

Features

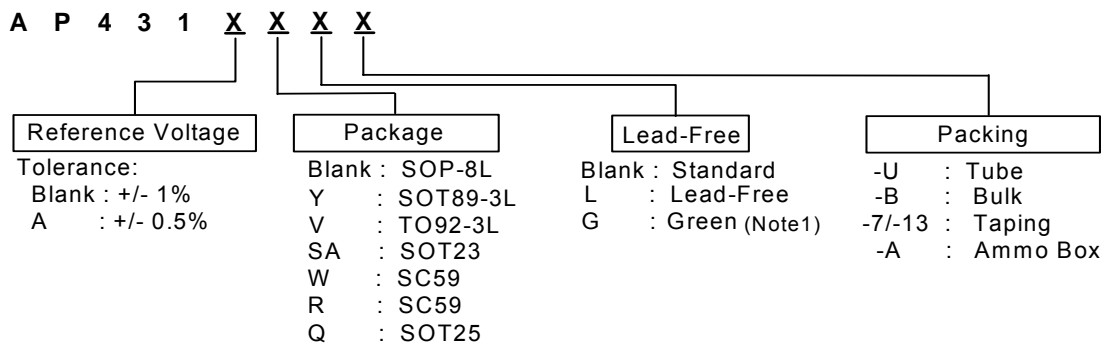
- Precision reference voltage
AP431 : 2.495V ± 1%
AP431A : 2.495V ± 0.5%
- Sink current capability: 200mA
- Minimum cathode current for regulation: 300µA
- Equivalent full-range temp coefficient: 30 ppm/°C
- Fast turn-on response
- Low dynamic output impedance: 0.2Ω
- Programmable output voltage to 36V
- Low output noise
- Packages: TO92-3L, SOT89-3L, SOP-8L, SOT23, SOT25, SC-59

Description

The AP431 and AP431A are 3-terminal adjustable precision shunt regulators with guaranteed temperature stability over the applicable extended commercial temperature range. The output voltage may be set at any level greater than 2.495V (V_{REF}) up to 36V merely by selecting two external resistors that act as a voltage divider network. These devices have a typical output impedance of 0.2Ω. Active output circuitry provides very sharp turn-on characteristics, making these devices excellent improved replacements for Zener diodes in many applications.

The precise (+/-) 1% Reference voltage tolerance of the AP431/AP431A make it possible in many applications to avoid the use of a variable resistor, consequently saving cost and eliminating drift and reliability problems associated with it.

Ordering Information

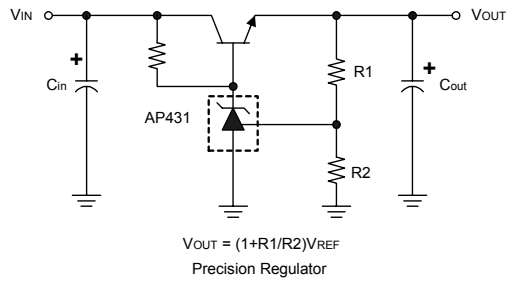


Note: 1. Only for SOT23 and SC59

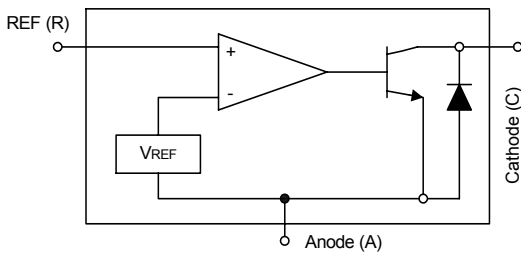
Device (Note 2)	Package Code	Packaging (Note 3)	7" Tape and Reel		13" Tape and Reel		Ammo Box	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix	Quantity	Part Number Suffix
AP431(A)SA	SA	SOT23	3000/Tape & Reel	-7	10000/Tape & Reel	-13	NA	NA
AP431(A)Q	Q	SOT25	3000/Tape & Reel	-7	10000/Tape & Reel	-13	NA	NA
AP431(A)W	W	SC59	3000/Tape & Reel	-7	10000/Tape & Reel	-13	NA	NA
AP431(A)R	R	SC59	3000/Tape & Reel	-7	10000/Tape & Reel	-13	NA	NA
AP431(A)		SOP-8L	NA	NA	2500/Tape & Reel	-13	NA	NA
AP431(A)Y	Y	SOT89-3L	NA	NA	2500/Tape & Reel	-13	NA	NA
AP431(A)V	V	TO92-3L	NA	NA	NA	NA	2000/Box	-A

- Notes: 2. Suffix "A" denotes AP431A device.
3. 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>.

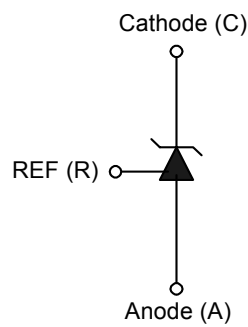
Typical Application Circuit



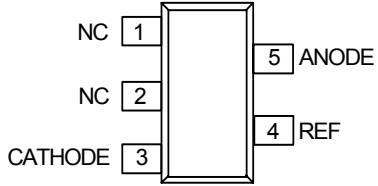
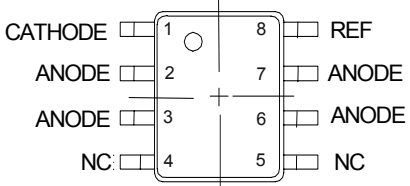
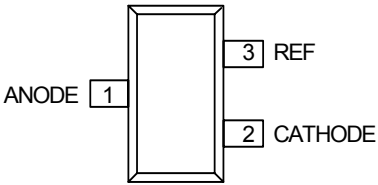
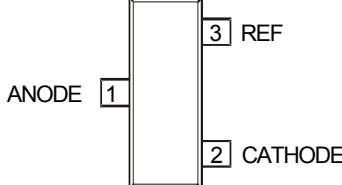
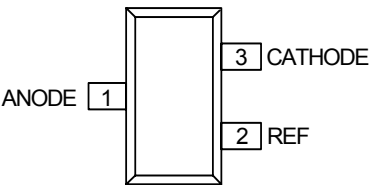
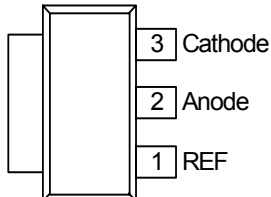
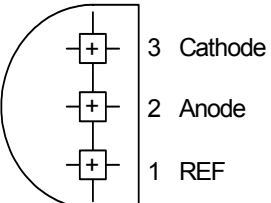
Typical Application Circuit



Typical Application Circuit



Pin Configuration

Package	Pin Configuration (Top View)	Package	Pin Configuration (Top View)
SOT25		SOP-8L	
SC-59 (Package Code-W)		SOT23	
SC-59 (Package Code-R)		SOT89-3L	
TO92-3L			

Absolute Maximum Ratings

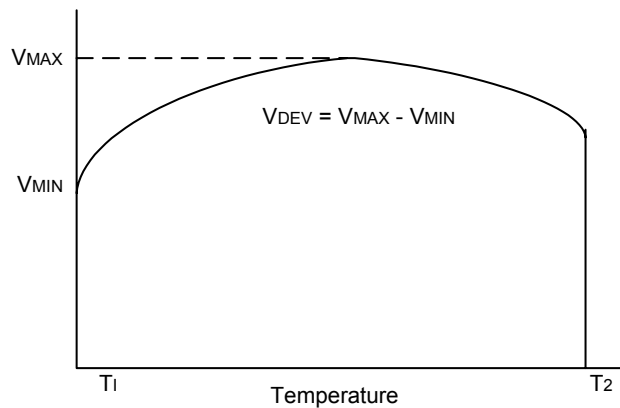
Cathode Voltage	36V
Continuous Cathode Current	-10mA ~ 250mA
Reference Input Current Range	10mA
Operating Temperature Range	-20°C ~ 85°C
Lead Temperature.....	260°C
Storage Temperature	-65°C ~ 150°C
Power Dissipation (Notes 4, 5)	
SOT23 Package.....	250mW
SOT25 Package	250mW
SC59 Package.....	400mW
SOP-8L Package	600mW
SOT89-3L Package	800mW
TO92-3L Package	780mW

Note 4. T_J , max =150°C

Note 5. Ratings apply to ambient temperature at 25°C

Electrical Characteristics ($T_A = 25^{\circ}\text{C}$, $V^+ = +5.0\text{V}$, unless otherwise stated)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT	
Reference voltage	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$ (Fig.1)	AP431 AP431A V_{REF}	2.470 2.482	2.495	2.520 2.507	V	
Deviation of Reference input voltage over temperature (Note 6)	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$, $T_a = \text{Full range}$ (Fig.1)	V_{REF}	—	8.0	20	mV	
Ratio of the change in Reference voltage to the change in Cathode voltage	$I_{KA} = 10\text{mA}$ (Fig.2)	$V_{KA} = 10\text{V} \sim V_{REF}$	ΔV_{REF}	—	-1.4	-2.0	mV/V
		$V_{KA} = 36\text{V} \sim 10\text{V}$	ΔV_{KA}	—	-1	-2	mV/V
Reference input current	$R1 = 10\text{K}\Omega$, $R2 = \infty$ $I_{KA} = 10\text{mA}$ (Fig.2)	I_{REF}	—	1.4	3.5	μA	
Deviation of Reference input current over temperature	$R1 = 10\text{K}\Omega$, $R2 = \infty$ $I_{KA} = 10\text{mA}$ $T_a = \text{Full range}$ (Fig.2)	αI_{REF}	—	0.4	1.2	μA	
Minimum Cathode current for regulation	$V_{KA} = V_{REF}$ (Fig.1)	$I_{KA(MIN)}$	—	0.19	0.5	mA	
Off-state current	$V_{KA} = 36\text{V}$, $V_{REF} = 0\text{V}$ (Fig.3)	$I_{KA(OFF)}$	—	0.1	1.0	μA	
Dynamic output impedance (Note 7)	$V_{KA} = V_{REF}$ $V_{KA} = V_{REF}$ $\Delta I_{KA} = 0.1\text{mA} \sim 15\text{Ma}$ Frequency $\leq 1\text{KHz}$ (Fig.1)	$ Z_{KA} $	—	0.2	0.5	Ω	



Note: 6. Deviation of reference input voltage, V_{DEV} , is defined as the maximum variation of the reference over the full temperature range. The average temperature coefficient of the reference input voltage αV_{REF} is defined as:

$$|\alpha V_{REF}| = \frac{\left(\frac{V_{DEV}}{V_{REF}(25^{\circ}\text{C})}\right) \cdot 10^6}{T_2 - T_1} \dots\dots\dots (\text{ppm}/^{\circ}\text{C})$$

Where:

$T_2 - T_1 =$ full temperature change.

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

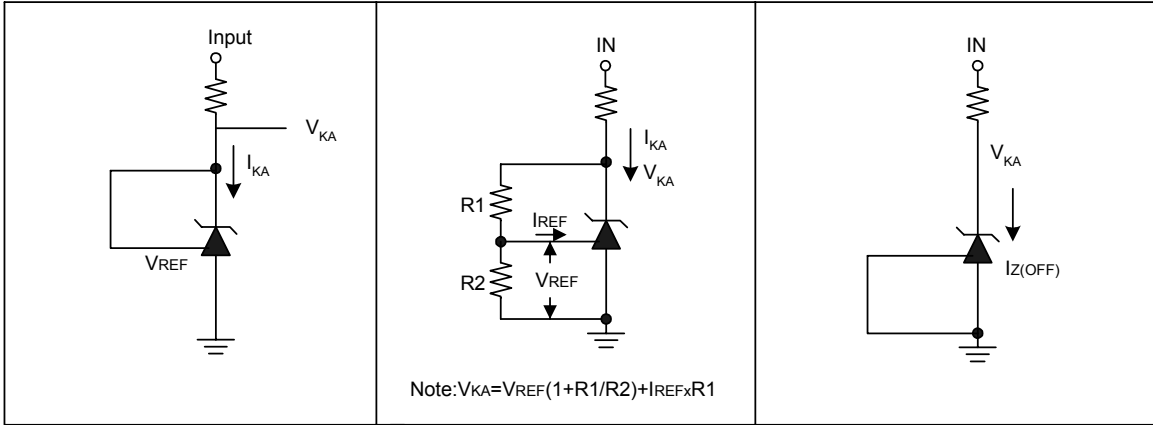
Note: 7. The dynamic output impedance, R_Z , is defined as:

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

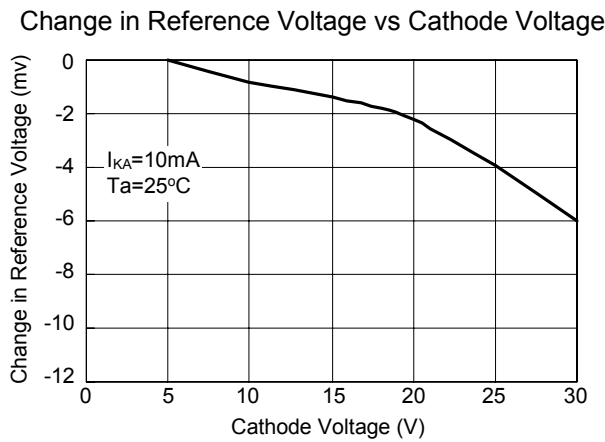
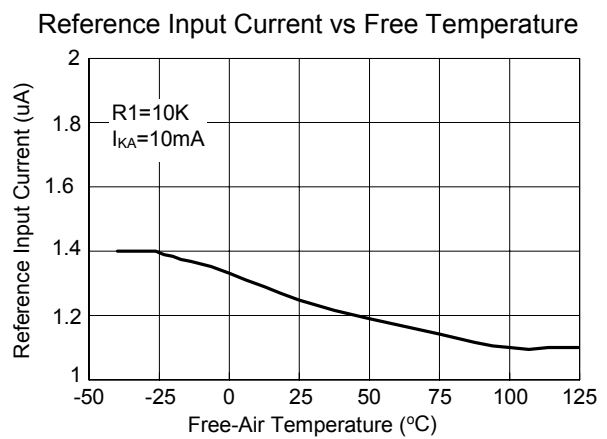
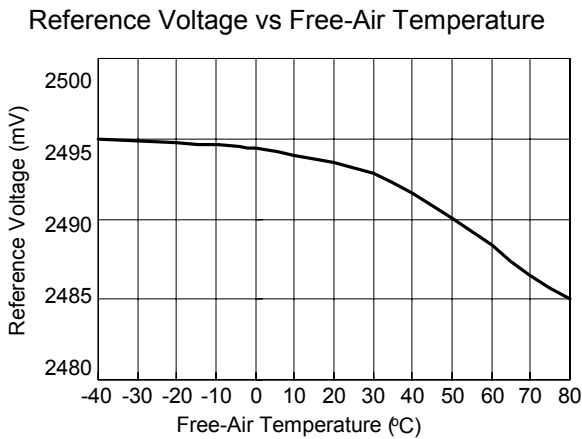
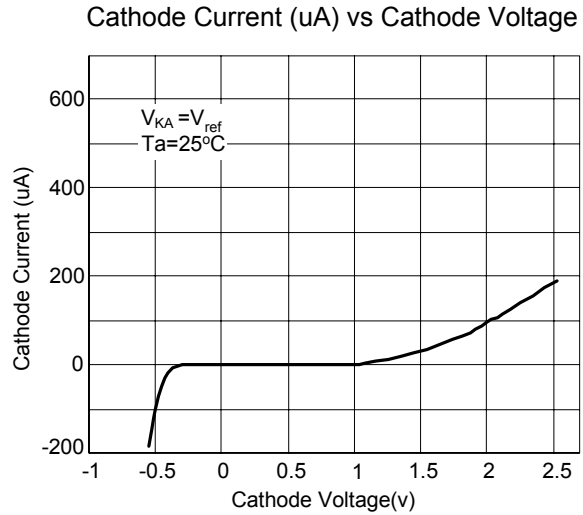
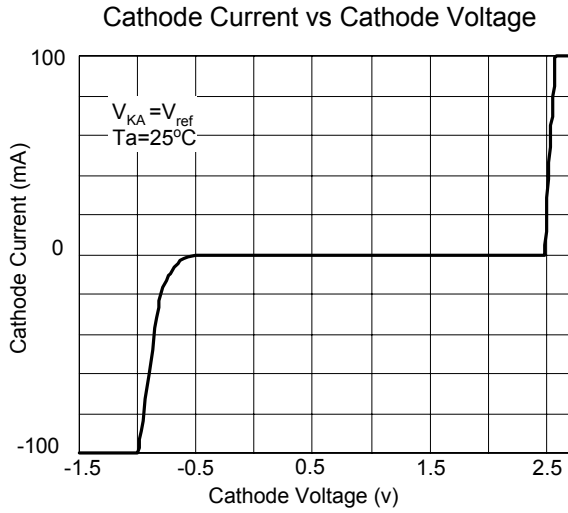
When the device is programmed with two external resistors $R1$ and $R2$ (see Figure 2.), the dynamic output impedance of the overall circuit, is defined as:

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

Test Circuits

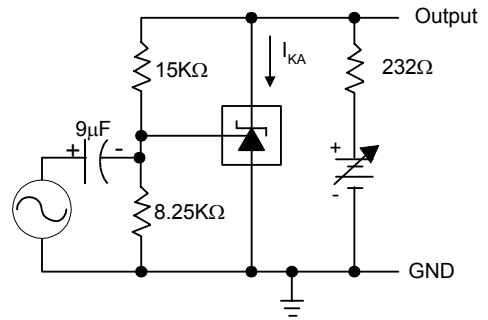
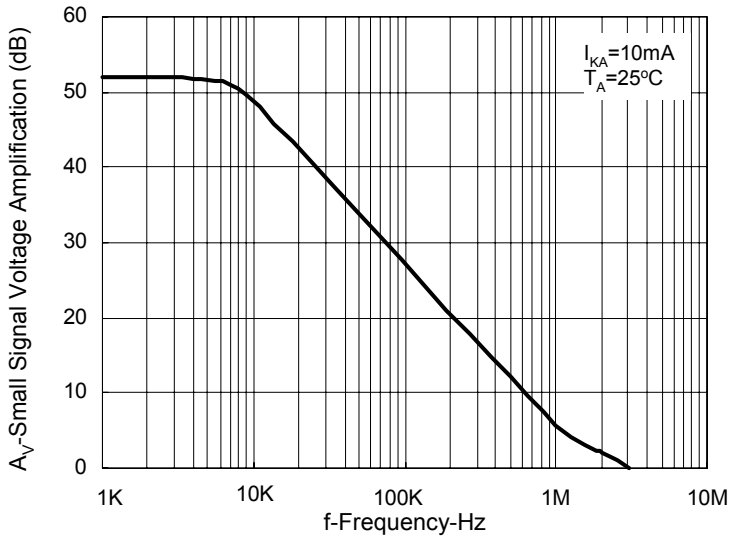


Typical Performance Characteristics



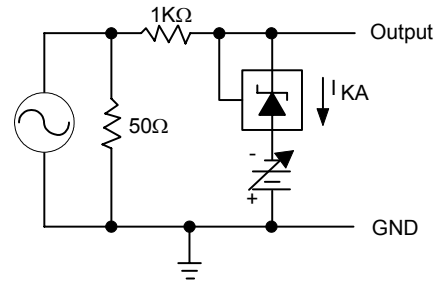
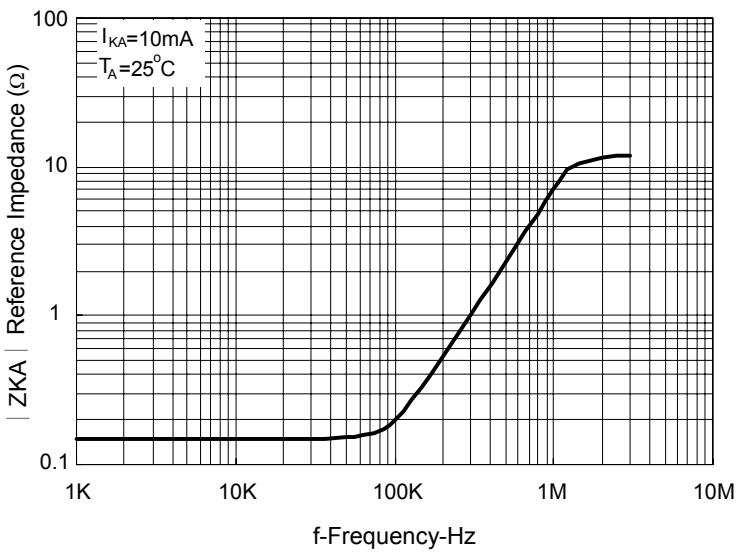
Typical Performance Characteristics (Continued)

Small-Signal Voltage Amplification vs Frequency



Test Circuit for Voltage Amplification

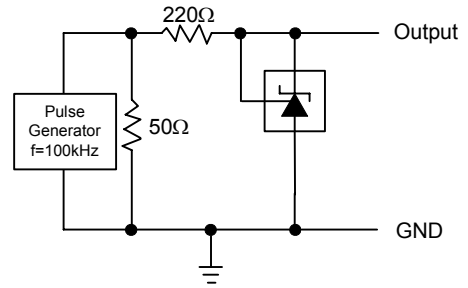
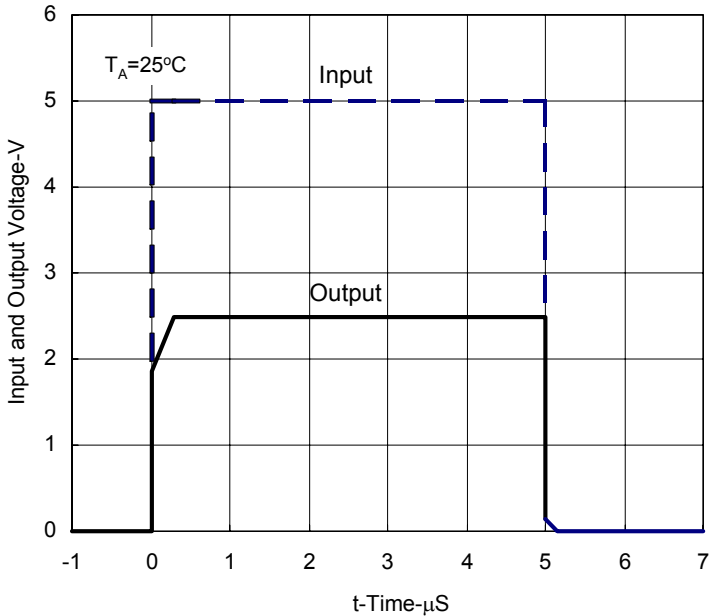
Reference Impedance vs Frequency



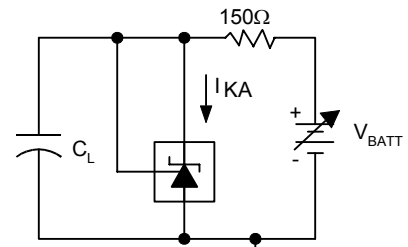
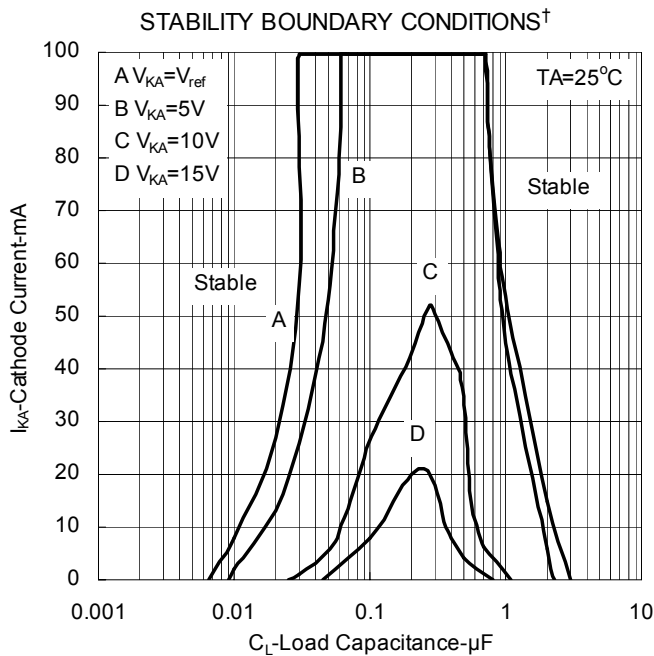
Test Circuit for Reference Impedance

Typical Performance Characteristics (Continued)

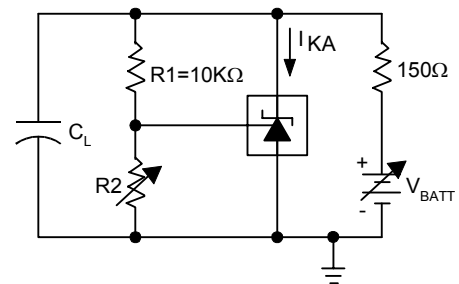
Pulse Response



Test Circuit for Pulse Response



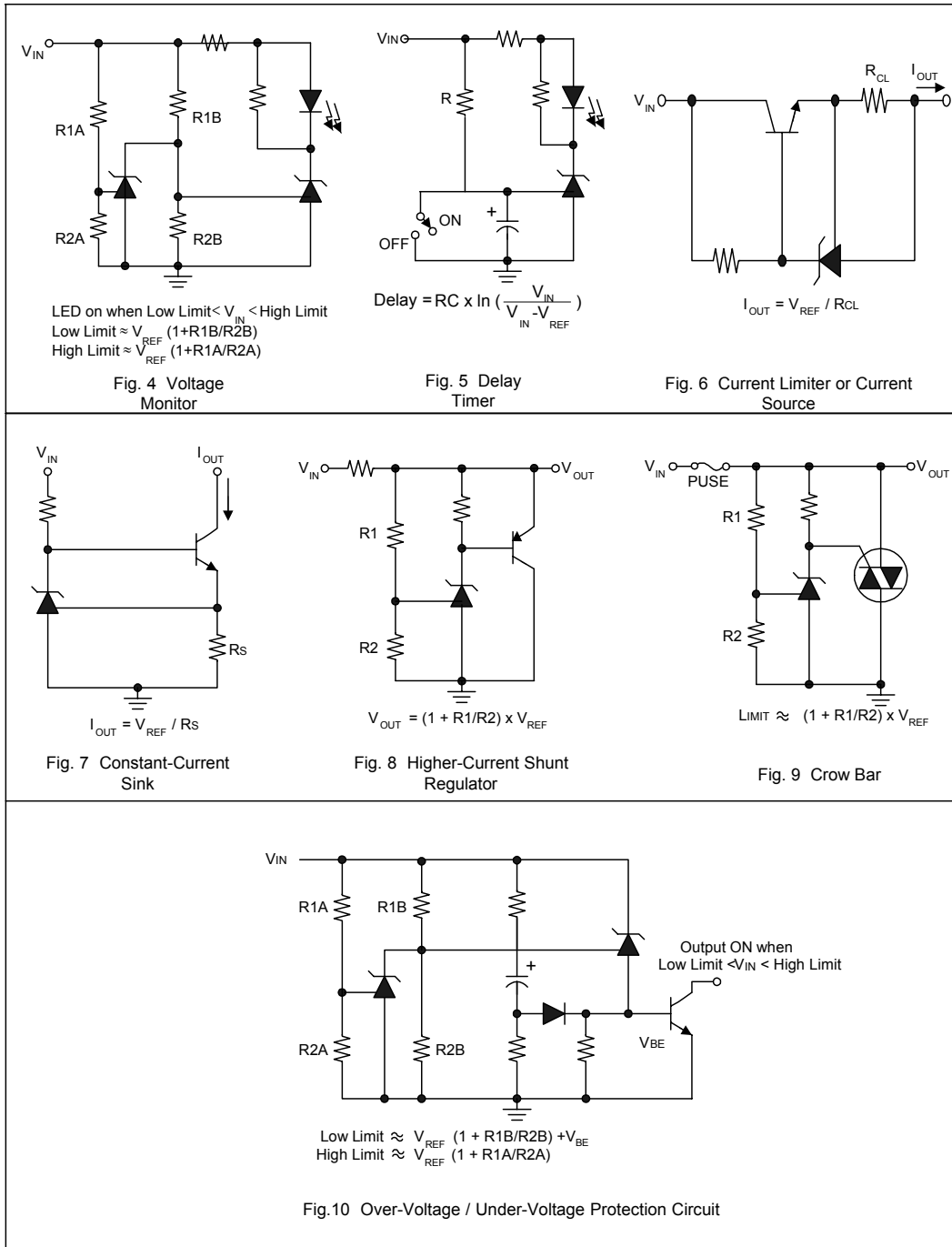
Test Circuit for Curve A



Test Circuit for Curve B, C, and D

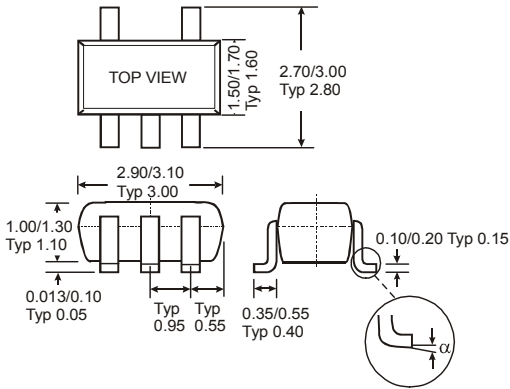
† The areas under the curves represent conditions that may cause the device to oscillate. For curves B, C, and D, R_2 and V_+ were adjusted to establish the initial V_{KA} and I_{KA} conditions with $C_L = 0$. V_{BATT} and C_L were then adjusted to determine the ranges of stability.

Application Examples

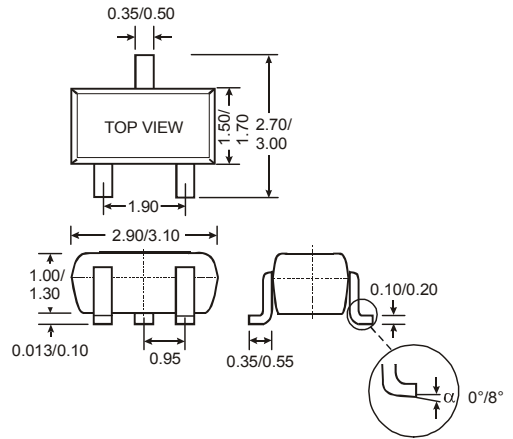


Package Diagrams (All Dimensions in mm)

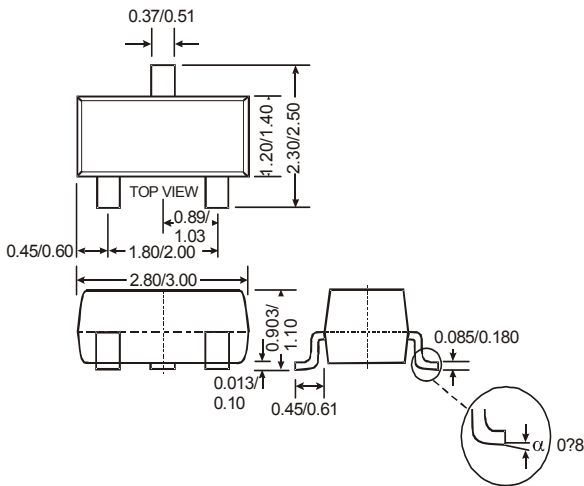
(1) SOT25



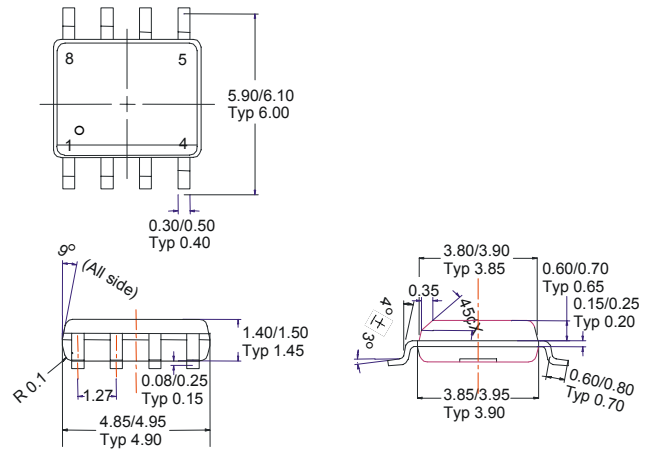
(2) SC59



(3) SOT23

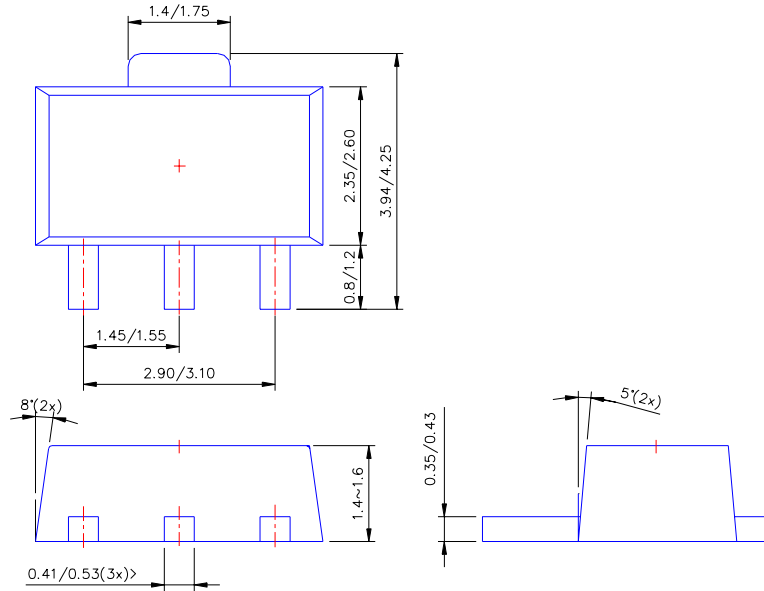


(4) SOP-8L

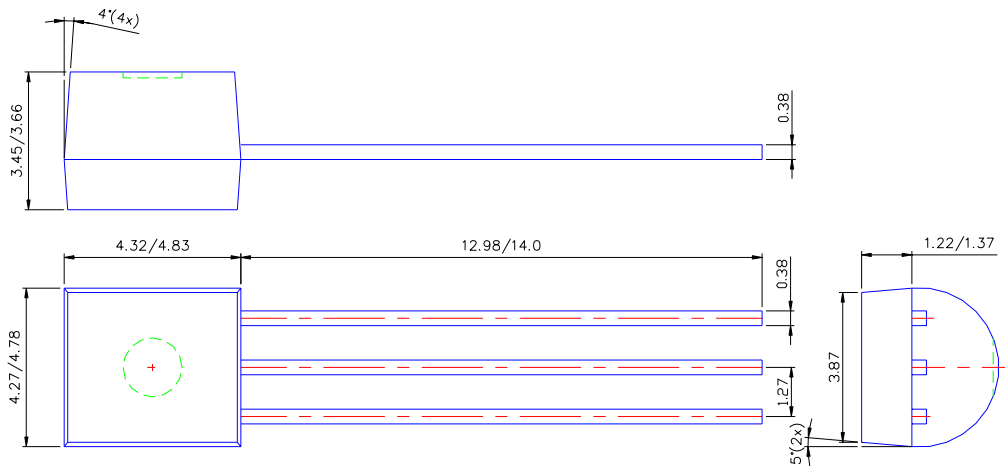


Package Diagrams (Continued) (All Dimensions in mm)

(5) SOT89-3L

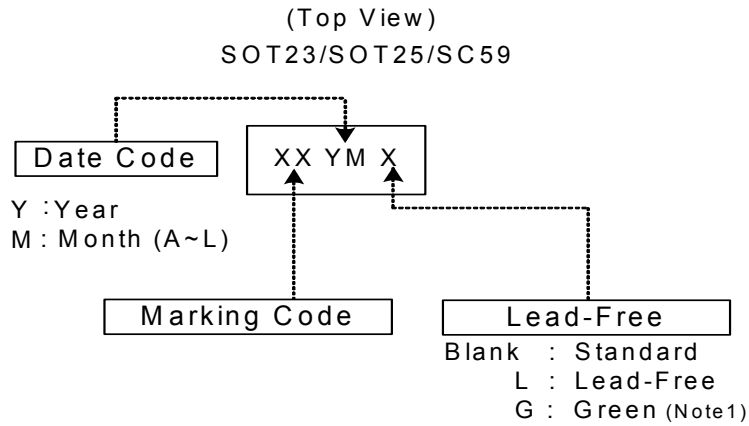


(6) TO92-3L



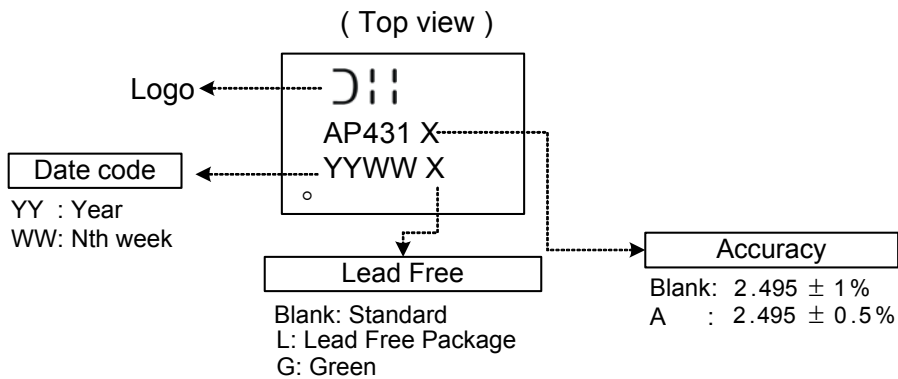
Marking Information

(1) SOT23/SOT25/SC59

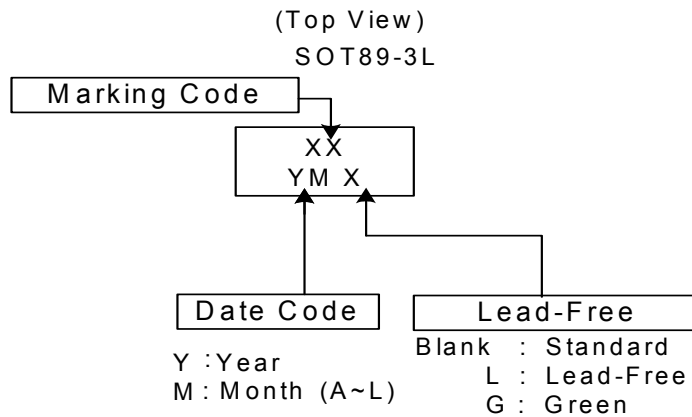


Note: 1. Only for SOT23 and SC59

(2) SOP

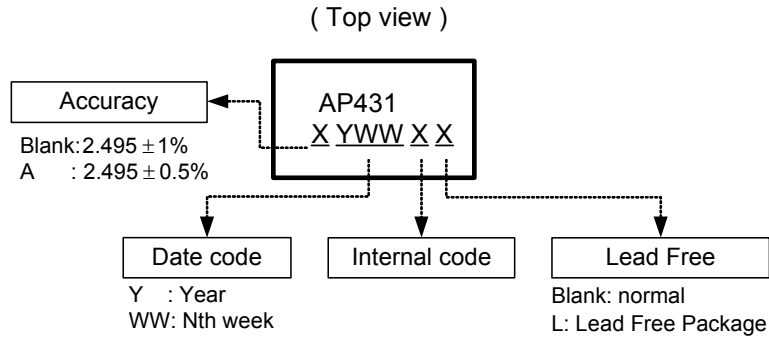


(3) SOT89-3L



Marking Information (Continued)

(4) TO92-3L



Marking Code Table

Device	Package(Note 8)	Marking Code	Date Code
AP431SA	SOT23	D1	YM
AP431ASA	SOT23	D2	YM
AP431Q	SOT25	A2	YM
AP431AQ	SOT25	A3	YM
AP431W	SC59	A6	YM
AP431AW	SC59	A7	YM
AP431R	SC59	A8	YM
AP431AR	SC59	A9	YM
AP431Y	SOT89-3L	A4	YM
AP431AY	SOT89-3L	A5	YM

Notes: 8. For Packaging Details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

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