CERAMATE

CP431

Adjustable Precision shunt Regulator

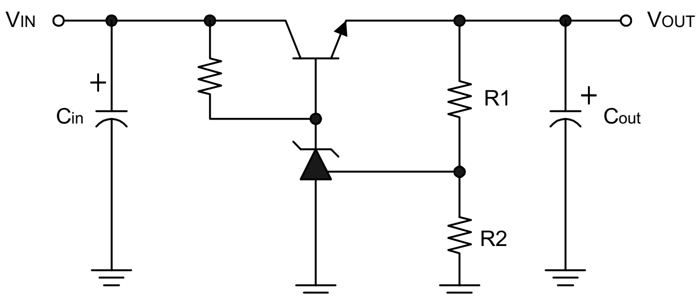
■ Features

- Precision reference voltage
  CP431 : 2.495V ± 1%
  CP431A : 2.495V ± 0.5%
- Sink current capability: 200mA
- Minimum cathode current for regulation: 300 μA
- 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,SOT23

■ Description

The CP431/CP431A 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 a 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 AP431/431A 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.

■ Typical Application Circuit



$V_{OUT} = (1+R1/R2)V_{REF}$

Precision Regulator

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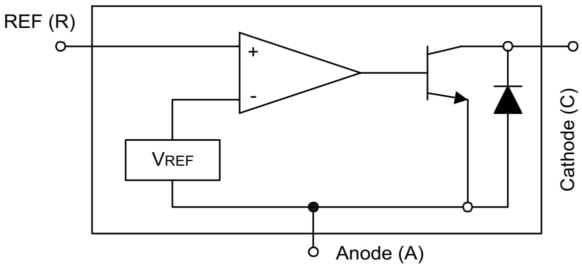
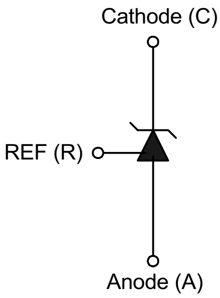
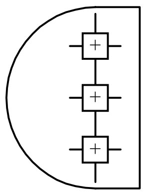
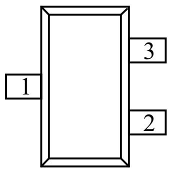
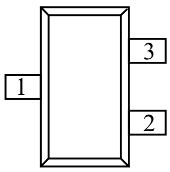
■ Block Diagram



■ Symbol



■ Pin Configuration

Order Number	Pin Configuration (Top View)
CP431V CP431AV (TO-92)	 3 Cathode 2 Anode 1 Ref
CP431W CP431AW (SOT-23)	 Anode 1 3 Cathode 2 Ref
CP431R CP431AR (SOT-23)	 Anode 1 3 Ref 2 Cathode

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■ Absolute Maximum Ratings

Cathode Voltage ……………………………………………………………………………………36V
Continuous Cathode Current …………………………………………………………… -10mA ~ 150mA
Reference Input Current Range ……………………………………………………………………… 10mA
Operating Temperature Range ……………………………………………………………… $0^oC \sim 70^oC$
Lead Temperature……………………………………………………………………………………… 260^oC
Storage Temperature ……………………………………………………………………… $-65^oC \sim 150^oC$
Power Dissipation

TO-92 Package …………………………………………………………………… 0.78W
SOT-23 package …………………………………………………………………… 0.23W

■ Electrical Characteristics (Ta=25^oC , unless otherwise specified.)

PARAMETER	TEST CONDITIONS		SYMBOL	MIN.	TYP.	MAX.	UNIT
Reference voltage	V_{KA} = VRef, I_{KA} = 10mA (Fig.1)	CP431	V_{REF}	2.470	2.495	2.520	V
		CP431A		2.482		2.507	
Deviation of Reference input voltage over temperature (Note 3)	$V_{KA} = V_{REF}$, I_{KA} = 10mA , Ta = $0^oC \sim +70^oC$		V_{REF}		8.0	20	mV
Ratio of the change in Reference voltage to the change in Cathode voltage	I_{KA} = 10mA (Fig.2)	$V_{KA} = 10V \sim V_{REF}$	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$		-1.4	-2.0	mV/V
		$V_{KA} = 36V \sim 10V$			-1	-2	mV/V
Reference input current	R1 = 10KΩ,R2 = ∞ I_{KA}= 10mA		I_{REF}		1.4	3.5	μA
Deviation of Reference input current over temperature	R1 = 10KΩ,R2 = ∞ I_{KA} = 10mA, Ta = Full range		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} = 36V , V_{REF} = 0V		$I_{KA(OFF)}$		0.1	1.0	μA
Dynamic output impedance	$V_{KA} = V_{REF}$ $V_{KA} = V_{REF}$, ΔI_{KA} = 1mA ~ 100mA, Frequency ≤ 1KHz (Fig.1)		$\lvert Z_{KA} \rvert$		0.2	0.5	Ω

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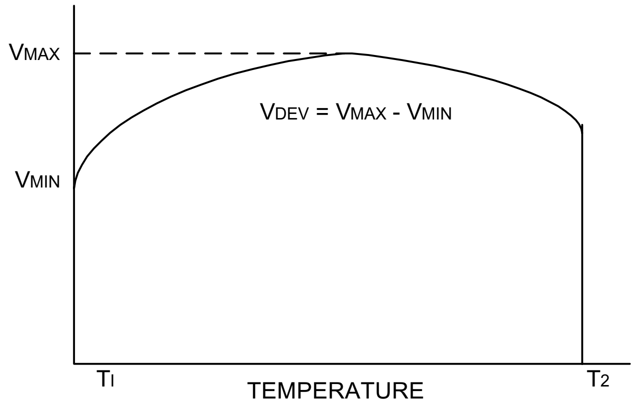


Note . Deviation of reference input voltage, V_{DEV}, is defined as the maximum variation of the reference over the full temperature range.

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

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

Where:

T2 – T1 = full temperature change.

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

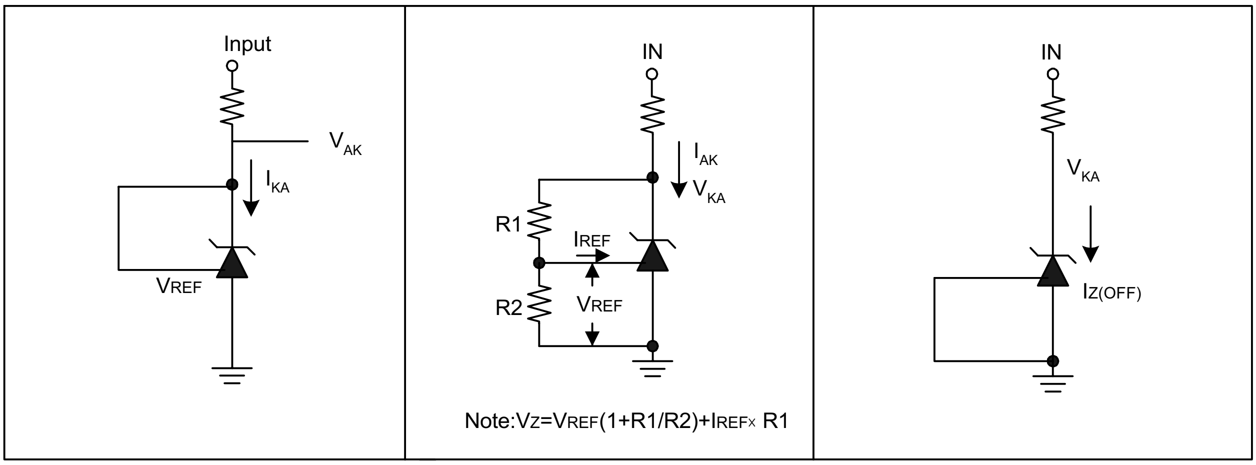
Note 4. The dynamic output impedance, R_Z, is defined as:

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

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:

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

■ Test Circuits



Test Circuit for $V_{KA} = V_{REF}$ Test circuit for $V_{KA} > V_{REF}$ Test Circuit for off-state Current

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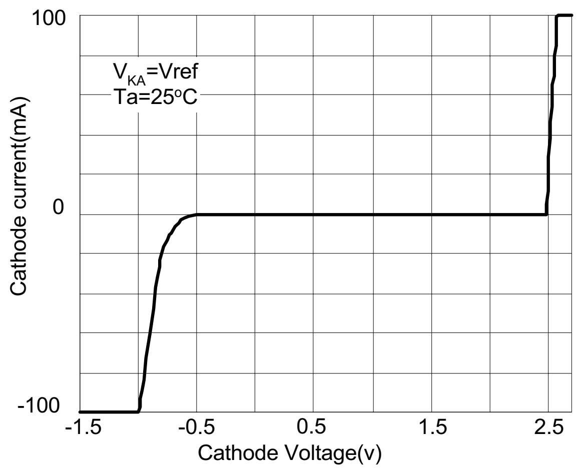
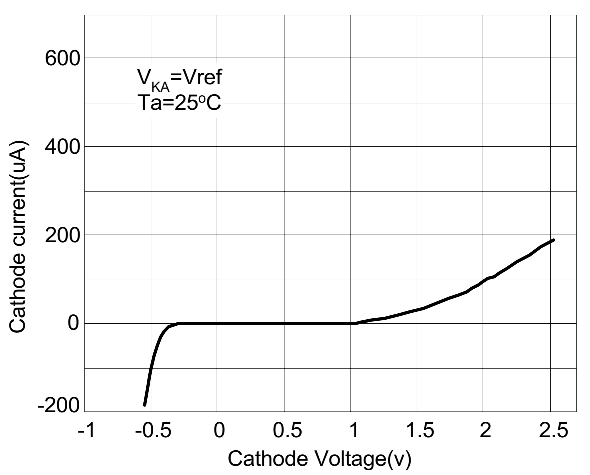
■ Typical Performance Characteristics

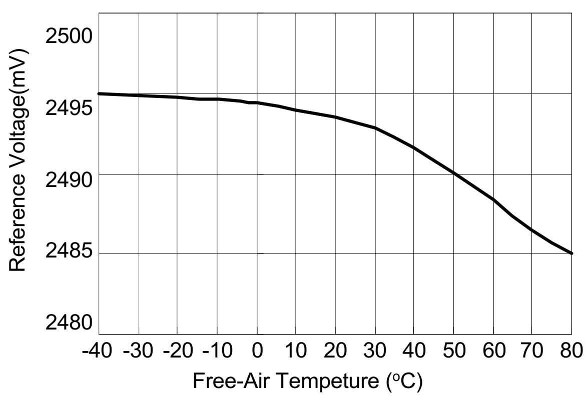
Cathode current Vs Cahode Voltage



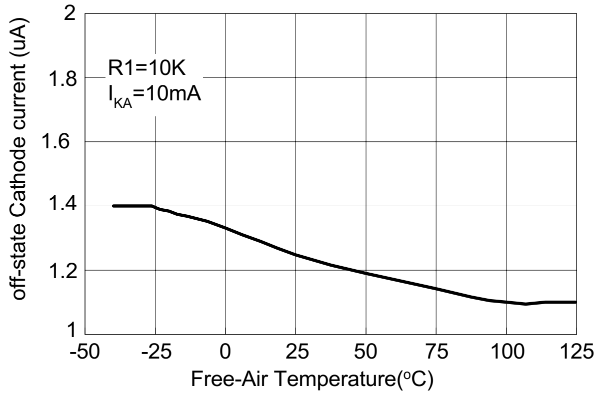
Cathode current (uA)



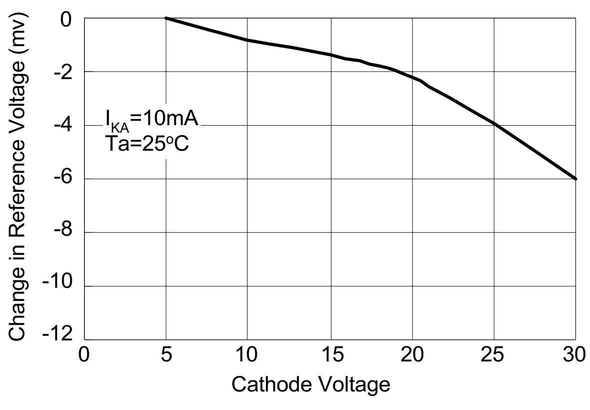
Reference Voltage Vs Free-Air Temperature



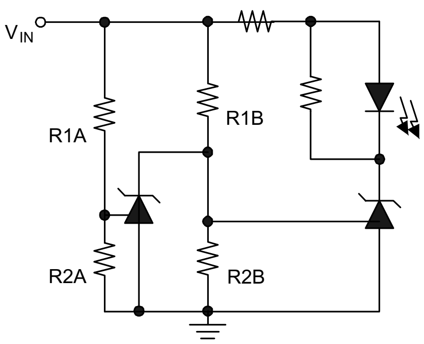
Reference input current Vs free Temperature



Change in Reference Voltage vs Cathode Voltage

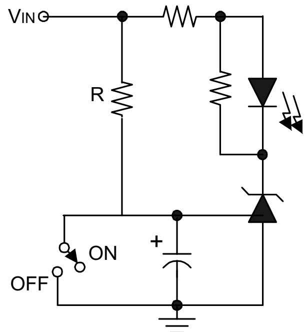


■ Application Examples



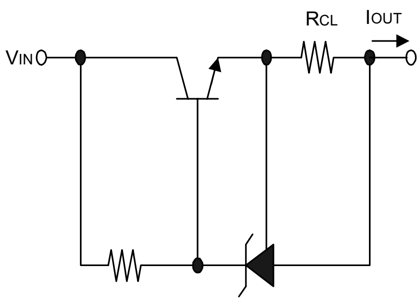
LED on when Low Limit < V_{IN} < High Limit
Low Limit ≈ V_{REF} (1+R1B/R2B)
High Limit ≈ V_{REF} (1+R1A/R2A)

Fig.1 Voltage Monitor



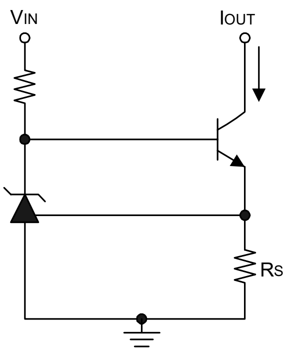
$$\text{Delay} = RC \times \ln\left(\frac{V_{IN}}{V_{IN} - V_{REF}}\right)$$

Fig.2 Delay Timer



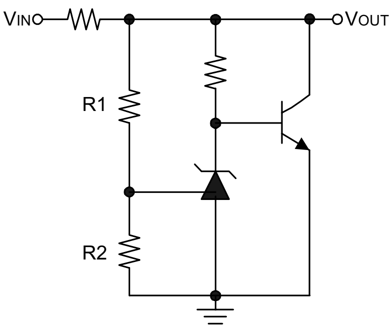
$I_{OUT} = V_{REF} / R_{CL}$

Fig.3 Current Limiter or Current Source



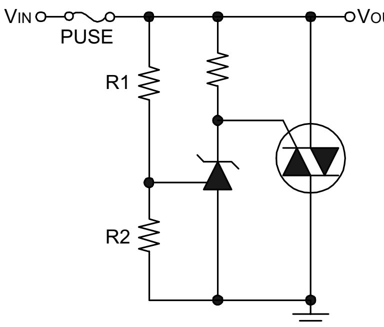
$I_{OUT} = V_{REF} / R_S$

Fig.4 Constant-Current Sink



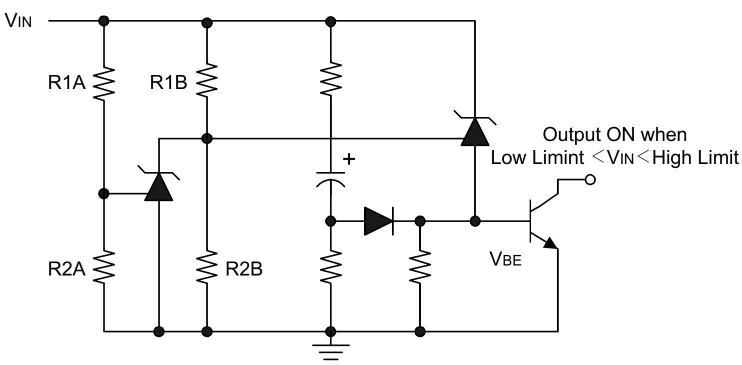
$V_{OUT} = (1 + R1/R2) \times V_{REF}$

Fig.5 Higher-Current Shunt Regulator



LIMIT ≈(1 + R1/R2) × V_{REF}

Fig.6 Crow Bar



Low Limit ≈ V_{REF}(1 + R1B/R2B) +V_{BE}
High Limit ≈ V_{REF}(1 + R1A/R2A)

Fig.7 Over-Voltage / Under-Voltage Protection Circuit

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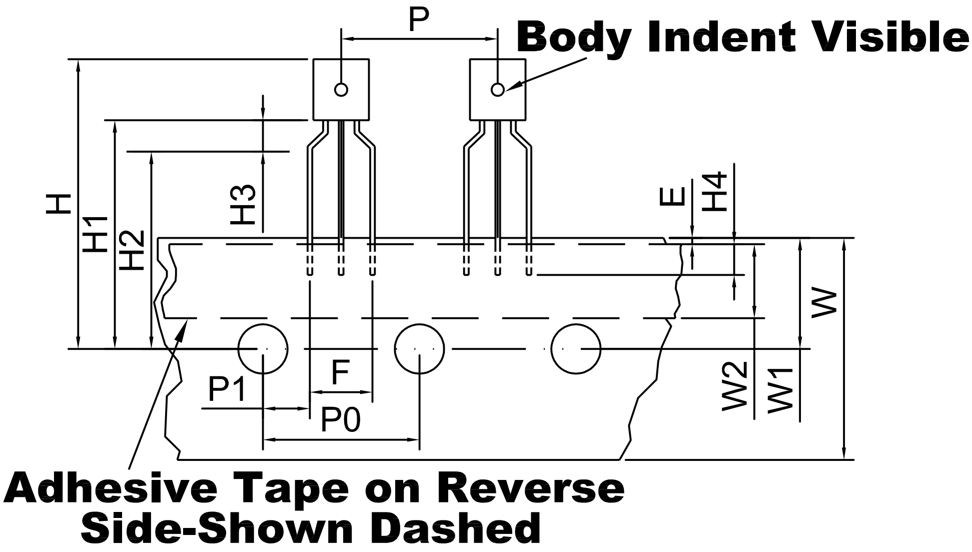
■ Taping Specifications For TO-92 package



SYMBOL	SPECIFICATIONS (mm)	SPECIFICATIONS (inch)
P	12.7 ± 1.0	0.50 ± 0.07
P0	12.7 ± 1.0	0.50 ± 0.07
P1	3.81 ± 0.4	0.15 ± 0.016
H	21.0~26.0	0.828~1.024
H1	17.0~21.0	0.669~0.828
H2	14.0~18.0	0.551~0.709
H3	3.4 max.	0.125 max.
H4	2.5 min.	0.098 min.
F	5.08 ± 0.2	0.2 ± 0.008
W	18.0 ± 0.5	0.708 ± 0.020
W1	9.0 ± 0.5	0.354 ±0.020
W2	6.0 ± 0.5	0.236 ±0.020
ΦD0	4.0 ± 0.2	0.157 ± 0.008
E	0.5 max.	0.020 max.

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