Description

The TL431 and TL432 are three terminal adjustable shunt regulators offering excellent temperature stability and output current handling capability up to 100mA. The output voltage may be set to any chosen voltage between 2.5 and 36 volts by selection of two external divider resistors.

The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance. Diodes' TL431 has the same electrical specifications as the industry standard '431 and is available in 2 grades with initial tolerances of 1% and 0.5% for the A and B grades respectively.

Features

- Temperature range -40 to +125ºC
- Reference Voltage Tolerance at 25°C
  - TL431A: 2.495V ± 1.0%
  - TL431B: 2.495V ± 0.5%
- Low Output Noise
- 0.2Ω Typical Output Impedance
- Sink Current Capability: 1mA to 100mA
- Adjustable Output Voltage: V_{REF} to 36V
- All devices are:
  - Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)
  - Halogen and Antimony Free. "Green" Device (Note 3)

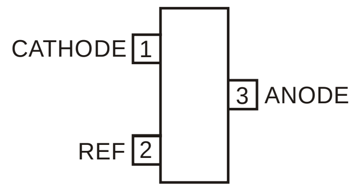
Applications

- Opto-Coupler Linearisers
- Shunt Regulators
- Improved Zener
- Variable Reference

Pin Assignments

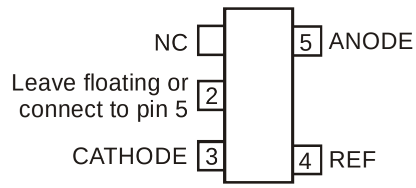
TL431

(Top View)



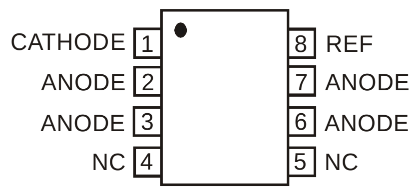
SOT23

(Top View)



SOT25

(Top View)

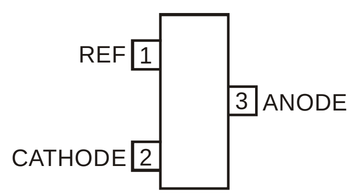


SO-8

SO-8 is a future product

TL432

(Top View)



SOT23

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen and Antimony free, "Green" and Lead-Free.
3. Halogen and Antimony free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Absolute Maximum Ratings (Note 4)

Symbol	Parameter		Rating	Unit
V_{KA}	Cathode Voltage		40	V
I_{KA}	Continuous Cathode Current		150	mA
I_{REF}	Reference Input Current		-0.050 to +10	mA
T_J	Operating Junction Temperature		+150	°C
T_{ST}	Storage Temperature		-55 to +150	°C
P_D	Power Dissipation (Notes 5, 6)	SOT23	330	mW
		SOT25	500	
		SO-8*	700	

Notes: 4. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability. Unless otherwise stated voltages specified are relative to the ANODE pin.
5. $T_{J,\ MAX}$ =150°C.
6. Ratings apply to ambient temperature at 25°C.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{KA}	Cathode Voltage	V_{REF}	36	V
I_{KA}	Cathode Current	1	100	mA
T_A	Operating Ambient Temperature	-40	+125	°C

Electrical Characteristics (T_A = +25°C, unless otherwise noted)

Symbol	Parameter	Test Conditions		Min	Typ.	Max	Unit
V_{REF}	Reference voltage	$V_{KA} = V_{REF}$, I_{KA} = 10mA	TL431A	2.470	2.495	2.520	V
			TL431B	2.482	2.495	2.507	
V_{DEV}	Deviation of reference voltage over full temperature range (Note 5)	$V_{KA} = V_{REF}$, I_{KA} = 10mA	T_A = 0 to 70°C		6	16	mV
			T_A = -40 to +85°C		14	34	
			T_A = -40 to +125°C		14	34	
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of the change in reference voltage to the change in cathode voltage	I_{KA} = 10mA	V_{KA} = 10V to V_{REF}		-1.4	-2.7	mV/V
			V_{KA} = 36V to 10V		-1	-2	
I_{REF}	Reference input current	I_{KA} = 10mA, R1 = 10KΩ, R2 = ∞			1	4	µA
ΔI_{REF}	I_{REF} deviation over full temperature range (Note 7)	I_{KA} = 10mA, R1 = 10KΩ, R2 = ∞	T_A = 0 to 70°C		0.8	1.2	µA
			T_A = -40 to +85°C		0.8	2.5	
			T_A = -40 to +125°C		0.8	2.5	
$I_{KA(MIN)}$	Minimum cathode current for regulation	$V_{KA} = V_{REF}$			0.4	0.7	mA
$I_{KA(OFF)}$	Off-state current	V_{KA} = 36V, V_{REF} = 0V			0.05	0.5	µA
$\lvert Z_{KA}\rvert$	Dynamic output impedance (Note 8)	$V_{KA} = V_{REF}$, f = 0Hz			0.2	0.5	Ω
θ_{JA}	Thermal Resistance Junction to Ambient	SOT23			380		°C/W
		SOT25			250		
		SO-8*			70		

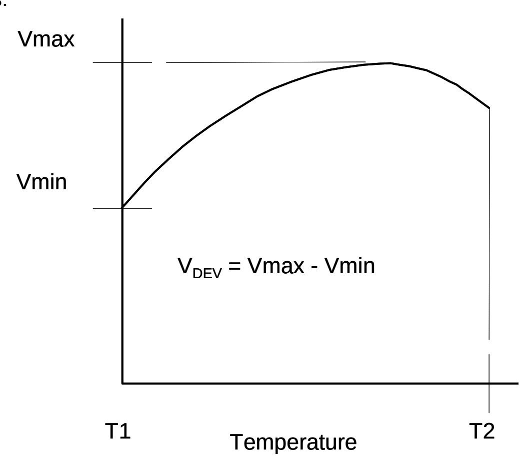
Notes: 7. Deviation of V_{DEV}, and ΔI_{REF} are defined as the maximum variation of the values over the full temperature range.

The average temperature coefficient of the reference input voltage αV_{REF} is defined as:

$$\left|\alpha V_{REF}\right| = \frac{\left(\dfrac{V_{DEV}}{V_{REF}\ @\ 25^oC}\right) X\ 10^6}{T2 - T1}\ \text{ppm/}^oC$$

Where:
T2 – T1 = full temperature change.

αV_{REF} can be positive or negative depending on whether the slope is positive or negative.



Notes: 8. The dynamic output impedance, R_Z, is defined as:

$$\left|Z_{KA}\right| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$$

When the device is programmed with two external resistors R1 and R2, the dynamic output impedance of the overall circuit, is defined as:

$$\left|Z'\right| = \frac{\Delta V}{\Delta I} \approx \left|Z_{KA}\right|\left(1 + \frac{R1}{R2}\right)$$

Test Circuits

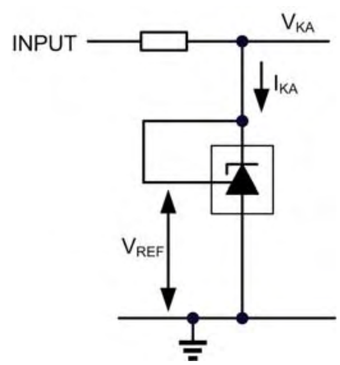


Figure 1. Test circuit for $V_{KA} = V_{REF}$

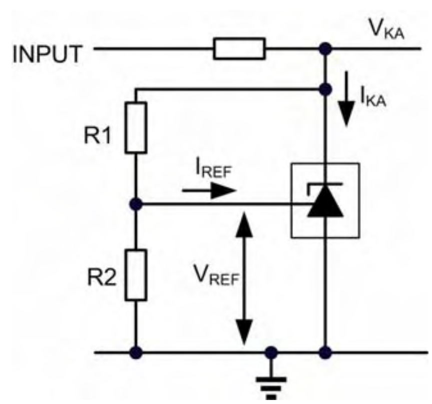


Figure 2. Test circuit for $V_{KA} > V_{REF}$

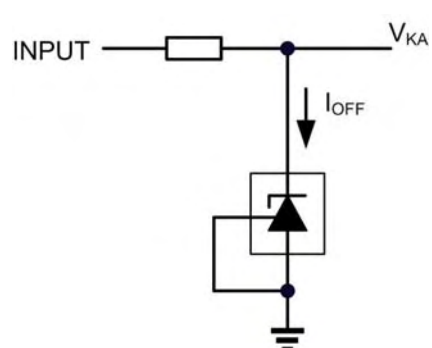
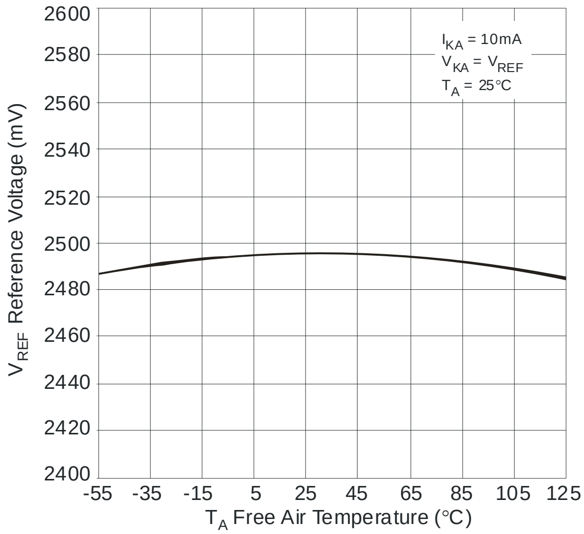
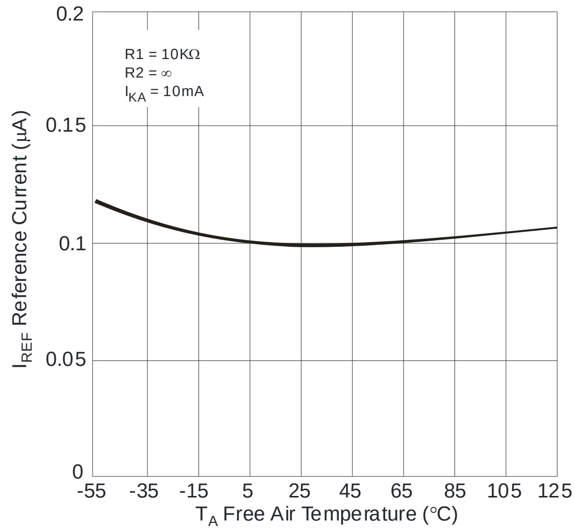


Figure 3. Test circuit for I_{OFF}

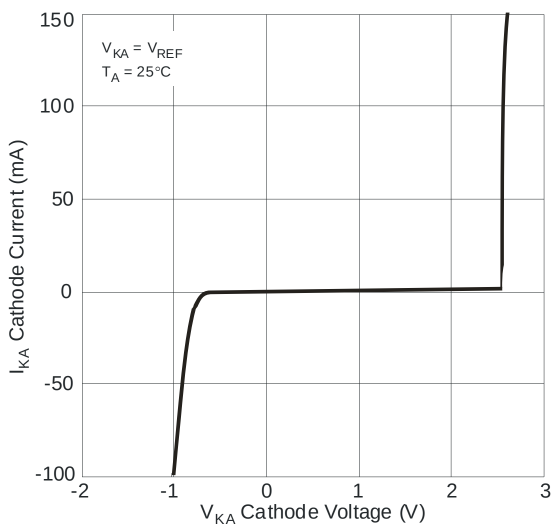
Typical Performance Characteristics



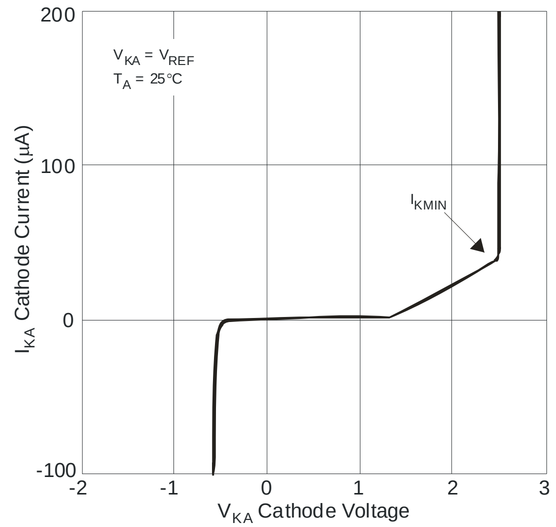
Reference Voltage vs. Free Air Temperature



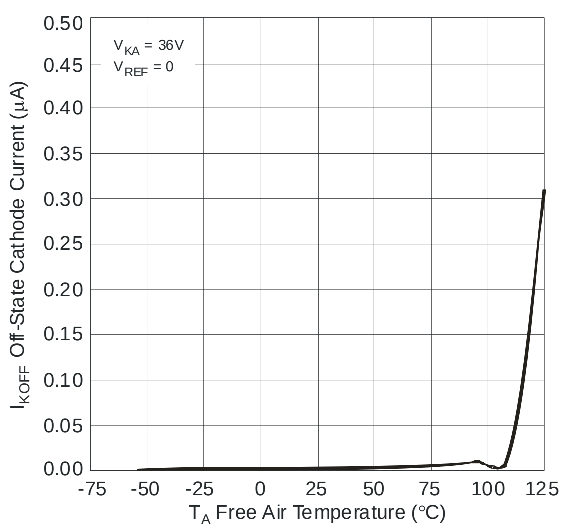
Reference Current vs. Free Air Temperature



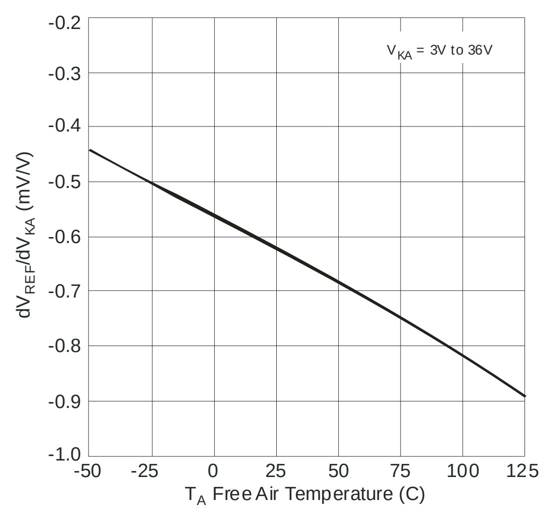
Cathode Current vs. Cathode Voltage



Cathode Current vs. Cathode Voltage

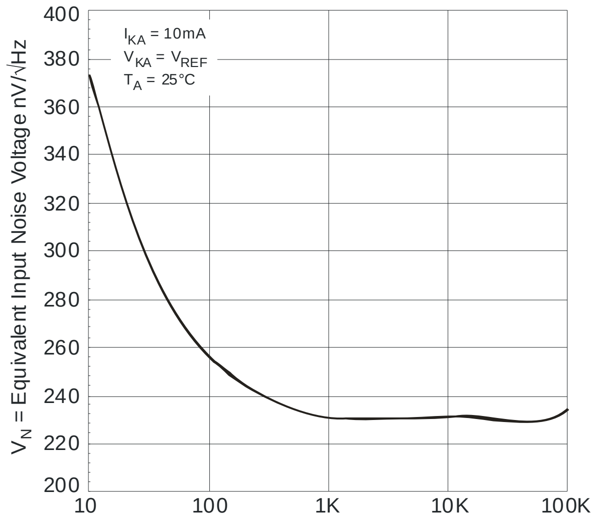


Off-State Cathode Current vs. Free Air Temperature

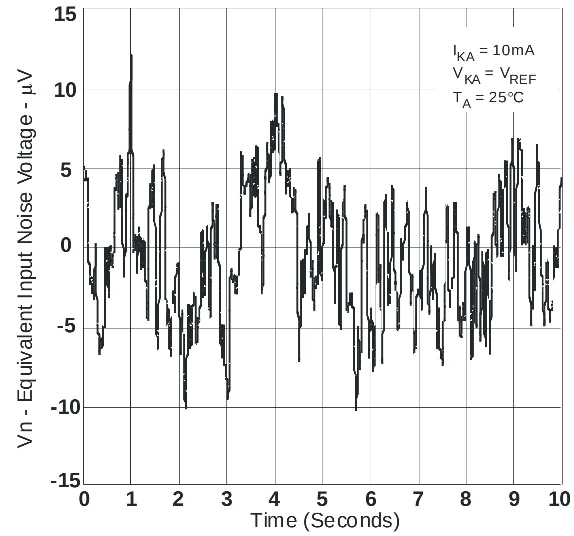


Ratio of Delta Reference Voltage to Delta Cathode Voltage vs. Free Air Temperature

Typical Performance Characteristics (cont.)



Equivalent Input Noise Voltage vs. Frequency



Equivalent Input Noise Voltage Over A 10-S Period

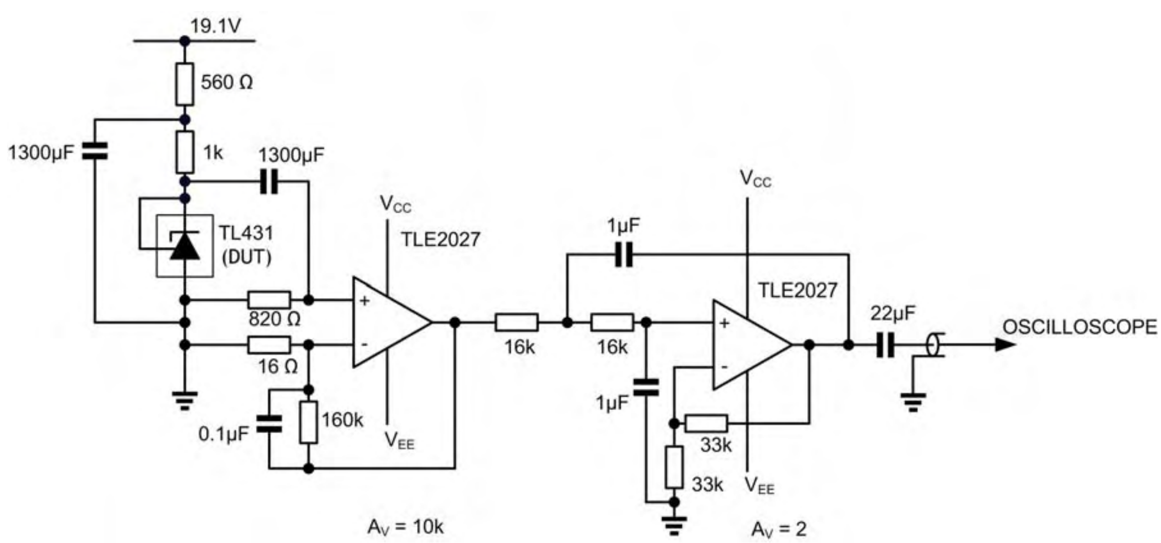
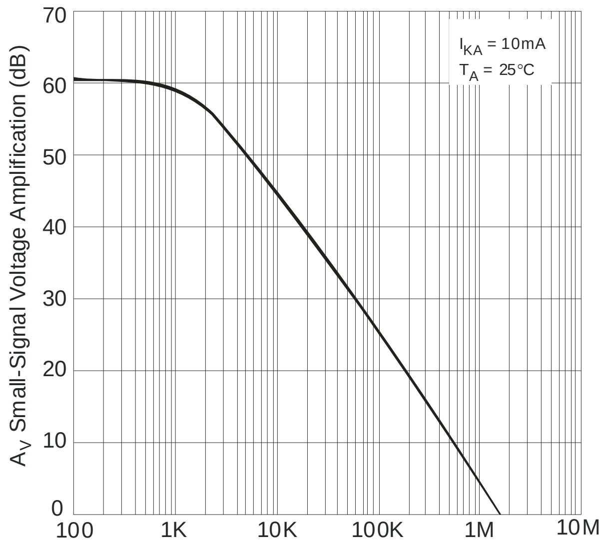
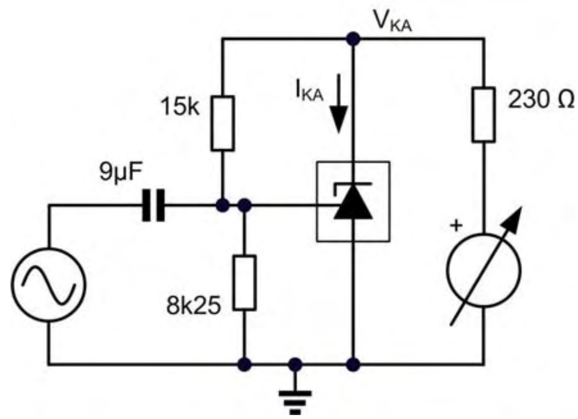


Figure 4. Test circuit for noise input voltage

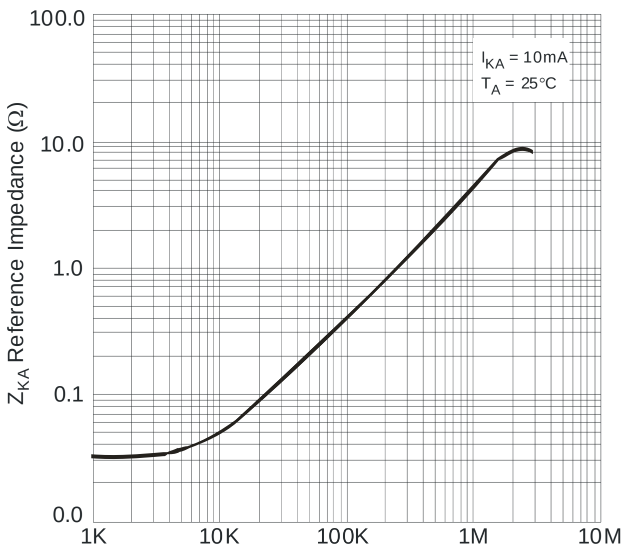
Typical Performance Characteristics (cont.)



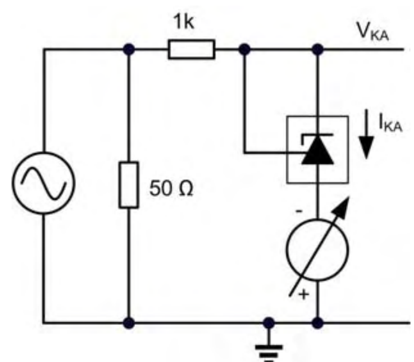
Small-Signal Voltage Amplification vs. Frequency



Test circuit for voltage amplification

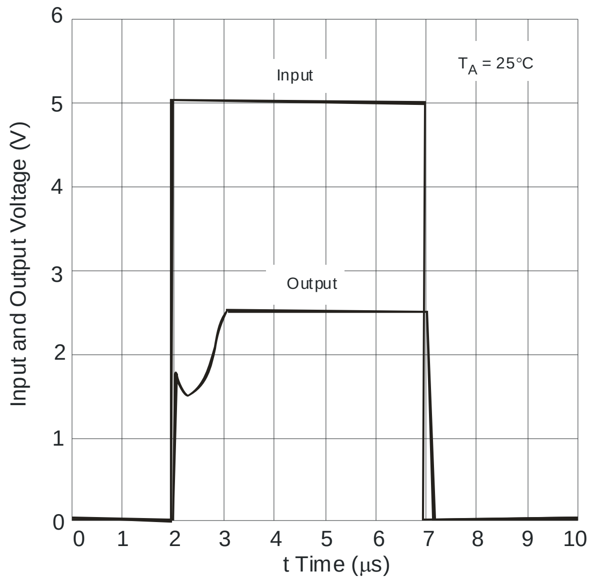


Reference Impedance vs. Frequency

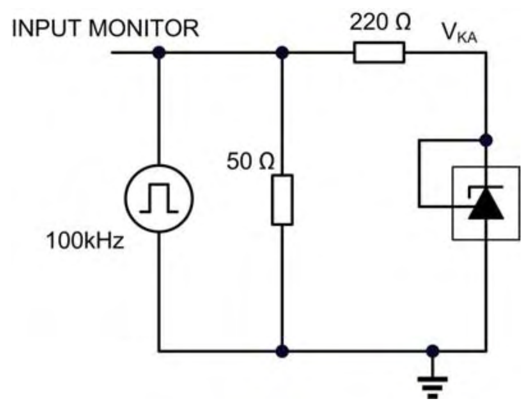


Test circuit for reference impedance

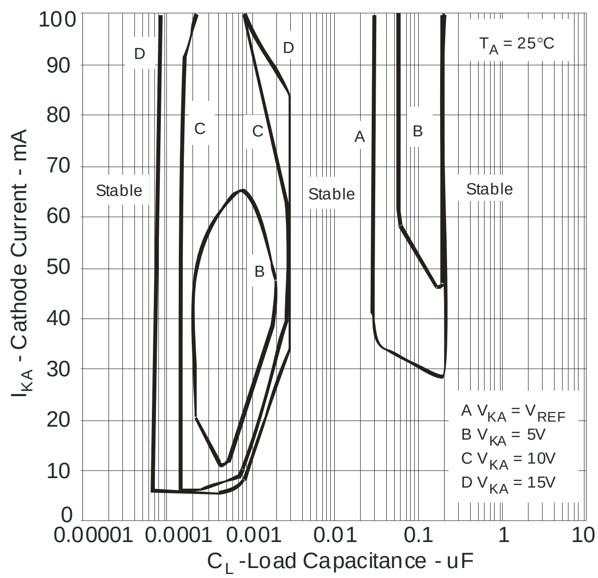
Typical Performance Characteristics (cont.)



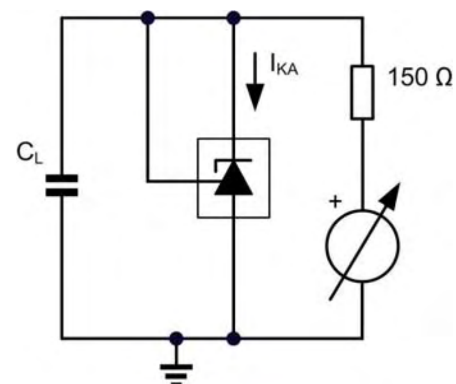
Pulse Response



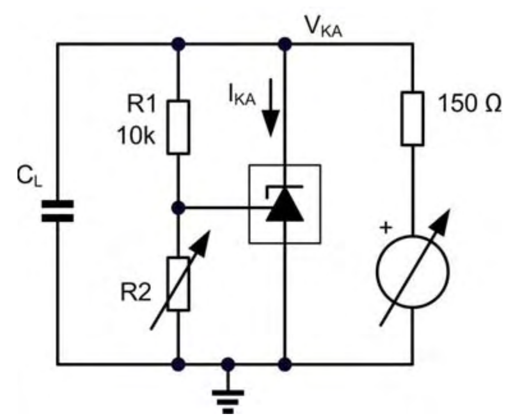
Test Circuit for Pulse Response



Stability Boundary Conditions



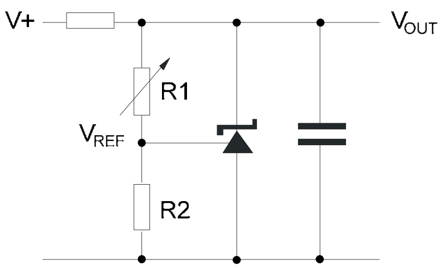
Test Circuit for Curve A



Test Circuit for Curves B, C, D

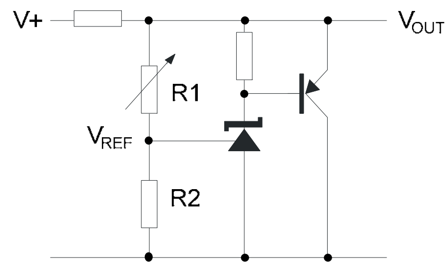
The device is stable under all conditions with a load capacitance not exceeding 50pF. The device is stable under all conditions with a load capacitance between 5nF and 20nF. The device is stable under all conditions with a load capacitance exceeding 300nF. With a cathode current not exceeding 5mA, the device is stable with any load capacitance.

Applications Information



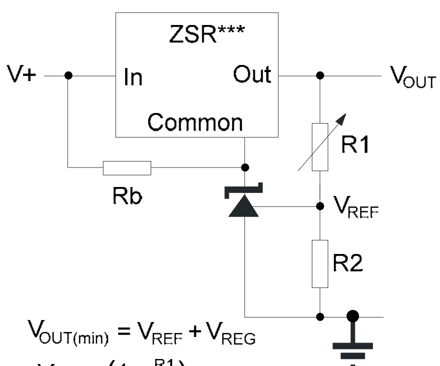
$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$

Shunt Regulator



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

Higher Current Shunt Regulator

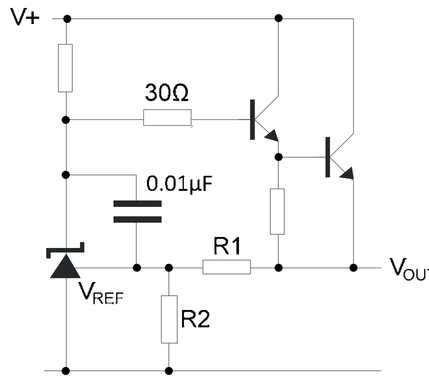


$V_{OUT(min)} = V_{REF} + V_{REG}$

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

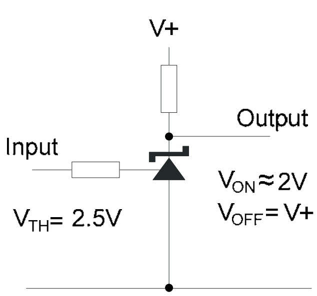
Rb - Optional to provide minimum cathode current

Output Control of a Three Terminal Fixed Regulator

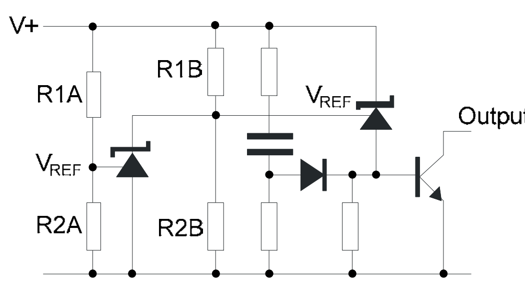


$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$

Series Regulator



Single Supply Comparator with Temperature Compensated Threshold



Low Limit $= \left(1 + \frac{R1B}{R2B}\right) V_{REF}$

High Limit $= \left(1 + \frac{R1A}{R2A}\right) V_{REF}$

Over Voltage / Under Voltage Protection Circuit

Ordering Information

TL43 X X XX - 7

Pinout Variation	Tolerance	Package	Packing
1: Standard pinout	A: ± 1.0%	SA: SOT23	7: Tape & Reel
2: Reversed pinout in SOT23	B: ± 0.5%	W5: SOT25	13: Tape & Reel
		S: SO-8	

Device	Package Code	Packaging (Note 9)	7" Tape and Reel		Ammo Box	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
TL431A(B)SA-7	SA	SOT23	3000/Tape & Reel	-7	NA	NA
TL431A(B)W5-7	W5	SOT25	3000/Tape & Reel	-7	NA	NA
TL431A(B)S-13*	S	SO-8*	2500/Tape & Reel	-13	NA	NA
TL432A(B)SA-7	SA	SOT23	3000/Tape & Reel	-7	NA	NA

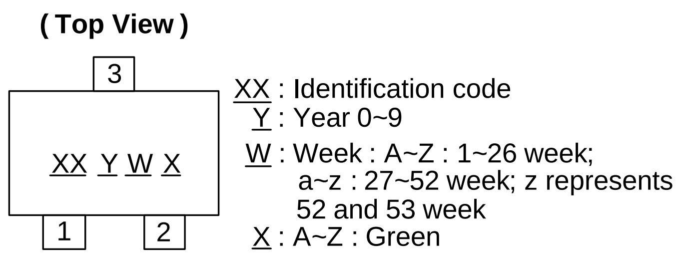
* Suffix "B" denotes TL431B device.

Notes: 9. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.

*SO-8 is a future package

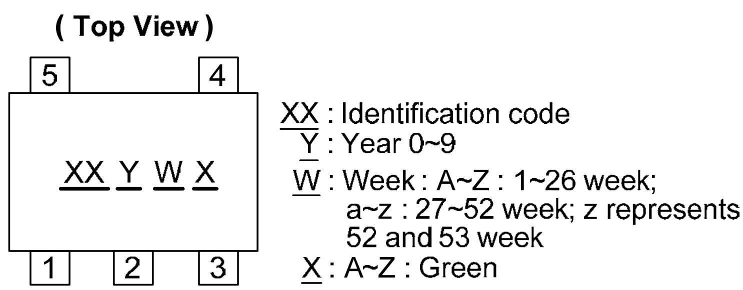
Marking Information

(1) SOT23



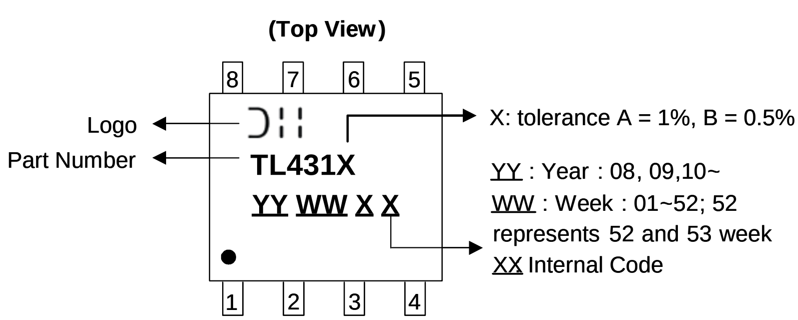
Device	Package	Identification Code
TL431ASA	SOT23	AA
TL431BSA	SOT23	AB
TL432ASA	SOT23	BA
TL432BSA	SOT23	BB

(2) SOT25



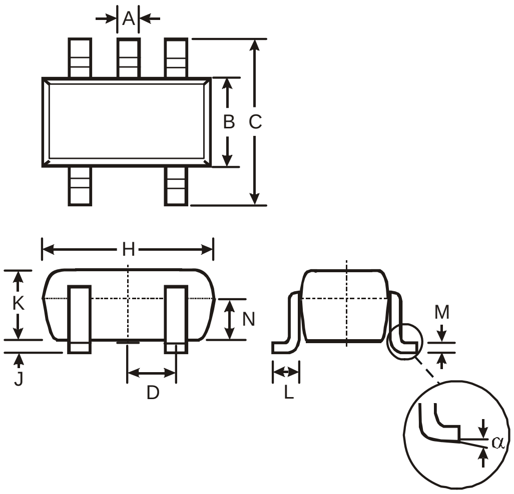
Device	Package	Identification Code
TL431AW5	SOT25	AA
TL431BW5	SOT25	AB

(3) SO-8*



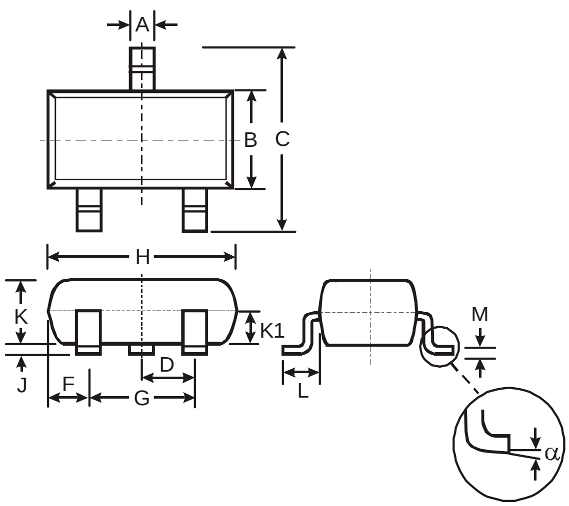
Package Outline Dimensions (All Dimensions in mm)

(1) Package type: SOT25



SOT25			
Dim	**Min**	**Max**	**Typ**
A	0.35	0.50	0.38
B	1.50	1.70	1.60
C	2.70	3.00	2.80
D	—	—	0.95
H	2.90	3.10	3.00
J	0.013	0.10	0.05
K	1.00	1.30	1.10
L	0.35	0.55	0.40
M	0.10	0.20	0.15
N	0.70	0.80	0.75
α	0°	8°	—
All Dimensions in mm			

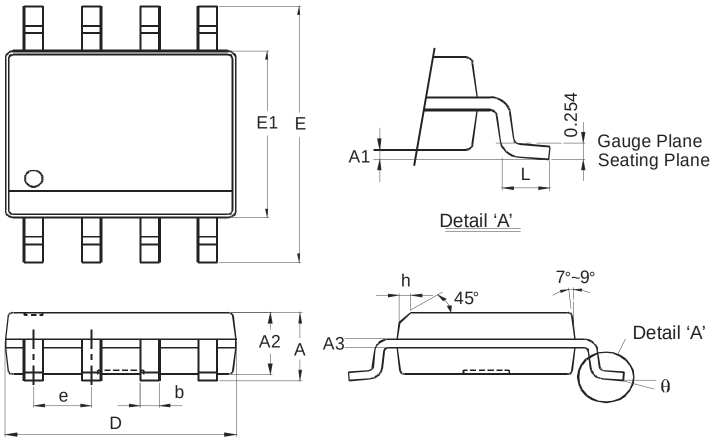
(2) Package Types: SOT23



SOT23			
Dim	**Min**	**Max**	**Typ**
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.903	1.10	1.00
K1	-	-	0.400
L	0.45	0.61	0.55
M	0.085	0.18	0.11
α	0°	8°	-
All Dimensions in mm			

Package Outline Dimensions (All Dimensions in mm)

(3) Package Types: SO-8*



SO-8*		
Dim	**Min**	**Max**
A	-	1.75
A1	0.10	0.20
A2	1.30	1.50
A3	0.15	0.25
b	0.3	0.5
D	4.85	4.95
E	5.90	6.10
E1	3.85	3.95
e	1.27 Typ	
h	-	0.35
L	0.62	0.82
θ	0°	8°
All Dimensions in mm		

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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

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Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения **«JONHON»**, а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов **«FORSTAR»**.

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

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