

Features

- Low-Voltage Operation: Down to 1.24V
- 1% Reference-Voltage Tolerance
- Adjustable Output Voltage, $V_o = V_{ref}$ to 12V
- Low Operational Cathode Current, ...50 μ A
- 0.25 Ω Typical Output Impedance
- SOT-23 and TO-92 Packages

Application

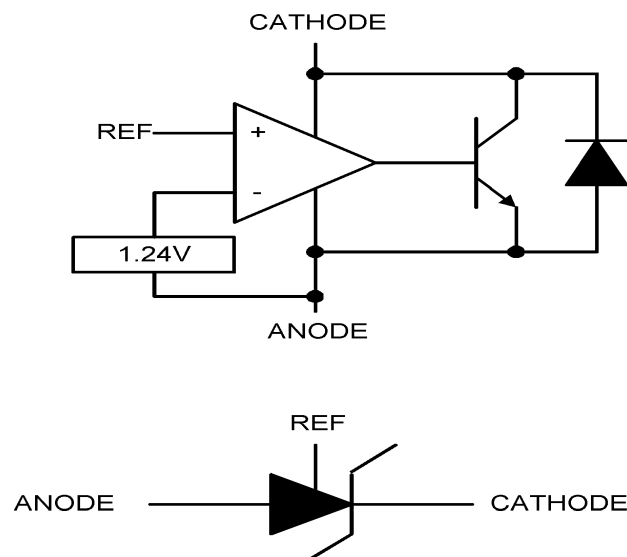
- Linear Regulators
- Voltage Reference for Power Circuit

Description

The AT431 is low-voltage three-terminal adjustable voltage reference with specified thermal stability over applicable commercial temperature ranges. Output voltage may be set to any value between V_{ref} (1.24V) and 12V with two external resistors (see Figure 2).

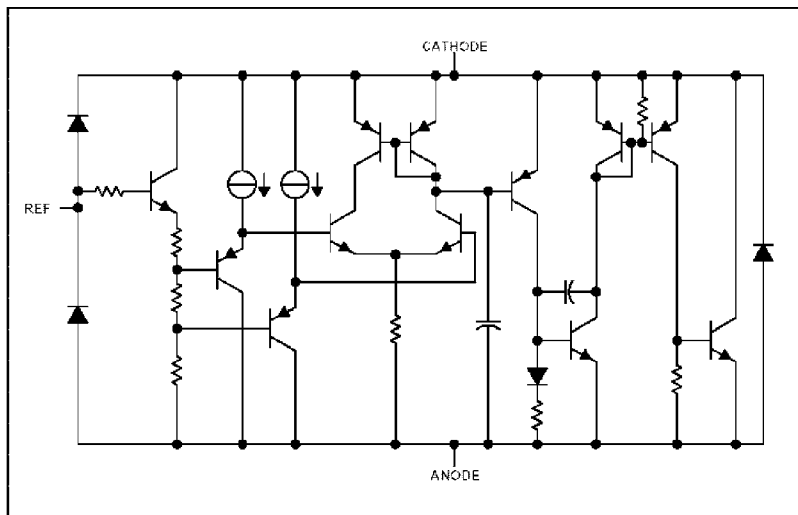
When used with an optocoupler, the AT431 is ideal voltage reference in isolated feedback supplies for 1.8V to 12 V switching-mode power supplies. This device has typical output impedance of 0.20 Ω . Active output circuitry provides a very sharp turn-on characteristic, making the AT431 excellent replacements for low-voltage zener diodes in many applications, including onboard regulation and adjustable power supplies.

Block Diagram and Symbol

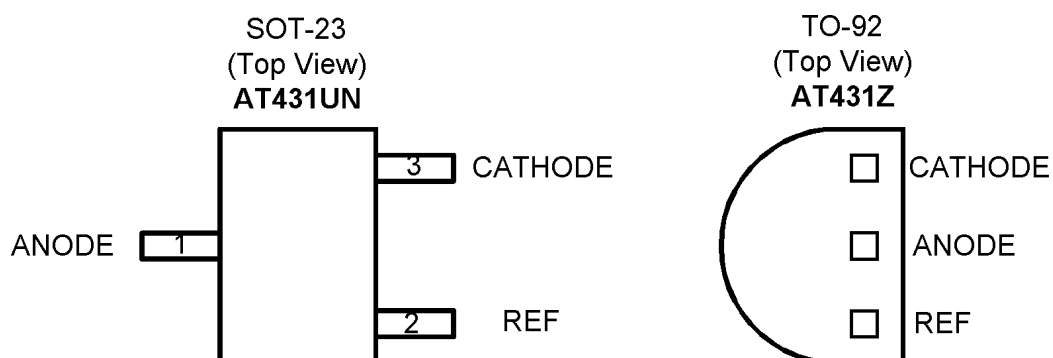


Aimtron reserves the right without notice to change this circuitry and specifications.

Equivalent Schematic



Pin Assignments



Ordering Information

Part number	Package	Marking
AT431Z	TO-92	□□□Z
AT431UN	SOT-23	□□□N

* □□□: Data Code

Absolute maximum ratings ($T_A = 25^\circ\text{C}$)

Parameter	Symbol	Limits	unit
Cathode voltage	V _{KA}	12	V
Continuous cathode current range	I _K	-20~20	mA
Reference Current	I _{REF}	-0.05~3	mA
Operating temperature	T _{OPR}	-30~+85	°C
Storage temperature	T _{STG}	-55~+150	°C
Package thermal impedance θ _{JA}	SOT-23-5 SOT-23-3	347	°C / W
	TO-92	156	
Power Dissipation	PD	(T _J (max)-T _A)/ θ _{JA}	

Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Recommend operating condition

Parameter	min	Max	unit
Cathode voltage V_{KA}	V_{ref}	12	V
Continuous cathode current range I_K	0.05	15	mA
Operating free-air temperature range T_A	0	70	$^\circ\text{C}$

Electrical characteristics (unless otherwise noted)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Reference Voltage	$V_{ref} (T_A = 25^\circ\text{C})$	1.228	1.24	1.252	V	$V_{KA} = V_{ref}$ $I_K = 10\text{mA}$ (Figure 1)
	$V_{ref} (T_A = \text{full range } 0 \sim 70^\circ\text{C})$	1.221	-	1.259	V	
V_{ref} deviation over full temperature range	$V_{ref}(\text{dev})$	-	4	20	mV	$V_{KA} = V_{ref}$ $I_K = 10\text{mA}$ (Figure 1)
Ratio of V_{ref} change in cathode voltage change	$\Delta V_{ref} / \Delta V_{KA}$	-	-1.5	-2.7	mV/V	$V_{KA} = V_{ref}$ to 12V $I_K = 10\text{mA}$ (Figure 2)
Reference terminal current	I_{ref}	-	0.15	0.5	μA	$I_K = 10\text{mA}$ $R1 = 10\text{K}\Omega$ (Figure 2)
I_{ref} deviation over full temperature range	$I_{ref}(\text{dev})$	-	0.05	0.3	μA	$I_K = 10\text{mA}$ $R1 = 10\text{K}\Omega$ $R2 = \text{open}$ (Figure 2)
Minimum cathode current for regulation	$I_{K(\text{min})}$	-	40	50	μA	$V_{KA} = V_{ref}$ (Figure 1)
Off-state cathode current	$I_{K(\text{off})}$	-	0.001	0.1	μA	$V_{KA} = 12\text{V}$ $V_{ref} = 0\text{V}$ (Figure 3)
Dynamic impedance	$ Z_{KA} $	-	0.20	0.4	Ω	$V_{KA} = V_{ref}$ $f \leq 1\text{KHz}$ $I_K = 0.1\text{mA}$ to 15mA (Figure 1)

* The dynamic impedance is defined as : $|Z_{KA}| = \Delta V_{KA} / \Delta I_{KA}$

Parameter Measurement Information

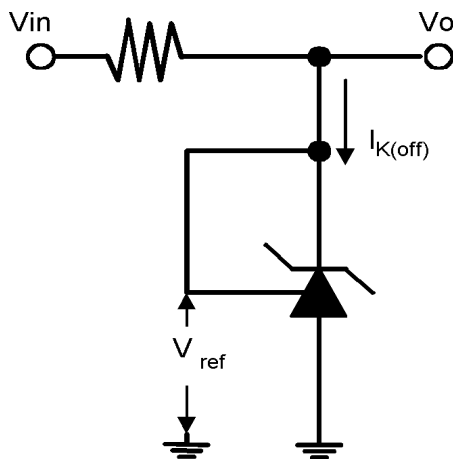


Figure 1. Test Circuit for $V_{KA} = V_{ref}$
 $V_O = V_{KA} = V_{ref}$

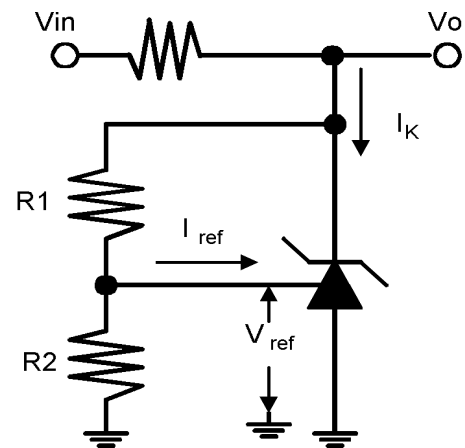


Figure 2. Test Circuit for $V_{KA} > V_{ref}$
 $V_O = V_{KA} = V_{ref} * (1 + R1/R2) + I_{ref} * R1$

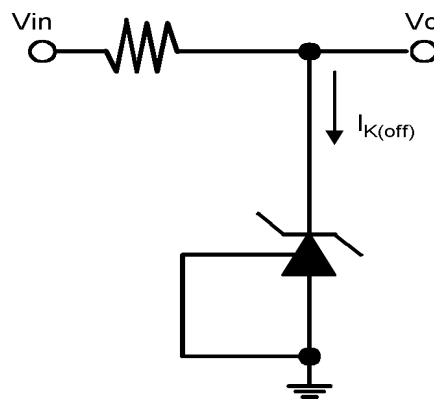


Figure 3. Test Circuit for $I_{K(off)}$

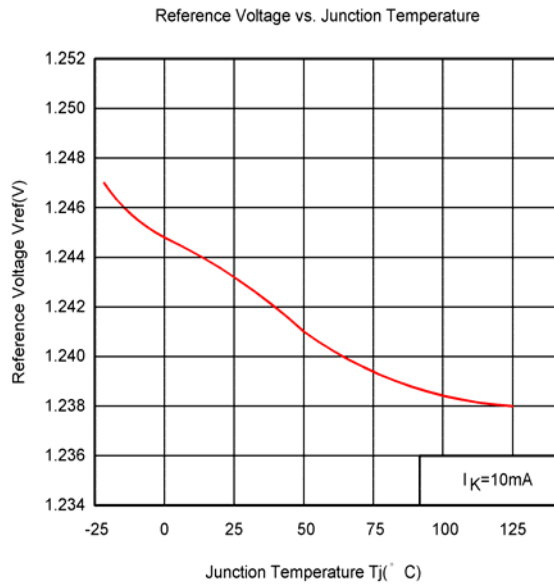


Figure 4.

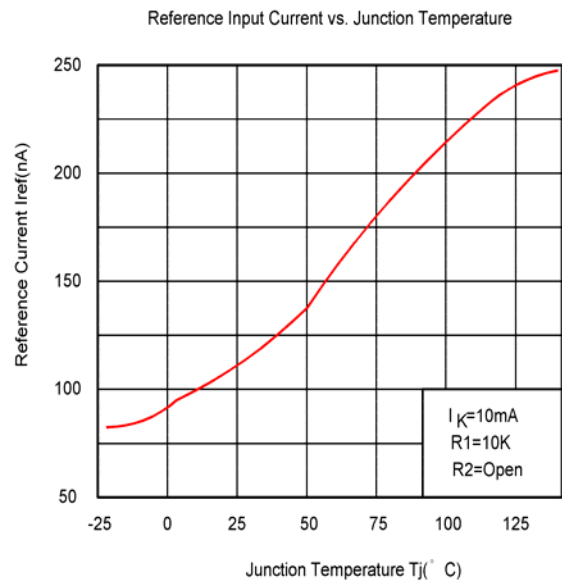


Figure 5.

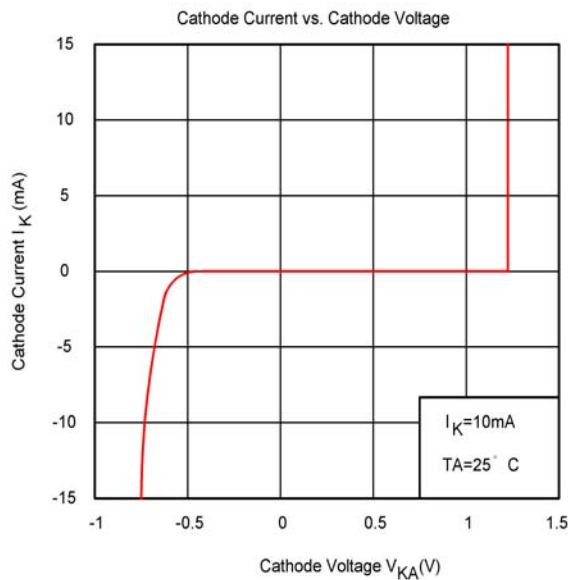


Figure 6.

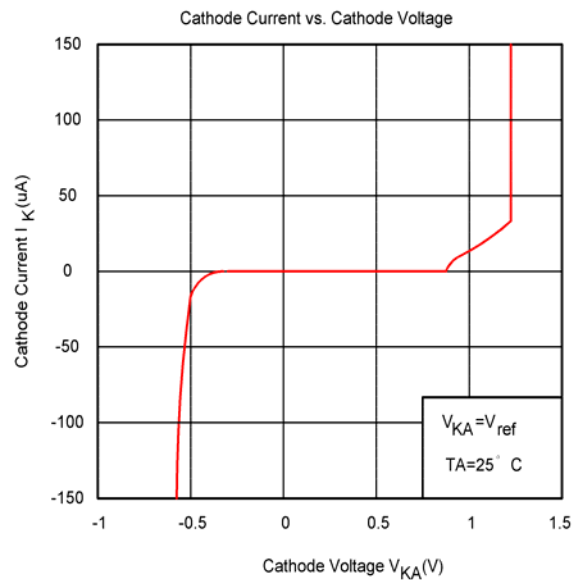


Figure 7.

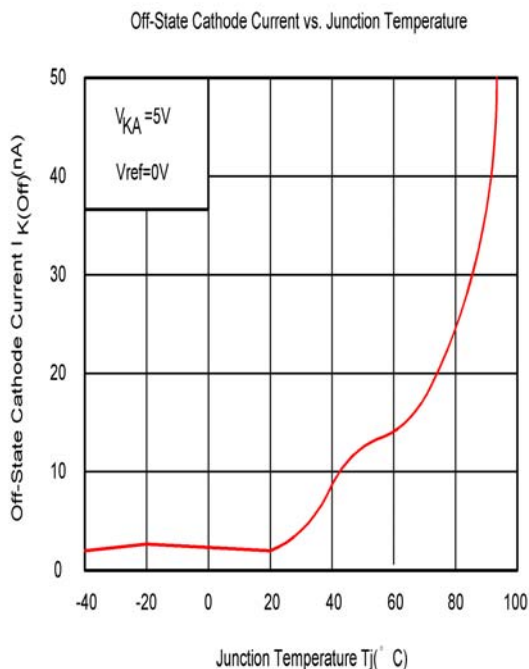


Figure 8.

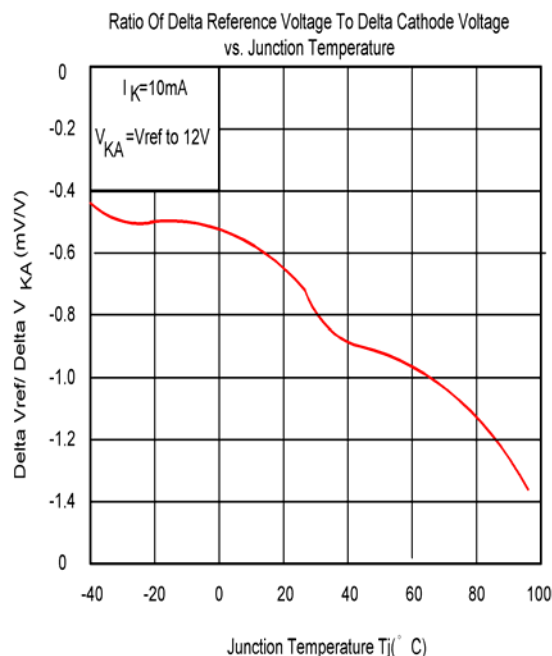


Figure 9.

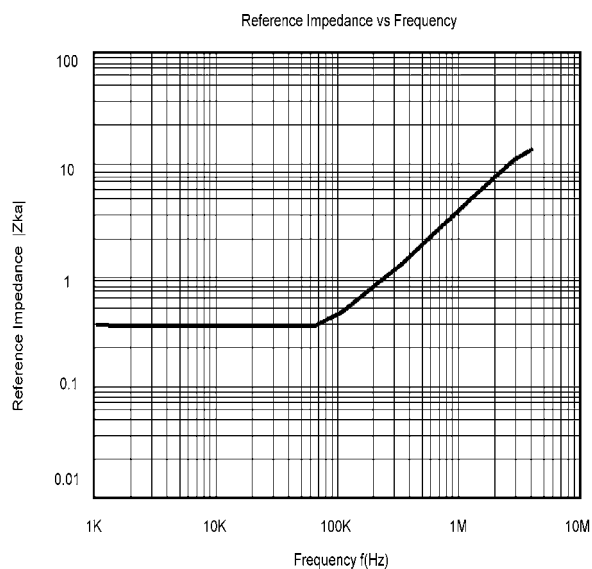
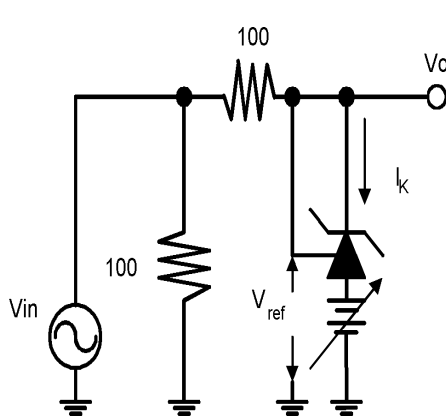
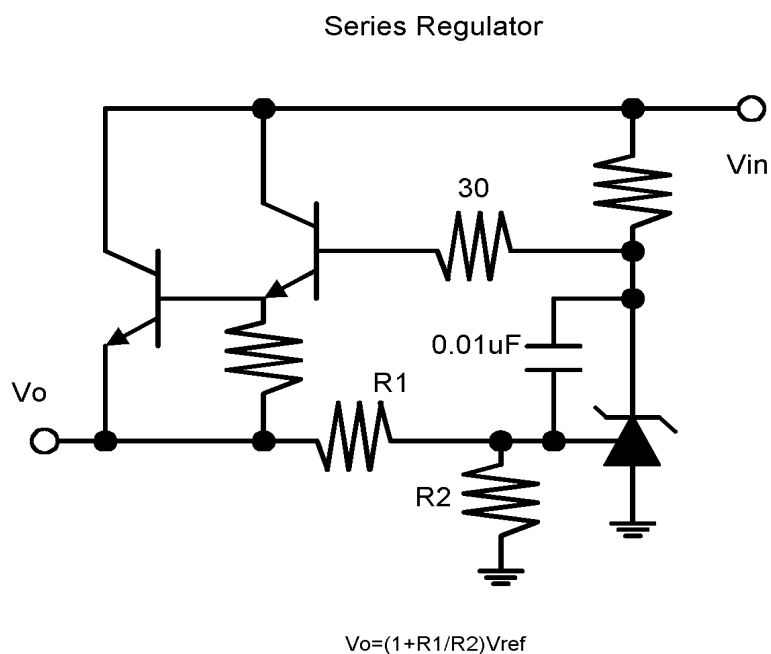
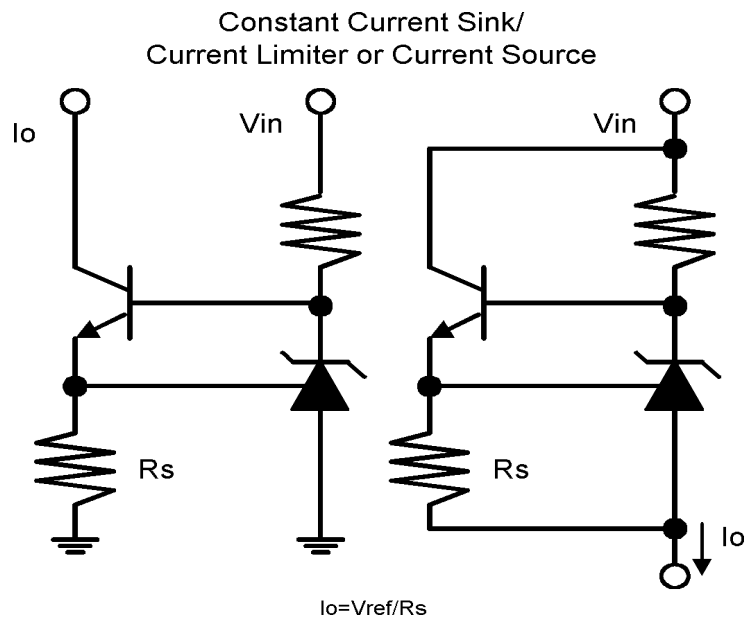
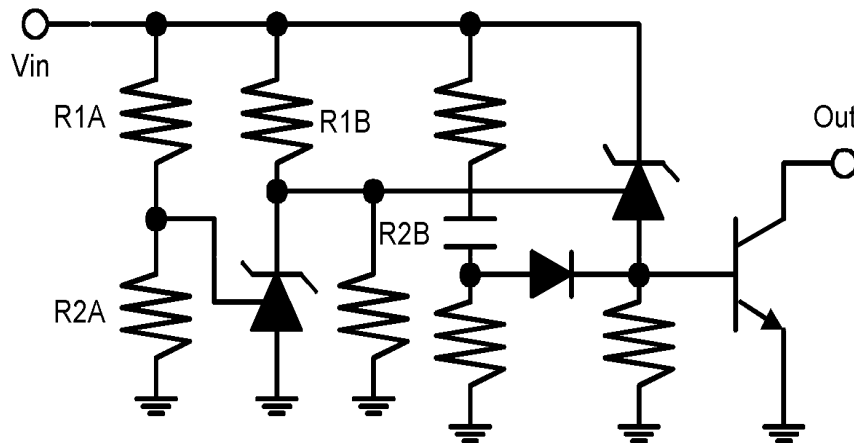


Figure 10.

Application Circuit

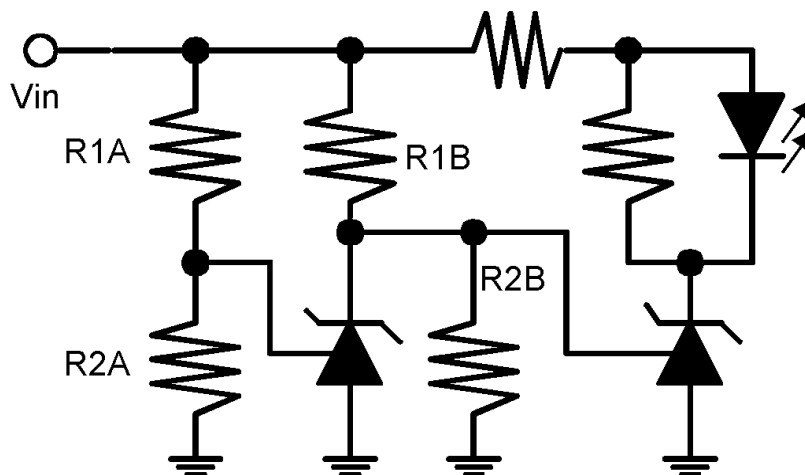


Over Voltage/Under Voltage Protection Circuit

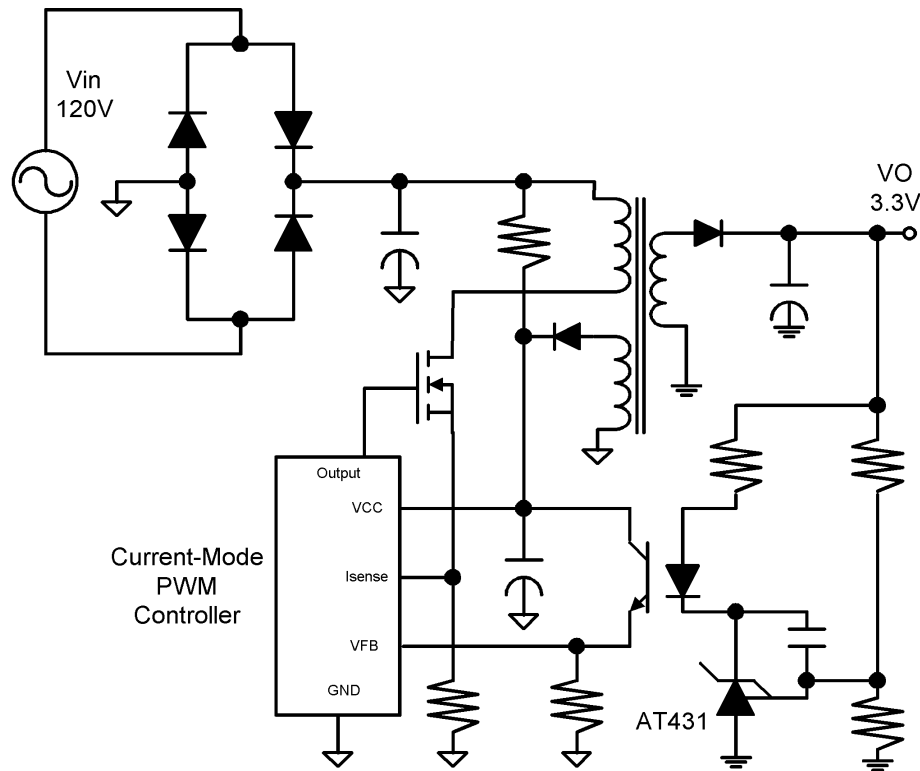


$$\begin{aligned}\text{Low Limit} &= (1 + R1B/R2B)V_{\text{ref}} + V_{\text{be}} \\ \text{High Limit} &= (1 + R1A/R2A)V_{\text{ref}} \\ \text{Out ON When } &\text{Low Limit} < V_{\text{in}} < \text{High Limit}\end{aligned}$$

Voltage Monitor Circuit

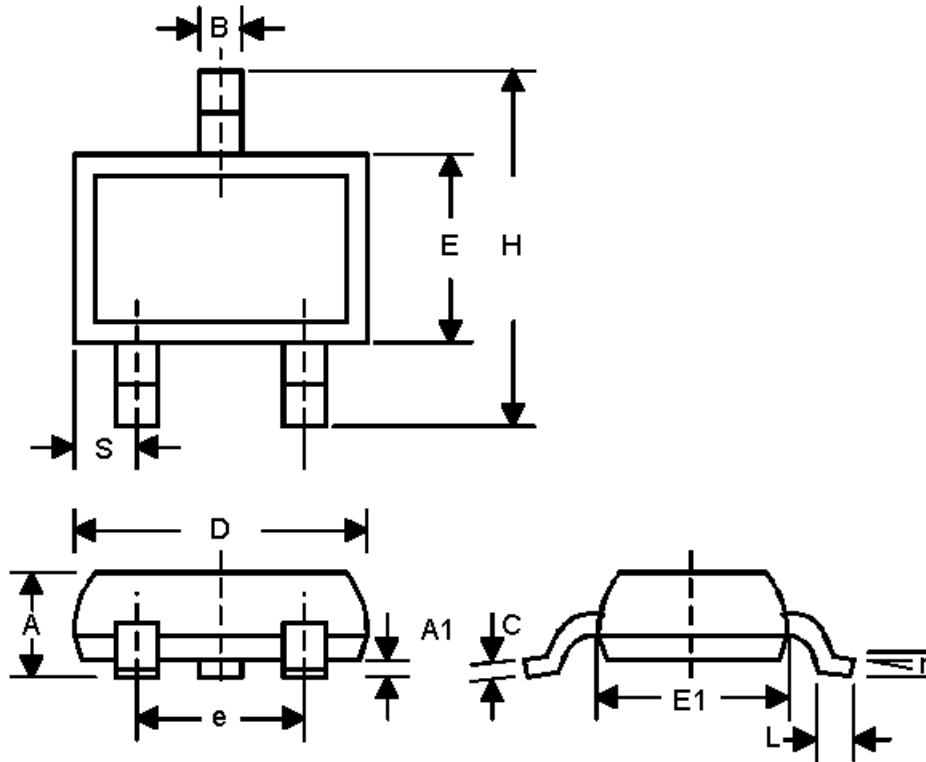


$$\begin{aligned}\text{Low Limit} &= (1 + R1B/R2B)V_{\text{ref}} \\ \text{High Limit} &= (1 + R1A/R2A)V_{\text{ref}} \\ \text{LED ON When } &\text{Low Limit} < V_{\text{in}} < \text{High Limit}\end{aligned}$$



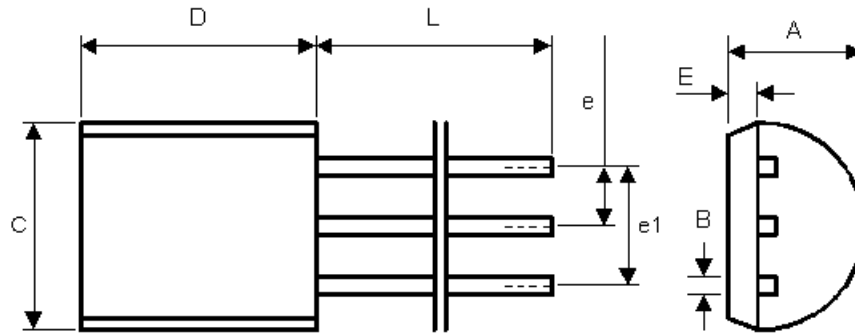
Above shows the AT431 used in a 3.3V isolated flyback supply. Output voltage V_o can be as low as reference voltage V_{ref} ($1.24V \pm 1\%$). The output of the regulator, plus the forward voltage drop of the optocoupler LED ($1.24 + 1.4 = 2.64V$), determine the minimum voltage that can be regulated in an isolated in an isolated supply configuration. Regulated voltage as low as 2.7V is possible using the circuit.

Package Information
SOT-23



SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.787	1.194	0.031	0.047
A1	0.025	0.127	0.001	0.005
B	0.356	0.559	0.014	0.022
C	0.086	0.152	0.0034	0.006
D	2.667	3.048	0.105	0.120
E	1.194	1.397	0.047	0.055
E	1.778	2.032	0.070	0.080
H	2.083	2.489	0.082	0.098
L	0.102	0.305	0.004	0.012
S	0.432	0.559	0.017	0.022
R	0°	8°	0°	8°

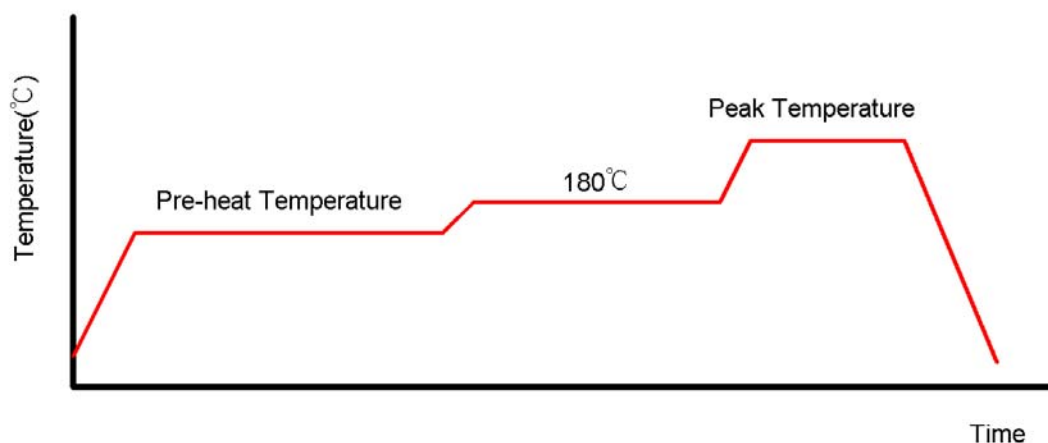
TO-92



SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	3.4	3.8	0.134	0.150
B	0.3	0.5	0.012	0.020
C	4.4	4.8	0.173	0.189
D	4.4	4.8	0.173	0.189
E	0.9	1.5	0.035	0.059
e	1.17	1.37	0.046	0.054
e1	2.39	2.69	0.094	0.106
L	12	16	0.472	0.630

Reflow Condition (IR/Convection or VPR Reflow)

Reference JEDEC Standard J-STD-020A



Classification Reflow Profiles

	Convection or IR/Convection	VPR
Average Heating Rate(180°C to peak)	5°C/second max.	10°C/second max.
Preheat Temperature(125±20°C)	120 seconds max.	
Temperature maintained above 180°C	10~150 seconds	
Time within 5°C of actual Peak Temperature	10~20 seconds	60 seconds
Peak Temperature Range(Note 1)	219~225°C or 235~240°C	219~225°C or 235~240°C
Cooling Rate	6°C /second max.	10°C/second max.
Time 25°C to Peak Temperature	6 minutes max.	

*1 The maximum peak temperatures for IR and VP reflow are depending on package dimensions.

Package Reflow Conditions

Pkg. Thickness ≥2.5mm and all bags	Pkg. Thickness <2.5mm and Pkg. Volume ≥350 mm ³	Pkg. Thickness <2.5mm and Pkg. Volume <350 mm ³
Convection 219~225°C		Convection 235~240°C
VPR 219~225°C		VPR 235~240°C
IR/Convection 219~225°C		IR/Convection 235~240°C