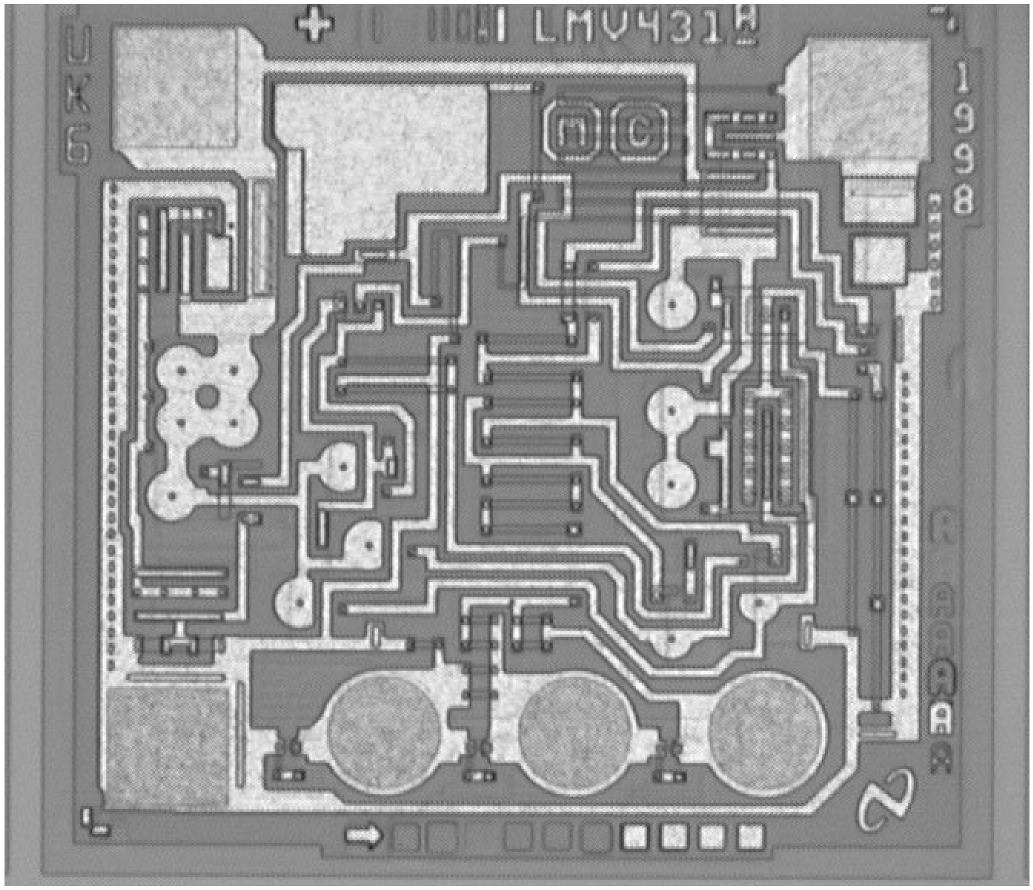
www.national.com

National Semiconductor Europe
Fax: +49 (0) 1 80-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 1 80-530 85 85
English Tel: +49 (0) 1 80-532 78 32
Français Tel: +49 (0) 1 80-532 93 58
Italiano Tel: +49 (0) 1 80-534 16 80

National Semiconductor Asia Pacific Customer Response Group
Tel: 65-2544466
Fax: 65-2504466
Email: sea.support@nsc.com

National Semiconductor Japan Ltd.
Tel: 81-3-5639-7560
Fax: 81-3-5639-7507

2.2 Die Photo



3.0 PROCESS INFORMATION

3.1 Process Details

Fabrication Site: Fab 3 , Greenock , Scotland
Process Technology: LB300
Minimum Feature Size: 3µm X 3µm
Wafer Diameter: 6 inches
Number of Masks: 12
Metallization: 0.5% Copper / Aluminum
Passivation: VOM & Nitride

3.2 Process Mask Steps

Name	Mask	FM_GDS
COLLECTOR	10	1
UP ISOLATION	19	2
PLUG	22	3
ISOLATION/DEEP BASE	28	4 + 5
FIELD THRESH ADJUST	26	6
BASE	30	7
EMITTER	40	8
RESISTOR	41	9
CAPACITOR	42	10
CONTACT	50	11
METAL	60	12
PAD	70	15

3.3 Process Flow

1. Initial Ox
2. Collector Mask
3. Collector Implant
4. Collector Drive
5. Up Isolation Mask
6. Up Isolation Implant
7. Epi Strip
8. Epi Growth
9. Epi Reox
10. Plug Mask
11. Plug Predep
12. Plug Diffusion
13. Iso/DB Mask
14. Pre Iso/DB Implant Oxidation
15. Iso/DB Implant
16. Iso/DB Drive
17. FTA Mask
18. FTA Implant
19. FTA Re-oxidation
20. Base Mask
21. Pre-BaseImplant Oxidation
22. Base Implant
23. Base Drive
24. Post Base Oxidation
25. Emitter Mask
26. Screen Oxidation
27. Emitter Implant
28. Emitter Drive
29. Resistor Mask
30. Resistor Implant
31. Vapox Over Emitter
32. Getter
33. Capacitor Mask
34. Capacitor Ox
35. MEC Anneal
36. Contact Mask
37. Pt Deposition
38. Pt Silicide
39. Pt Strip
40. TiW Deposition
41. Metal Deposition
42. Metal Mask
43. Dual Layer Passivation
44. Pad Mask
45. Anneal

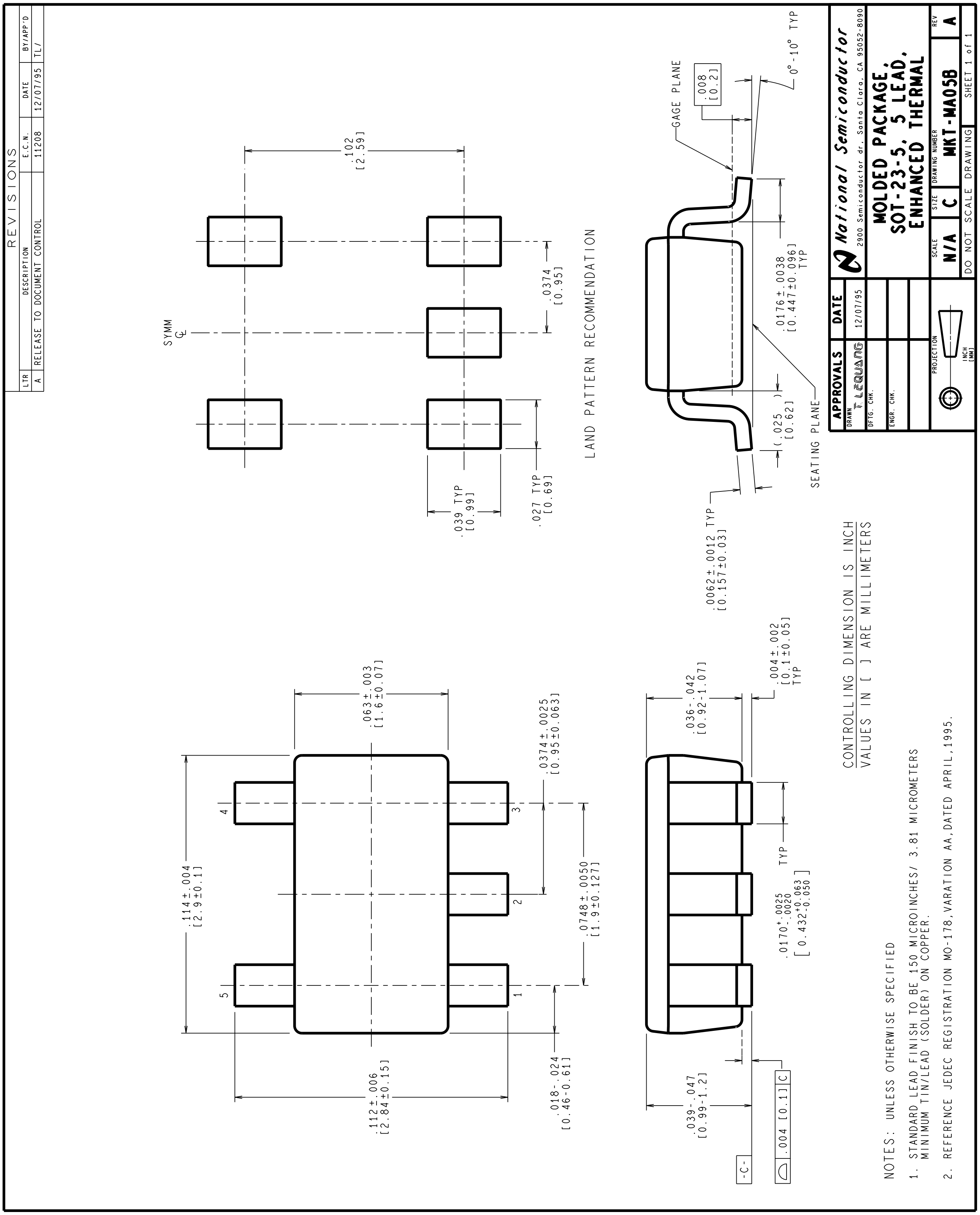
4.0 PACKAGING INFORMATION

4.1 Package Material

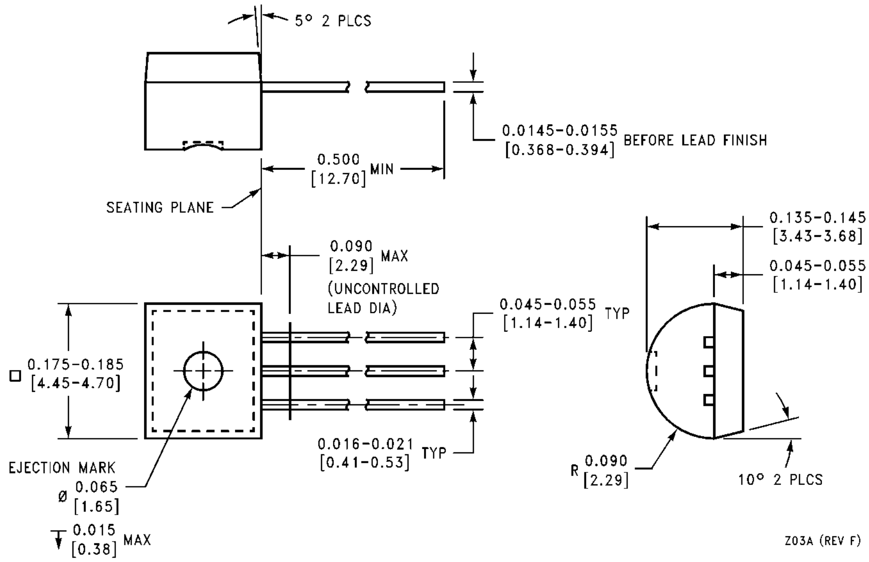
Generic Package Type	**SOT23-5**	**3 lead TO-92**
NS Package Number	MA05B	Z03A
Package Material Type	Molded Plastic	Molded Plastic
Mold Compound Manufacturer's Designation	Sumitomo B18	Plaskon B8
Lead Frame Material	Alloy 194	Copper
Lead Frame Manufacturer	POSSEHL	DCI (Dynacraft Industries)
External Lead Frame Coating	Tin/Lead on Copper	Tin/Lead on Copper
Die Attach Method	Preform (Eutectic)	Preform (Eutectic)
Bond Wire	Gold, (1Mil)	Gold, (1 Mil)
Bond Type	Thermosonic Ball	Thermosonic Ball
Package Thermal	289°C/W θjA,	125°C/W θjC 208°C/W θjA (still air)

4.2 Package Dimensions

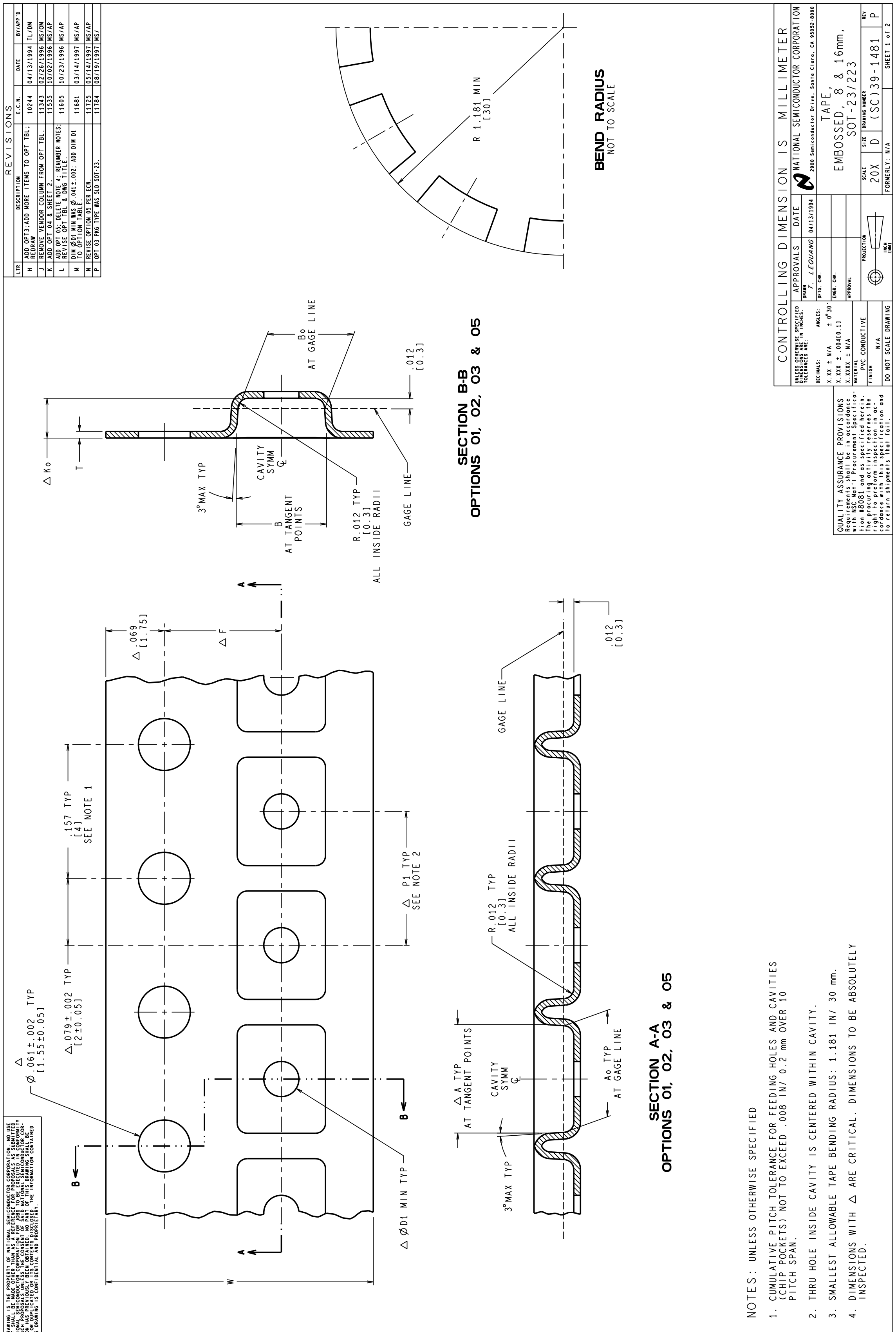
4.2.1 SOT23-5



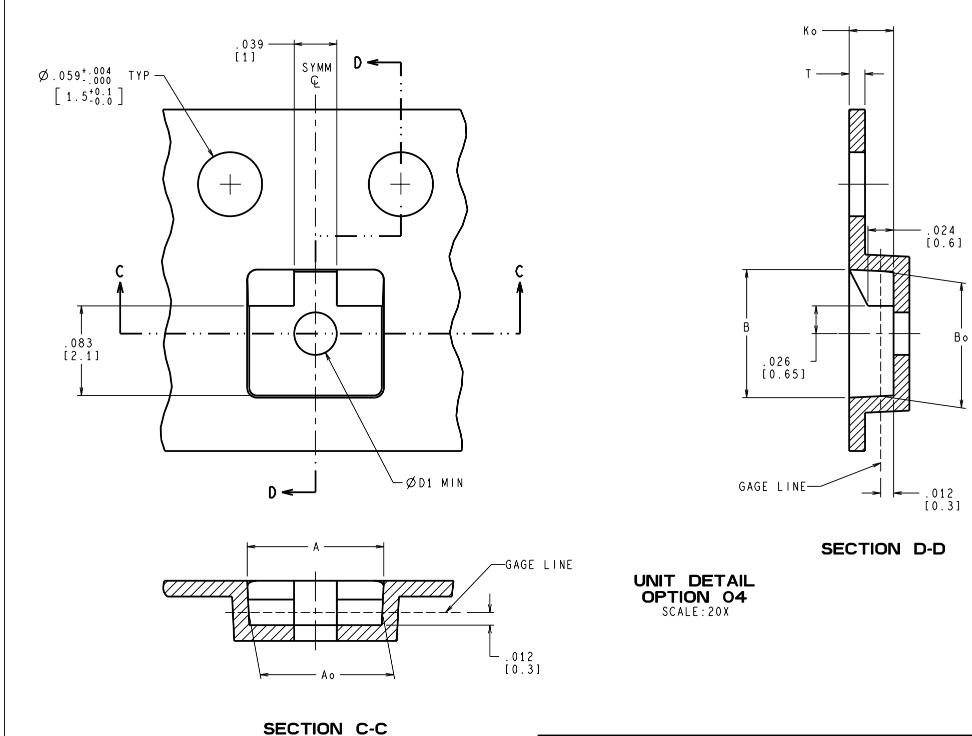
4.2.2 TO-92
NS Package Number Z03A



4.3 Tape & Reel Dimensions



REVISIONS				
LTR	DESCRIPTION	E.C.N.	DATE	BY/APP'D
	SEE SHEET 1			



OPT	STOCK #	DESC	PKG TYPE	TAPE SIZE	DIM A	DIM Ao	DIM B	DIM Bo	DIM D1	DIM F	DIM Ko	DIM P1	DIM T	DIM W
05	061444	STD PROFILE	3/4/5LD SOT-223	16 mm	.280 [7.1]	.276 [7]	.299 [7.6]	.295 [7.5]	.059 [1.5]	.295 ±.002 [7.5 ±0.05]	.087 ±.004 [2.2 ±0.1]	.472 [12]	.012 ±.004 [0.3 ±0.1]	.630 ±.012 [16 ±0.3]
04	060856	STD PROFILE	3LD SUPER SOT	8 mm	.126 [3.2]	.122 [3.1]	.118 [3]	.114 [2.9]	.039 [1]	.138 ±.002 [3.5 ±0.05]	.049 ±.004 [1.24 ±0.1]	.157 [4]	.0080 ±.0012 [0.20 ±0.03]	.315 +.012 -.004 [8 +0.3 -0.1]
03	052803	STD PROFILE	5/6LD SOT-23	8 mm	.130 [3.3]	.124 [3.15]	.130 [3.3]	.126 [3.2]	.039 [1]	.138 ±.002 [3.5 ±0.05]	.055 ±.004 [1.4 ±0.1]	.157 [4]	.008 ±.004 [0.2 ±0.1]	.315 ±.012 [8 ±0.3]
02	000579	LOW PROFILE	3LD SOT-23	8 mm	.130 [3.3]	.124 [3.15]	.106 [2.7]	.100 [2.55]	.039 [1]	.138 ±.002 [3.5 ±0.05]	.042 ±.002 [1.07 ±0.05]	.157 [4]	.008 ±.004 [0.2 ±0.1]	.315 ±.012 [8 ±0.3]
01	900553	STD PROFILE	3LD SOT-23	8 mm	.130 [3.3]	.124 [3.15]	.106 [2.7]	.100 [2.55]	.039 [1]	.138 ±.002 [3.5 ±0.05]	.047 ±.002 [1.19 ±0.05]	.157 [4]	.008 ±.004 [0.2 ±0.1]	.315 ±.012 [8 ±0.3]

CONTROLLING DIMENSION IS MILLIMETER

QUALITY ASSURANCE PROVISIONS
Requirements shall be in accordance with NSC Mat'l Procurement Specification #8081 and as specified herein. The procuring activity reserves the right to perform inspection in accordance with this specification and to return shipments that fail.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:
DECIMALS: .XX ± N/A, .XXX ± .004[0.1], .XXXX ± N/A
ANGLES: ± 0°30'
MATERIAL: PVC CONDUCTIVE
FINISH: N/A
DO NOT SCALE DRAWING

APPROVALS	DATE
DRAWN T. LEQUANG	04/13/1994
DFTG. CHK.	
ENGR. CHK.	

PROJECTION — INCH [MM]

National Semiconductor
2900 Semiconductor dr, Santa Clara, CA 95052-8090

TAPE, EMBOSSED, 8 & 16mm, SOT-23/223

SCALE	SIZE	DRAWING NUMBER	REV
20X	D	(SC)39-1481	P

FORMERLY: N/A — SHEET 2 of 2

5.0 RELIABILITY DATA

National Semiconductor

Reliability Test Report

File Number:
FEM19980537
Originator: Suresh Kumar
Date:December 1, 1998

Purpose

LMV431 New Device Qualification

Approvals

Reliability Engineer

Mgr Ref Engineering

Reference File Numbers

REM199803547
REM199803121
Q19980489

Distribution List

KP Kok, Nick Stanco, Steve Messer

Abstract

The LMV431 is a new device being qualified for the Standard Analog product line. The device is a low power LB300 process version of the previously qualified LM431 Shunt Regulator on the Bipolar Linear process. The LMV431 will be assembled in the 5L SOT-23 and 3L TO-92 packages, neither of which has been qualified with the LB300 process. The LMV431 is intended for general purpose release and will be qualified as a Category I device per (SC)CSP-5-252. Based on the extensive data available on both the 5L SOT-23 and 3L TO-92 packages with other Bipolar processes, the package related reliability test requirements for each package type will be reduced to one lot from the standard three lot requirement for unqualified process/package combinations. The LMV431 will be qualified via 3 lots of SOPL testing on the 3L TO-92 packaged version (to utilize current boards) along with one lot of ACLV, TMCL and THBT on each of the package types

Description

Test Request	Device Name	Sbgp	Wafer Die Run	Fab Loc	Fab Line	Pkg Code	# Leads	Assy Loc	Date Cd
REM199803121	LMV431AIM5 (Sot 23 5L)	A	XXXXXXXXXX	UK	6 INCH	N\TG23	5	EM	9836
REM199803547	LMV431AIZ (T092)	A	XXXXXXXXXX	UK	6 INCH	N\TO92	3	EM	9842
REM199803547	LMV431AIZ (T092)	B	XXXXXXXXXX	UK	6 INCH	N\TO92	3	EM	9842
REM199803547	LMV431AIZ (T092)	C	XXXXXXXXXX	UK	6 INCH	N\TO92	3	EM	9842

Tests Performed

Surface mount device will undergo the preconditioning

Preconditioning Flow
TMCL (-40/60) → Bake (125C) 24hrs → THST (85C/85%RH) 168hrs → Reflow (235C) 3 passes → Flux immersion → Rinse → Dry → Ate

Test: Autoclave Test (ACLV)

Test Request	Device	Sbgrp	Rel Humidity	Pressure	High Temp	Low Temp
REM199803121	LMV431AIM5	A	100	15	121	
REM199803547	LMV431AIZ	A	100	15	121	
REM199803547	LMV431AIZ	B	100	15	121	
REM199803547	LMV431AIZ	C	100	15	121	

Tests Performed

Timepoints:

Test Request	TP	Duration
REM199803121	1	168
REM199803547	1	168

Test: Operating Life Test (Static) (SOPL)

Test Request	Device	Sbgrp	Rel Humidity	Pressure	High Temp	Low Temp
REM199803547	LMV431AIZ	A			150	
REM199803547	LMV431AIZ	B			150	
REM199803547	LMV431AIZ	C			150	

Timepoints:

Test Request	TP	Duration
REM199803547	1	168
REM199803547	2	500
REM199803547	3	1000

Test: Temperature Cycle (TMCL)

Test Request	Device	Sbgrp	Rel Humidity	Pressure	High Temp	Low Temp
REM199803121	LMV431AIM5	A			150	-65
REM199803547	LMV431AIZ	A			150	-65
REM199803547	LMV431AIZ	B			150	-65
REM199803547	LMV431AIZ	C			150	-65

Timepoints:

Test Request	TP	Duration
REM199803121	1	500
REM199803121	2	1000
REM199803547	1	500
REM199803547	2	1000

Test: Temperature Humidity Bias Test (THBT)

Test Request	Device	Sbgrp	Rel Humidity	Pressure	High Temp	Low Temp
REM199803121	LMV431AIM5	A	85		85	
REM199803547	LMV431AIZ	A	85		85	
REM199803547	LMV431AIZ	B	85		85	
REM199803547	LMV431AIZ	C	85		85	

Timepoints:

Test Request	TP	Duration
REM199803121	1	168
REM199803121	2	500
REM199803121	3	1000
REM199803547	1	168
REM199803547	2	500
REM199803547	3	1000

Results/Discussion

Test: Autoclave Test (ACLV)

Test Request	Device	Sbgrp	TP	Duration	Sample Size	Rejects
REM199803121	LMV431AIM5	A	0	Precond	50	0
REM199803121	LMV431AIM5	A	1	168	50	0
REM199803547	LMV431AIZ	A	1	168	50	0
REM199803547	LMV431AIZ	B	1	168	50	0
REM199803547	LMV431AIZ	C	1	168	50	0

Test: Operating Life Test (Static) (SOPL)

Test Request	Device	Sbgrp	TP	Duration	Sample Size	Rejects
REM199803547	LMV431AIZ	A	1	168	100	0
REM199803547	LMV431AIZ	A	2	500	100	0
REM199803547	LMV431AIZ	B	1	168	100	0
REM199803547	LMV431AIZ	B	2	500	100	0
REM199803547	LMV431AIZ	C	1	168	100	0
REM199803547	LMV431AIZ	C	2	500	100	0

Test: Temperature Humidity Bias Test (THBT)

Test Request	Device	Sbgrp	TP	Duration	Sample Size	Rejects
REM199803121	LMV431AIM5	A	0	Precond	100	0
REM199803121	LMV431AIM5	A	1	168	100	0
REM199803121	LMV431AIM5	A	1	500	88	0
REM199803547	LMV431AIZ	A	1	168	100	0
REM199803547	LMV431AIZ	A	2	500	88	0
REM199803547	LMV431AIZ	B	1	168	100	0
REM199803547	LMV431AIZ	B	2	500	88	0
REM199803547	LMV431AIZ	C	1	168	100	0
REM199803547	LMV431AIZ	C	2	500	88	0

Test: Temperature Cycle (TMCL)

Test Request	Device	Sbgrp	TP	Duration	Sample Size	Rejects
REM199803121	LMV431AIM5	A	0	Precond	100	0
REM199803121	LMV431AIM5	A	1	500	100	0
REM199803121	LMV431AIM5	A	2	1000	100	0
REM199803547	LMV431AIZ	A	1	500	100	0
REM199803547	LMV431AIZ	A	2	1000	100	0
REM199803547	LMV431AIZ	B	1	500	100	0
REM199803547	LMV431AIZ	B	2	1000	100	0
REM199803547	LMV431AIZ	C	1	500	100	0
REM199803547	LMV431AIZ	C	2	1000	100	0

Conclusion

Based on the qualification results on the stress test, the LMV431 has passed the stress test in both Sot23 5 leads and TO92 package. They have passed the release time points.

National Semiconductor supplies a comprehensive set of service and support capabilities. Complete product information and design support is available from National's customer support centers.

To receive sales literature and technical assistance, contact the National support center in your area.

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Phone:

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English	**+44 (0) 870 24 0 2171**
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