



# THE DATASHEET OF LA431OHPA



## ADJUSTABLE PRECISION SHUNT REGULATION

### General Description

The DIODES™ LA431 is a low voltage three terminal adjustable shunt regulator with a guaranteed thermal stability over applicable temperature ranges. The output voltage can be set to any value between 2.495V (VREF) to 36V with two external resistors (please refer application circuit). The high precise Reference voltage tolerance is available in two grades:  $\pm 0.4\%$  and  $\pm 1.0\%$ . This device has a typical minimum cathode current of 0.1 mA. Active output circuitry provides a very sharp turn on characteristic, making this device excellent replacement for Zener diodes in many applications.

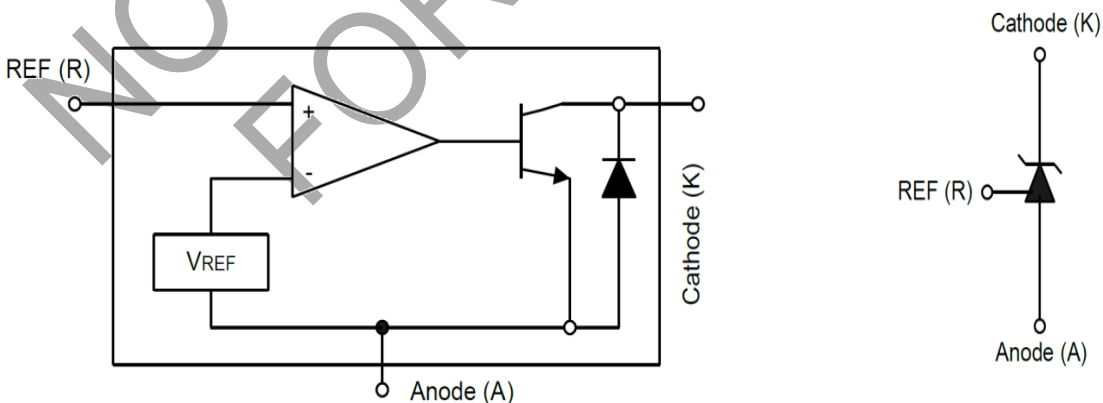
### Features

- Precision reference voltage :
  - LA431O :  $2.495V \pm 0.4\%$
  - LA431N :  $2.495V \pm 1.0\%$
- Adjustable output voltage is VREF to 36V
- Sink current capability is 120mA
- Low dynamic output impedance is  $0.2\Omega$  (typ.)
- Minimum Cathode current for regulation is 0.1mA (typ.)
- Plastic material has UL flammability classification 94V-0

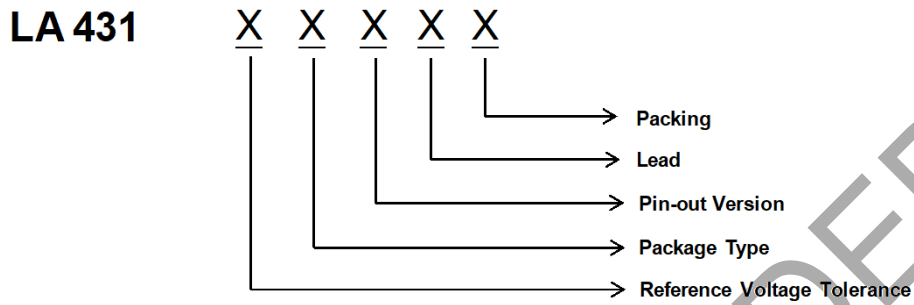
### Applications

- Switching Mode Power Supply
- Voltage Reference Application

### Block Diagram & Symbol



**Ordering Information**

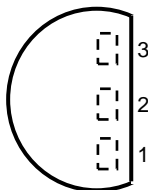


Reference Voltage Tolerance	Package Type	Pin-out Version	Lead	Packing
O : ±0.4% N : ±1.0%	H : TO92-3L C : SOT23-3L	Blank (TO92-3L)  A (SOT23-3L)  R (SOT23-3L)	1. REF 2. ANODE 3. CATHODE  1. CATHODE 2. REF 3. ANODE  1. REF 2. CATHODE 3. ANODE	P : RoHS & Halogen Free (ref. IEC 61249-2-21)  A : Tape & Reel

Product Number	Output Voltage Tolerance	Package	Lead	Packing
LA431OHPA	0.4 %	TO92-3L	RoHS& Halogen Free	Taping
LA431NHPA	1.0 %	TO92-3L	RoHS& Halogen Free	Taping
LA431OCAPA	0.4 %	SOT23-3L	RoHS& Halogen Free	Taping & Reel
LA431NCAPA	1.0 %	SOT23-3L	RoHS& Halogen Free	Taping & Reel
LA431OCRPA	0.4 %	SOT23-3L	RoHS& Halogen Free	Taping & Reel
LA431NCRPA	1.0 %	SOT23-3L	RoHS& Halogen Free	Taping & Reel

**Pin Assignment**

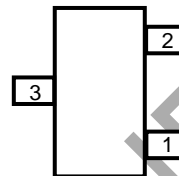
**TO92-3L  
(Top View)**



**LA431OHPA  
LA431NHPA**

- 1.R
- 2.A
- 3.C

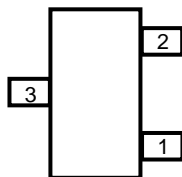
**SOT23-3L  
(Top View)**



**LA431OCAPA  
LA431NCAPA**

- 1.C
- 2.R
- 3.A

**SOT23-3L  
(Top View)**



**LA431OCRPA  
LA431NCRPA**

- 1.R
- 2.C
- 3.A

**Pin Descriptions**

Pin Name	Pin Description
R	Ref
A	Anode
C	Cathode

**Absolute Maximum Ratings**(at  $T_A=25^{\circ}\text{C}$ )

Note: Operate over the “Absolute Maximum Ratings” may cause permanent damage to the device.  
Exposure to such conditions for extended time may still affect the reliability of the device.

Characteristics		Symbol	Rating	Unit
Cathode Voltage		$V_{KA}$	40	V
Continuous Cathode Current		$I_{KA}$	120	mA
Reference Input Current		$I_{REF}$	10	mA
Junction Temperature		$T_J$	150	$^{\circ}\text{C}$
Storage Temperature		$T_{STG}$	-40~150	$^{\circ}\text{C}$
ESD Withstand Voltage: -Human Body Model (HBM), Model = 2 -Machine Model (MM) Model = B		$V_{ESD}$	2000 200	V V
Thermal Resistance (Junction to Case)	SOT23-3L	$\theta_{jc}$	110	$^{\circ}\text{C/W}$
	TO92-3L		80	
Thermal Resistance (Junction to Ambient)	SOT23-3L	$\theta_{ja}$	350	$^{\circ}\text{C/W}$
	TO92-3L		150	
Power dissipation	SOT23-3L	$P_D$	285	mW
	TO92-3L		625	
Moisture Sensitivity		MSL	Please refer the MSL label on the IC package bag/carton for detail	

Note1: Ratings apply to ambient temperature at  $25^{\circ}\text{C}$

**Recommended Operating Conditions**

Characteristics	Symbol	Min	Max	Unit
Cathode Voltage	$V_{KA}$	$V_{REF}$	36	V
Cathode Current	$I_{KA}$	0.3	100	mA
Operating Temperature (Operating free-air temperature)	$T_A$	-40	125	$^{\circ}\text{C}$

**Electrical Characteristics**

(T<sub>A</sub>=25°C, unless otherwise specified)

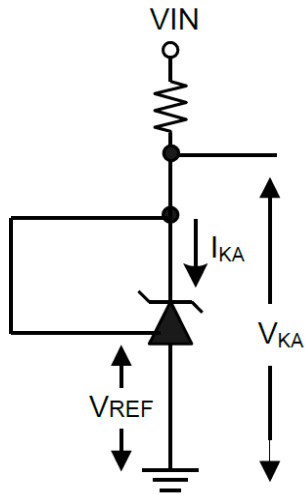
Characteristics	Symbol	Conditions	Min	Typ	Max	Unit	
Reference Voltage	V <sub>REF</sub>	V <sub>KA</sub> = V <sub>REF</sub> , I <sub>KA</sub> = 1mA (Fig.1)	0.4 %	2.485	2.495	2.505	V
			1.0 %	2.470		2.520	
Deviation of Reference Input Voltage over full temperature Range (*Note 2)	V <sub>REF(DEV)</sub>	V <sub>KA</sub> = V <sub>REF</sub> , I <sub>KA</sub> = 10mA, T <sub>A</sub> = -20~85°C (Fig.1)		20	30	mV	
		V <sub>KA</sub> = V <sub>REF</sub> , I <sub>KA</sub> = 10mA, T <sub>A</sub> = -40~125°C (Fig.1)		25	35		
Reference Input Current	I <sub>REF</sub>	R1 = 10KΩ, R2 = ∞, I <sub>KA</sub> = 10mA (Fig.2)		1.5	3.5	uA	
Deviation of Reference Input Current over Temperature (*Note 2)	I <sub>REF(DEV)</sub>	R1 = 10KΩ, R2 = ∞, I <sub>KA</sub> = 10mA T <sub>A</sub> = -40~125°C (Fig.2)		0.4	1.2	uA	
Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	ΔV <sub>REF</sub> / ΔV <sub>KA</sub>	I <sub>KA</sub> = 10mA (Fig.2)	V <sub>KA</sub> = 10V ~ V <sub>REF</sub>	-1.2	-2.0	mV/V	
			V <sub>KA</sub> = 36V ~ 10V	-1	-2.0		
Minimum Cathode Current for Regulation	I <sub>KA(min)</sub>	V <sub>KA</sub> = V <sub>REF</sub> (Fig.1)		0.1	0.3	mA	
Off-state Cathode Current	I <sub>KA(OFF)</sub>	V <sub>KA</sub> = 36V, V <sub>REF</sub> = 0V (Fig.3)		0.1	1	uA	
Dynamic Output Impedance	Z <sub>KA</sub>	V <sub>KA</sub> = V <sub>REF</sub> Frequency ≤ 1KHz (Fig.1)		0.2	0.5	Ω	

Note 2 : The specifications are guaranteed by designed and are not tested when in mass-production.

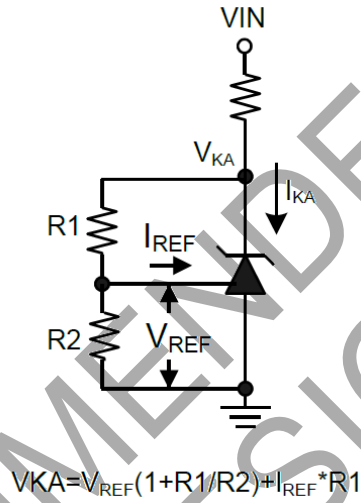
NOT RECOMMENDED FOR NEW DESIGN

**Application Circuit**

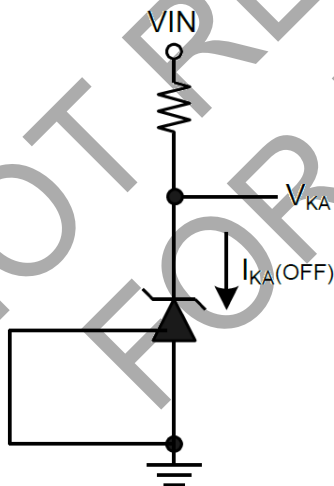
**Fig1:  $V_{KA}=V_{REF}$**



**Fig2:  $V_{KA}>V_{REF}$**

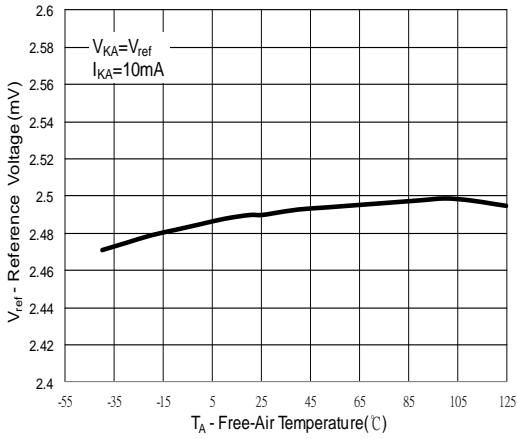


**Fig3: Off state current**

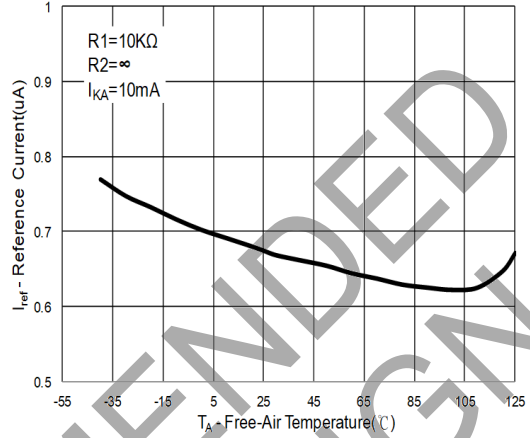


**Typical Characteristics**

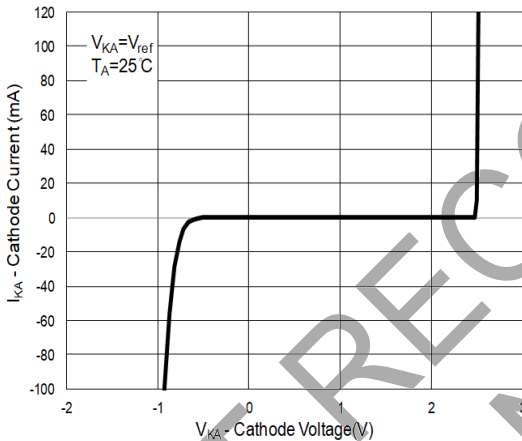
**REFERENCE VOLTAGE VS. FREE-AIR TEMPERATURE**



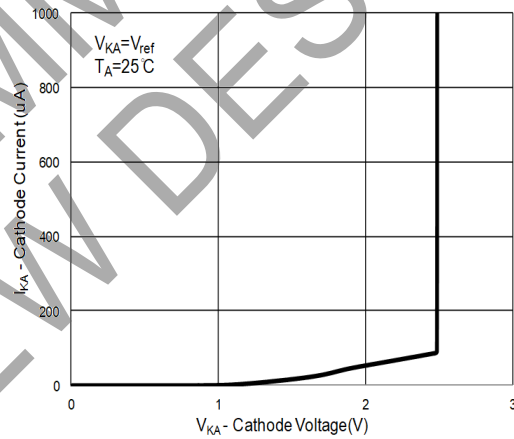
**REFERENCE CURRENT VS. FREE-AIR TEMPERATURE**



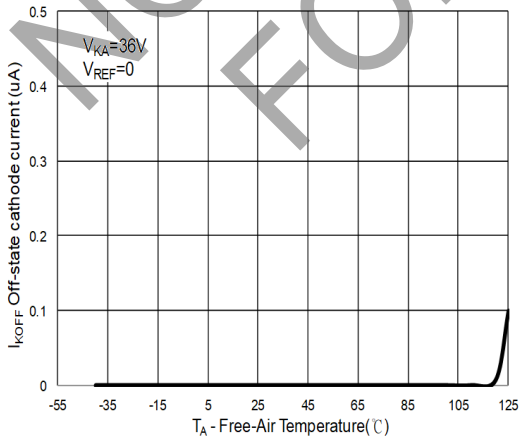
**CATHODE CURRENT VS. CATHODE VOLTAGE**



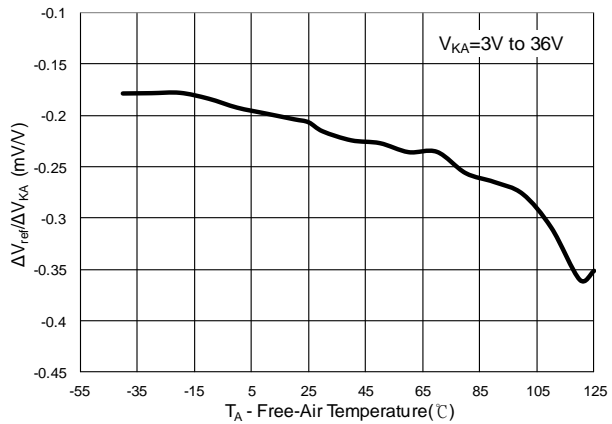
**CATHODE CURRENT VS. CATHODE VOLTAGE**



**OFF-STATE CATHODE CURRENT VS. FREE-AIR TEMPERATURE**

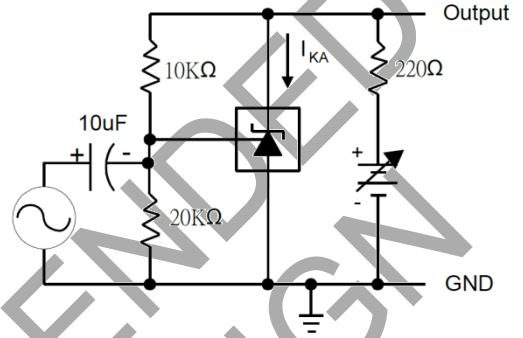
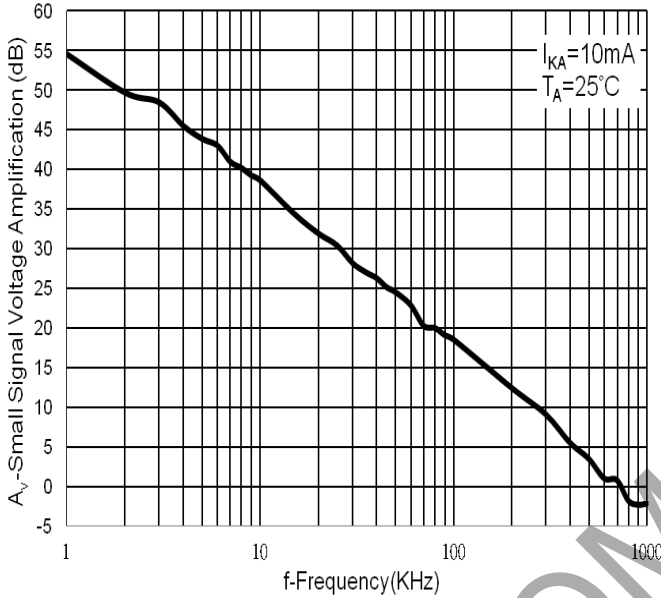


**RATIO OF DELTA REFERENCE VOLTAGE TO DELTA CATHODE VOLTAGE VS. FREE-AIR TEMPERATURE**



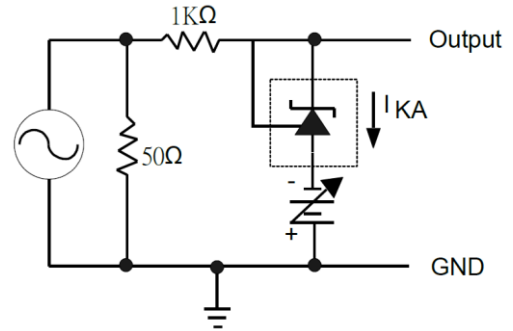
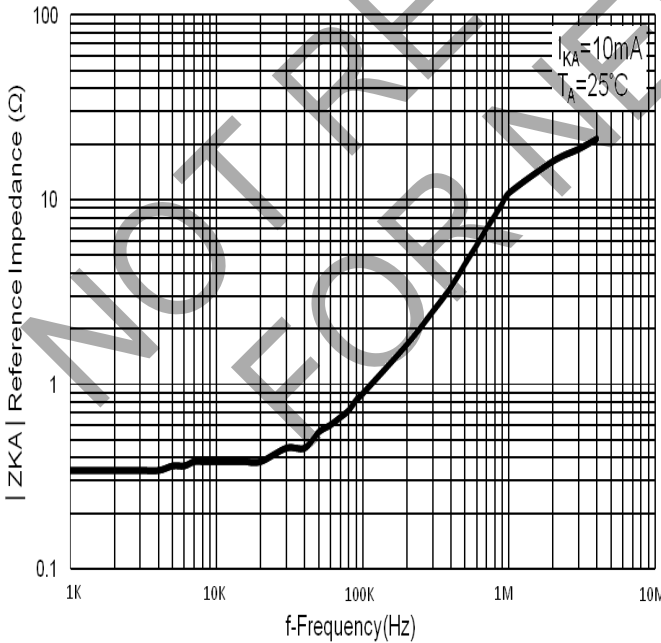
**Typical Characteristics(Continued)**

**(1) Small Signal Voltage Amplification Vs Frequency**



**Test Circuit For Voltage Amplification**

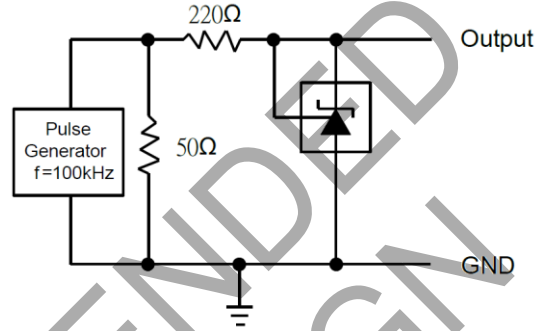
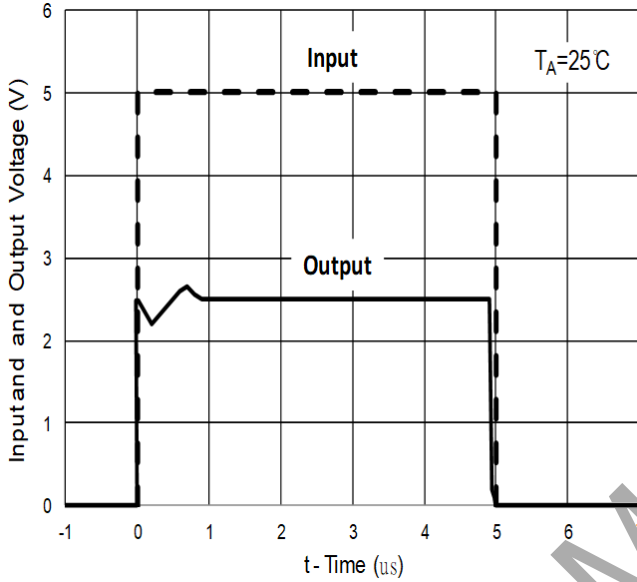
**(2) Reference Impedance VS Frequency**



**Test Circuit For Reference Impedance**

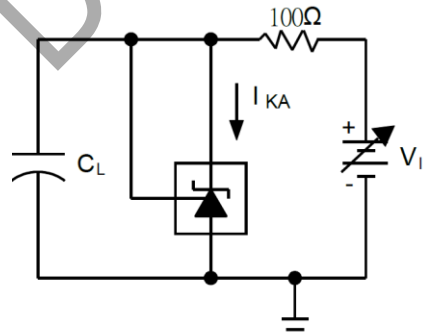
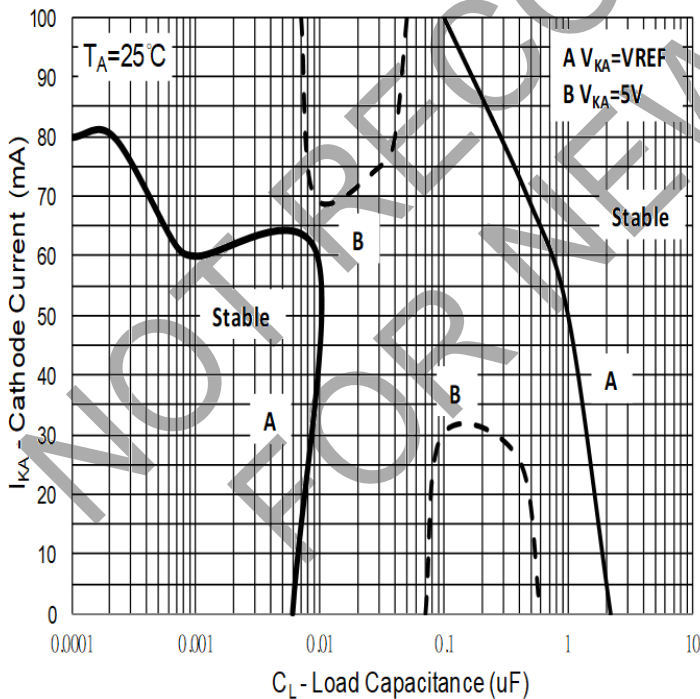
**Typical Characteristics (Continued)**

**(3) Pulse Response**

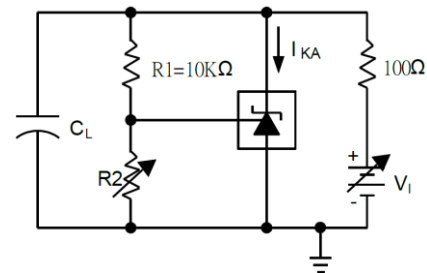


Test Circuit For Pulse Response

**(4) Stability boundary conditions**



Test Circuit For Curve A

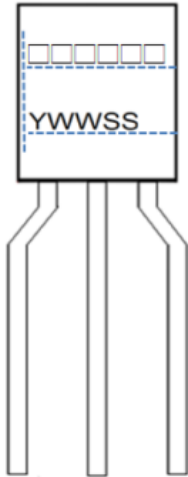


Test Circuit For Curve B

**Marking Information (NEW)**

Effective Date: 2015/11/1

**(1) TO92-3L**



1) YWWSS = Date Code,

Y: Year

WW: Week

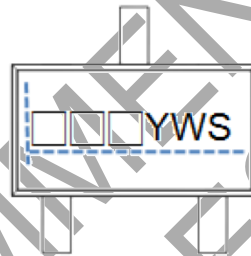
SS: Internal control code

2) □□□□□□ = Marking Number

LA431OHPA: 431OHP

LA431NHPA: 431NHP

**(2) SOT23-3L**



1) YWS = Date Code,

Y: Year

W: Week

S: Internal control code

2) □□□ = Marking Number

LA431OCAPA: OAA

LA431NCAPA: NAA

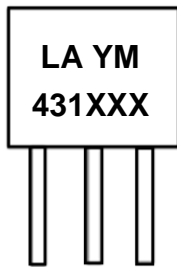
LA431OCRPA: OAR

LA431NCRPA: NAR

**Marking Information (OLD)**

Before 2015/10/31 (included) production, the marking code of parts were used as below.

**(1) TO92-3L**



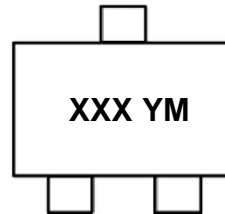
1) YM = Date Code,  
Y: Year, M: Month

2) 431xxx = Marking Number

LA431OHPA: 431OHP

LA431NHPA: 431NHP

**(2) SOT23-3L**



1) YM = Date Code,  
Y: Year, M: Month

2) xxx = Marking Number

LA431OCAPA: OAA

LA431NCAPA: NAA

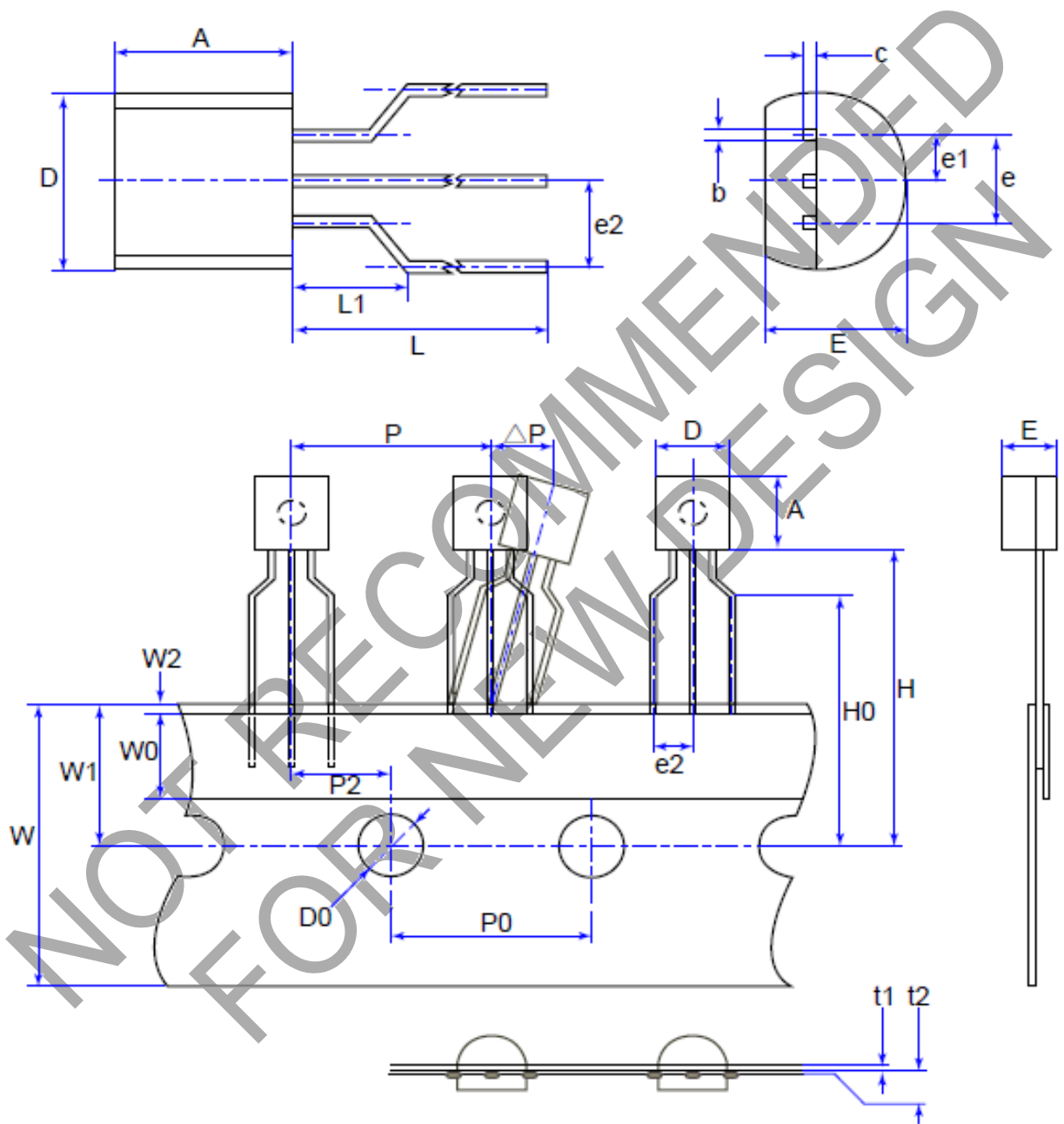
LA431OCRPA: OAR

LA431NCRPA: NAR

NOT RECOMMENDED FOR NEW DESIGN

**Mechanical Information**

(1) Package type: TO92-3L



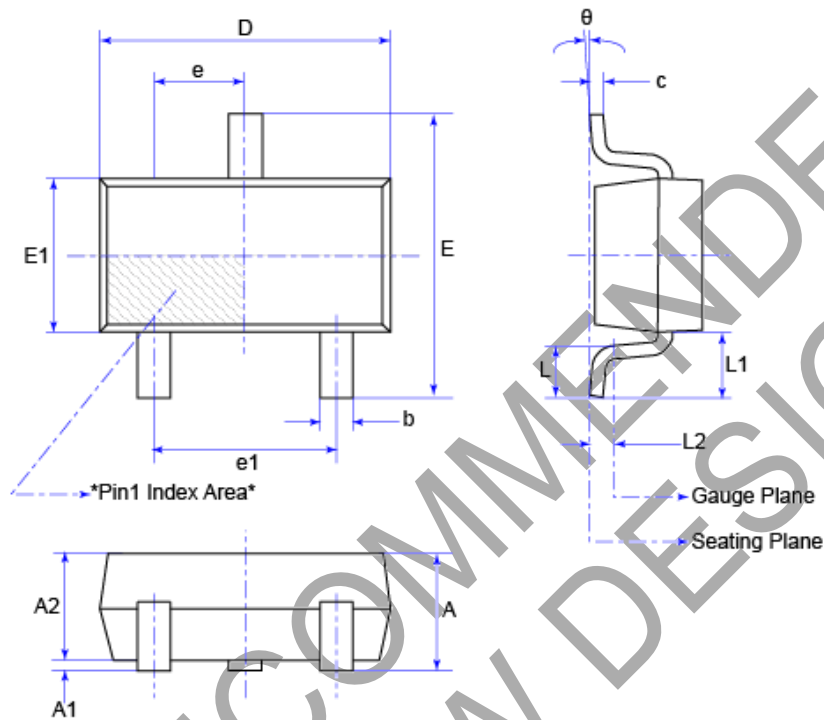
**Mechanical Information (Continued)**

Unit: mm

Symbol	Min	Max
A	4.30	4.70
b	0.38	0.55
c	0.36	0.51
D	4.30	4.70
D0	3.80	4.20
E	3.30	3.70
e	2.44	2.64
e1	1.27 TYP	
e2	2.20	2.96
H	18.00	21.00
H0	15.50	16.50
L	12.70	-
L1	2.50	4.50
P	12.40	13.00
P0	12.50	12.90
P2	6.05	6.65
t1	0.35	0.45
t2	0.15	0.25
W	17.50	19.00
W0	5.50	6.50
W1	8.50	9.50
W2	-	1.00
ΔP	-	1.00

**Mechanical Information (Continued)**

(1) Package type: SOT23-3L



Unit: mm

Variations Symbol	SOT23 ( A )	
	Min	Max
A	0.900	1.150
A1	-	0.100
A2	0.890	1.100
b	0.300	0.500
c	0.070	0.202
D	2.800	3.040
E	2.100	2.640
E1	1.200	1.400
e	0.950 REF	
e1	1.800	2.000
L	0.300	0.500
L1	0.550 REF	
L2	0.250 BSC	
$\theta$	0°	8°

**MSL (Moisture Sensitive Level) Information**

**IPC/JEDEC J-STD-020D.1 Moisture Sensitivity Levels Table**

LEVEL	FLOOR LIFE		SOAK REQUIREMENTS				
			Standard		Accelerated Equivalent <sup>1</sup>		CONDITION
	TIME	CONDITION			TIME (hours)	CONDITION	
1	Unlimited	≤30 °C /85% RH	168 +5/-0	85 °C /85% RH	NA	NA	NA
2	1 year	≤30 °C /60% RH	168 +5/-0	85 °C /60% RH	NA	NA	NA
2a	4 weeks	≤30 °C /60% RH	696 <sup>2</sup> +5/-0	30 °C /60% RH	120 -1/+0	168 -1/+0	60 °C/ 60% RH
3	168 hours	≤30 °C /60% RH	192 <sup>2</sup> +5/-0	30 °C /60% RH	40 -1/+0	52 -1/+0	60 °C/ 60% RH
4	72 hours	≤30 °C /60% RH	96 <sup>2</sup> +2/-0	30 °C /60% RH	20 +0.5/-0	24 +0.5/-0	60 °C/ 60% RH
5	48 hours	≤30 °C /60% RH	72 <sup>2</sup> +2/-0	30 °C /60% RH	15 +0.5/-0	20 +0.5/-0	60 °C/ 60% RH
a	24 hours	≤30 °C /60% RH	48 <sup>2</sup> +2/-0	30 °C /60% RH	10 +0.5/-0	13 +0.5/-0	60 °C/ 60% RH
6	Time on Label (TOL)	≤30 °C /60% RH	TOL	30 °C /60% RH	NA	NA	NA

**Note 1:** CAUTION - To use the “accelerated equivalent” soak conditions, correlation of damage response (including electrical, after soak and reflow), should be established with the “standard” soak conditions. Alternatively, if the known activation energy for moisture diffusion of the package materials is in the range of 0.40 - 0.48 eV or 0.30 - 0.39 eV, the “accelerated equivalent” may be used. Accelerated soak times may vary due to material properties (e.g .mold compound, encapsulant, etc.). JEDEC document JESD22-A120 provides a method for determining the diffusion coefficient.

**Note 2:** The standard soak time includes a default value of 24 hours for semiconductor manufacturer’s exposure time (MET) between bake and bag and includes the maximum time allowed out of the bag at the distributor’s facility. If the actual MET is less than 24 hours the soak time may be reduced. For soak conditions of 30 °C/60% RH, the soak time is reduced by 1 hour for each hour the MET is less than 24 hours. For soak conditions of 60 °C/60% RH, the soak time is reduced by 1 hour for each 5 hours the MET is less than 24 hours. If the actual MET is greater than 24 hours the soak time must be increased. If soak conditions are 30 °C/60% RH, the soak time is increased 1 hour for each hour that the actual MET exceeds 24 hours. If soak conditions are 60 °C/60% RH, the soak time is increased 1 hour for each 5 hours that the actual MET exceeds 24 hours.

**IMPORTANT NOTICE**


1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).
2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.
3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.
4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.
5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (<https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/>) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.
7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.
8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.
9. This Notice may be periodically updated with the most recent version available at <https://www.diodes.com/about/company/terms-and-conditions/important-notice>

DIODES is a trademark of Diodes Incorporated in the United States and other countries.  
The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.  
© 2022 Diodes Incorporated. All Rights Reserved.

[www.diodes.com](http://www.diodes.com)

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

-  [View LA431OHPA on WIN SOURCE](#)
-  [Diodes Incorporated Information](#)

## Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management