AT431

Preliminary Product Information

1.24V low-Voltage Adjustable Precision Shunt Regulator

Features

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

Application

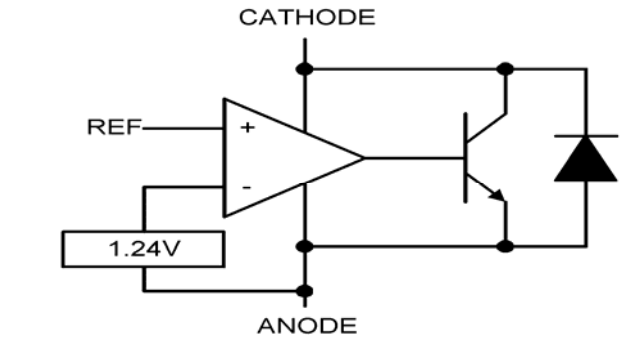
- Linear Regulators
- Voltage Reference for Power Circuit

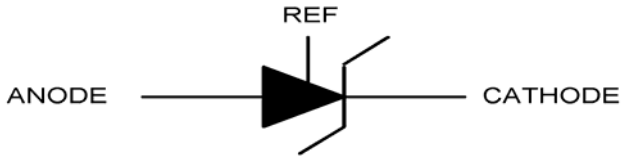
Description

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 circuits for 1.8V to 12 V switching-mode power supplies. This device has typical output impedance of 0.20Ω. 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.

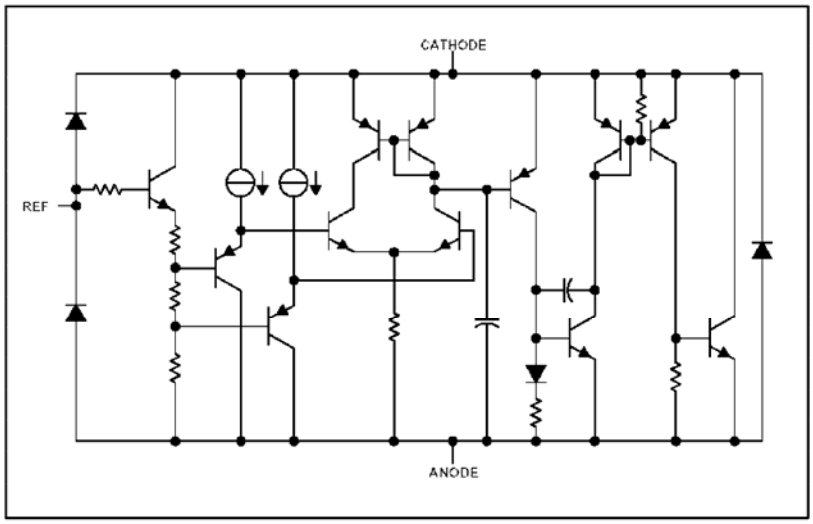
Block Diagram and Symbol



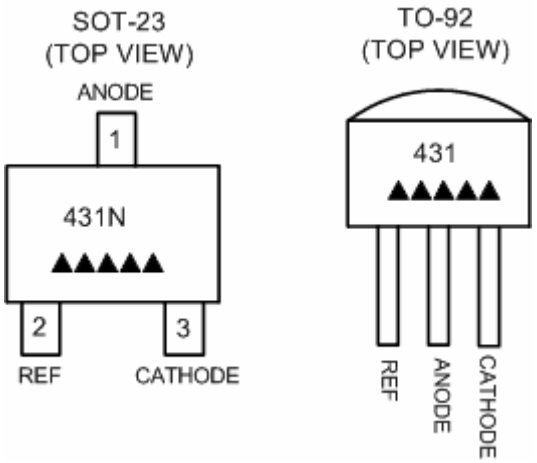


Aimtron reserves the right without notice to change this circuitry and specifications.

Equivalent Schematic



Pin Assignments



Ordering Information

Part number	Package	Marking
AT431Z	TO-92	▲▲▲▲▲ Date Code
AT431UN	SOT-23	▲▲▲▲▲ Date Code
AT431UN_GRE	SOT-23, Green	▲▲▲▲▲ (underlined), Date Code with one bottom line

▲▲▲▲▲: Date Code

**For more marking information, contact our sales representative directly*

Absolute maximum ratings (T_A = 25°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	$(T_J(max)-T_A)/\theta_{JA}$	

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 condtion

Parameter	min	Max	unit
Cathode voltage V_{KA}	Vref	12	V
Continuous cathode current range I_K	0.05	15	mA
Operating free-air temperature range T_A	0	70	°C

Electrical characteristics (unless otherwise noted)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Reference Voltage	V_{ref} (T_A = 25°C)	1.228	1.24	1.252	V	V_{KA}= V_{ref}
	V_{ref} (T_A = full range 0~70 °C)	1.221	-	1.259	V	I_K=10mA **(Figure 1)**
V_{ref} deviation over full temperature range	$V_{ref(dev)}$	-	4	20	mV	V_{KA}= V_{ref} I_K=10mA **(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=10mA **(Figure 2)**
Reference terminal current	I_{ref}	-	0.15	0.5	μA	I_K=10mA R1=10KΩ **(Figure 2)**
I_{ref} deviation over full temperature range	$I_{ref(dev)}$	-	0.05	0.3	μA	I_K=10mA R1=10KΩ R2=open **(Figure 2)**
Minimum cathode current for regulation	$I_{K(min)}$	-	40	50	μA	V_{KA}= V_{ref} **(Figure 1)**
Off-state cathode current	$I_{K(off)}$	-	0.001	0.1	μA	V_{KA}=12V V_{ref} =0V **(Figure 3)**
Dynamic impedance	$\lvert Z_{KA} \rvert$	-	0.20	0.4	Ω	V_{KA}= V_{ref} f≤1KHz I_K=0.1mA to 15mA **(Figure 1)**

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

Parameter Measurement Information

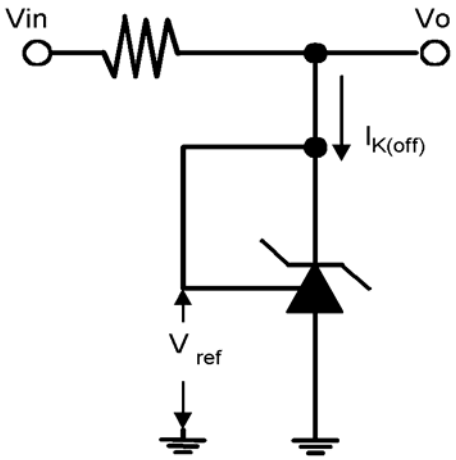


Figure 1. Test Circuit for $V_{KA}=V_{ref}$

$V_O= V_{KA}=V_{ref}$

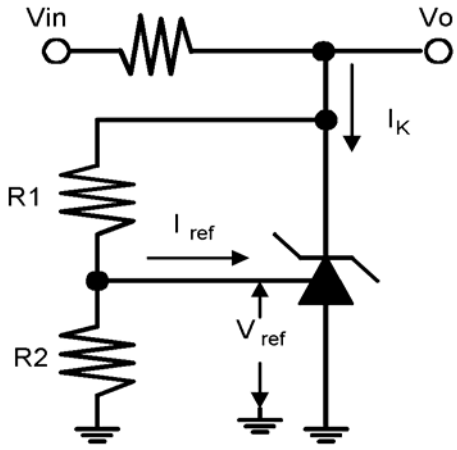


Figure 2. Test Circuit for $V_{KA}>V_{ref}$

$V_O= V_{KA}=V_{ref}$ *(1+R1/R2)+I_{ref} *R1

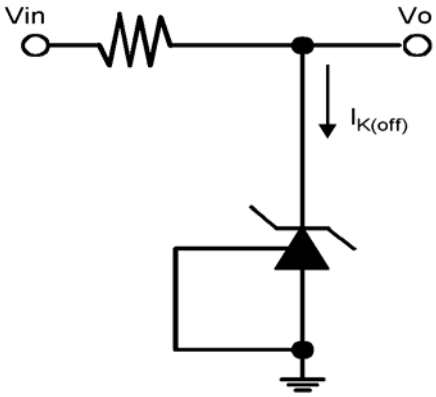


Figure 3. Test Circuit for $I_{K(off)}$

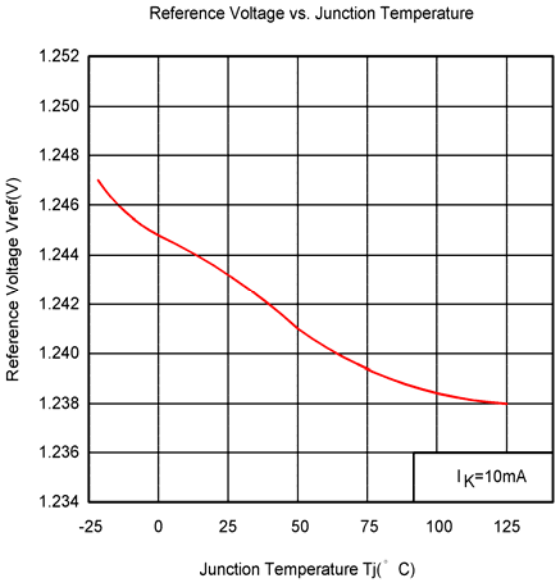


Figure 4.

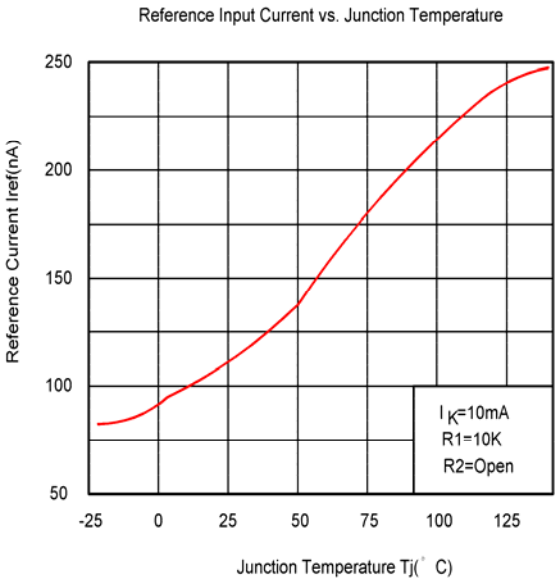


Figure 5.

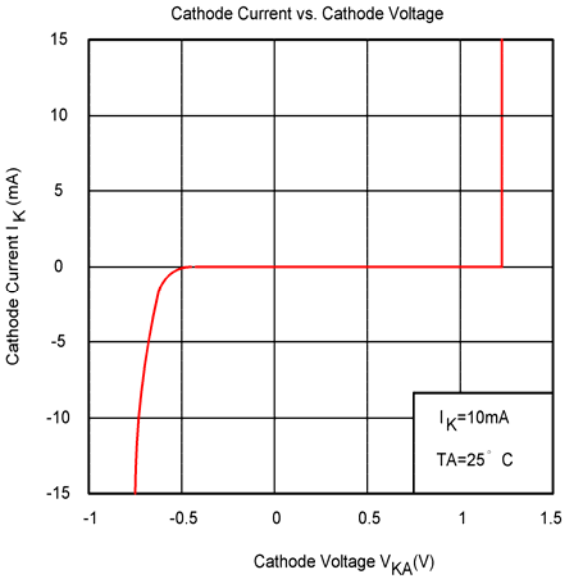


Figure 6.

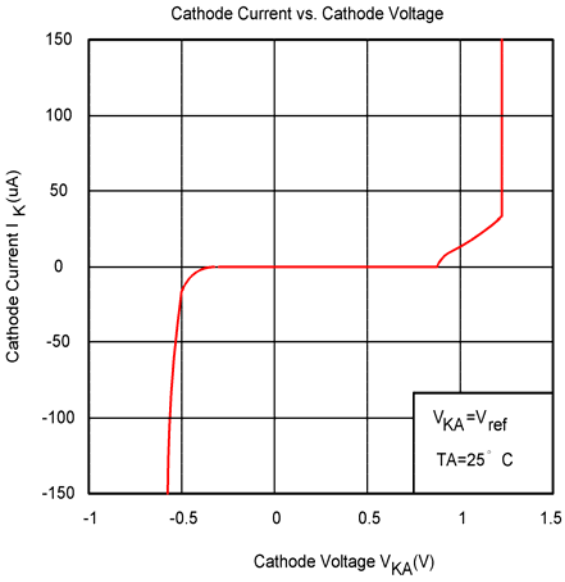


Figure 7.

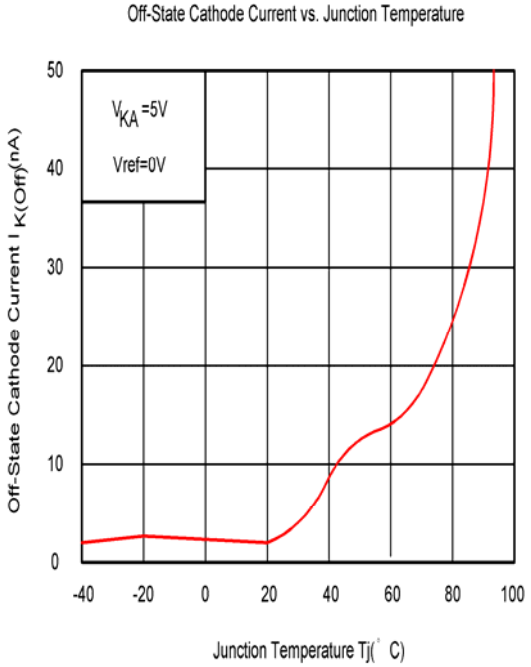


Figure 8.

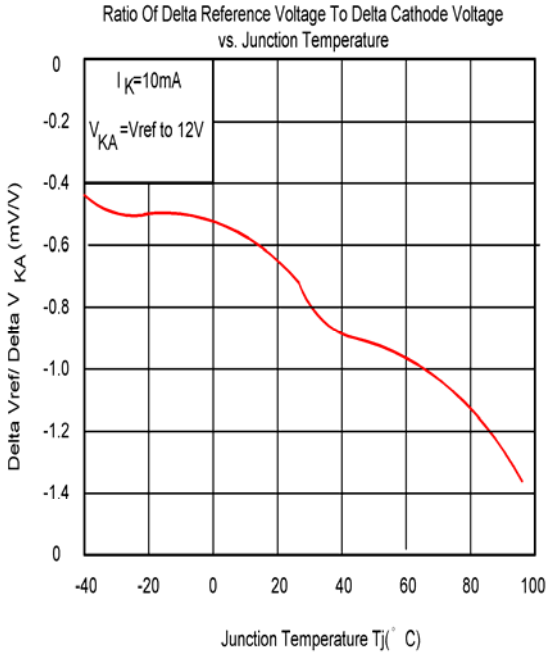


Figure 9.

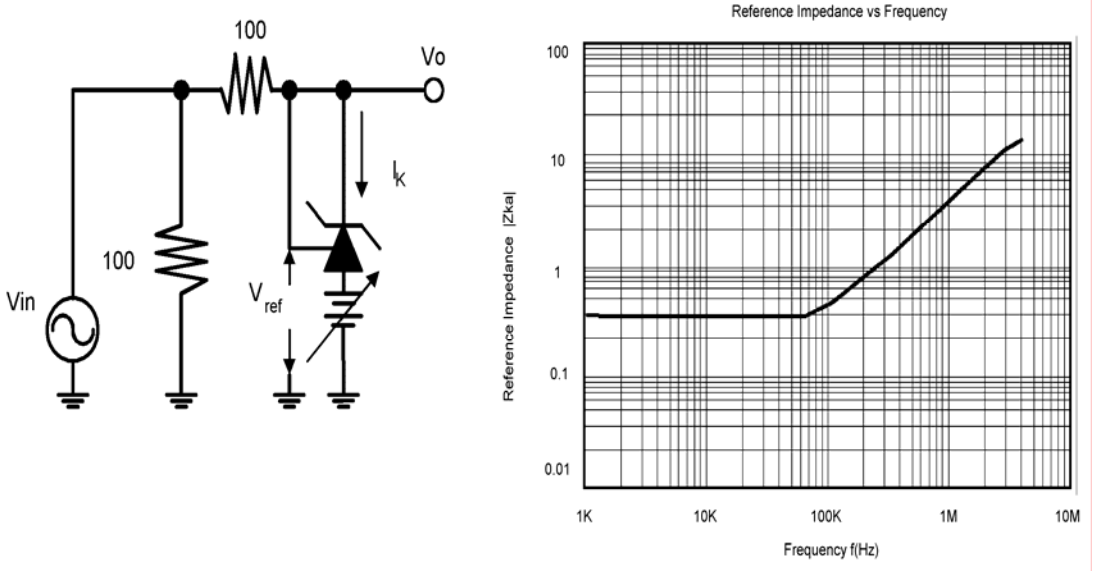
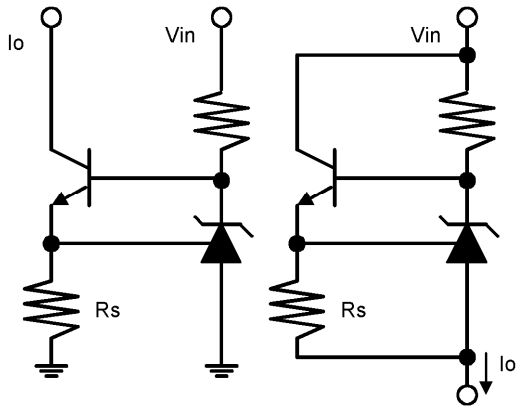


Figure 10.

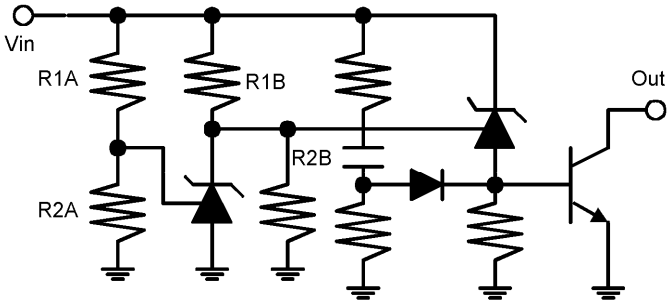
Application Circuit

Constant Current Sink/
Current Limiter or Current Source



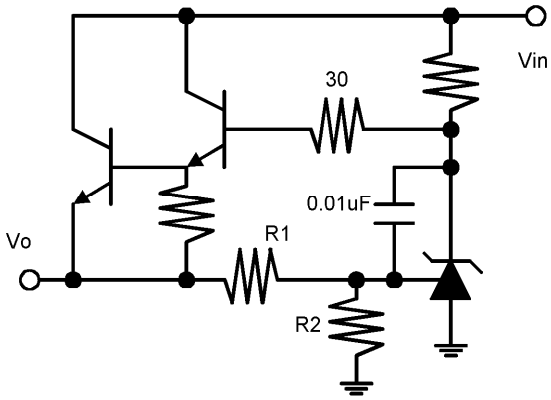
Io=Vref/Rs

Over Voltage/Under Voltage Protection Circuit



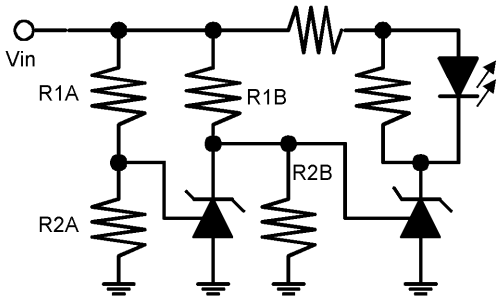
Low Limit=(1+R1B/R2B)Vref + Vbe
High Limit=(1+R1A/R2A)Vref
Out ON When Low Limit< Vin < High Limit

Series Regulator

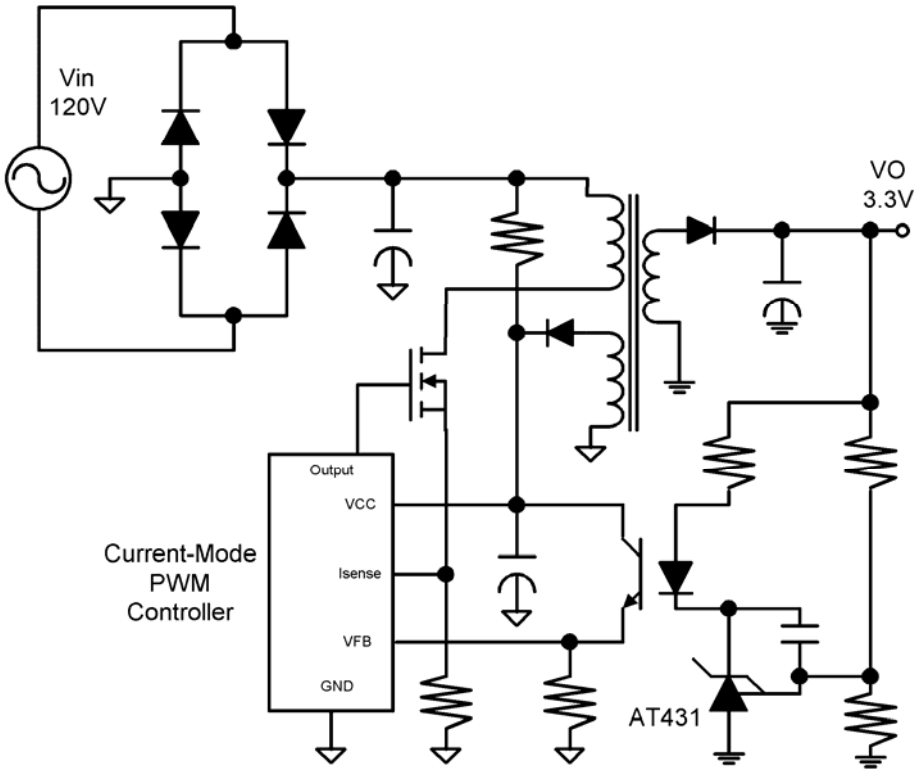


Vo=(1+R1/R2)Vref

Voltage Monitor Circuit



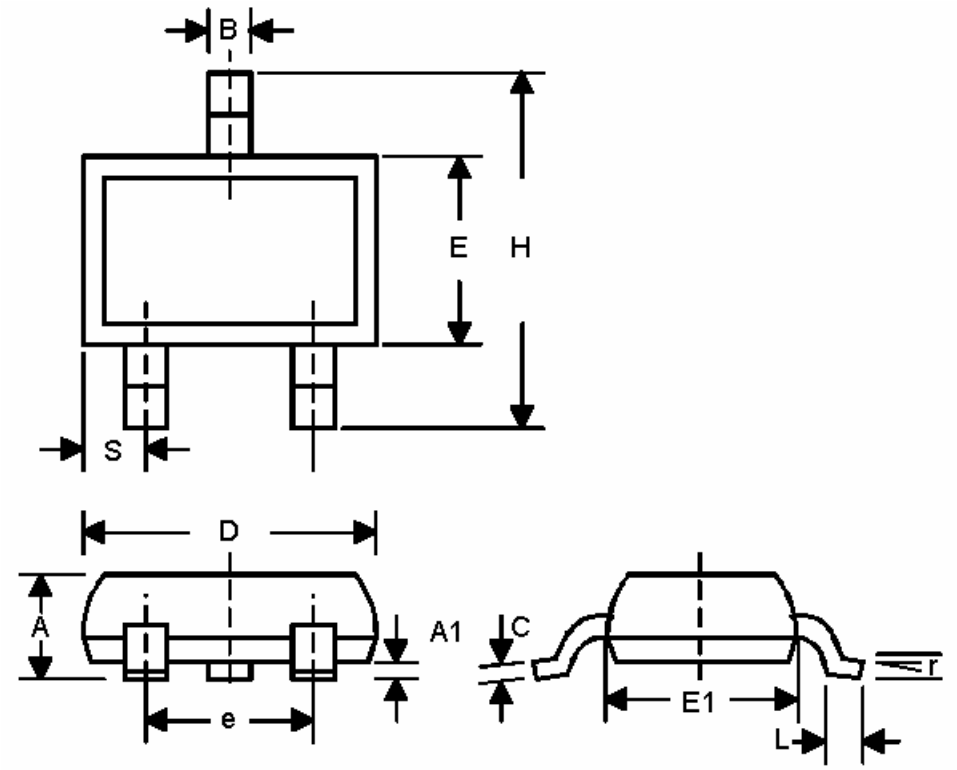
Low Limit=(1+R1B/R2B)Vref
High Limit=(1+R1A/R2A)Vref
LED ON When Low Limit< Vin < High Limit



Above shows the AT4311 used in a 3.3V isolated flyback supply. Output voltage Vo can be as low as reference voltage V_{ref} (1.24V±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.

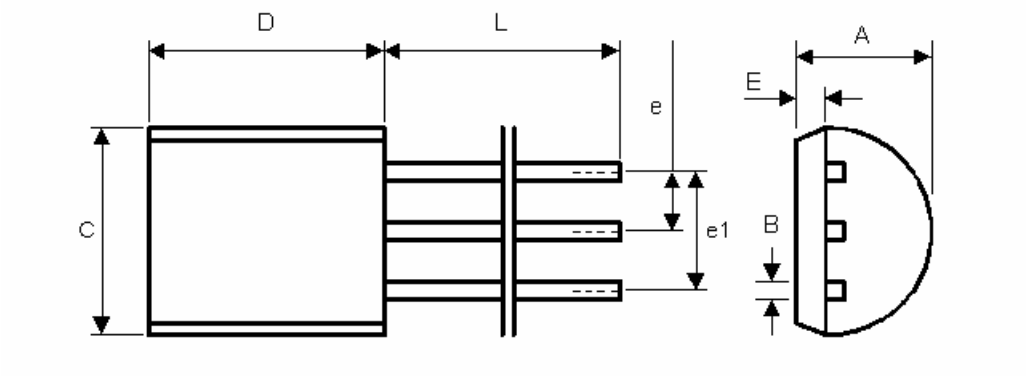
Package Information

SOT-23



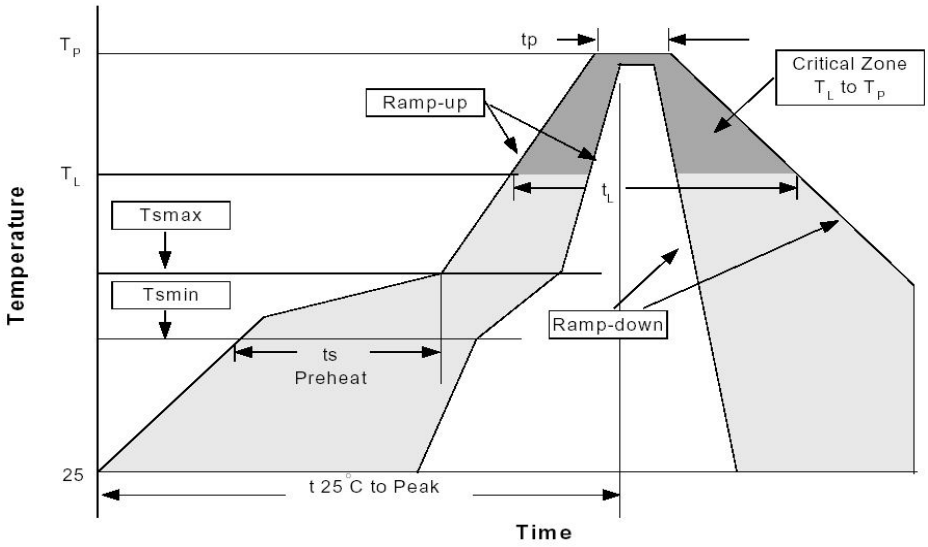
SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.787	1.194	0.031	0.047
A1	0.025	0.127	0.001	0.005
B	0.356	0.559	0.014	0.022
C	0.086	0.152	0.0034	0.006
D	2.667	3.048	0.105	0.120
E	1.194	1.397	0.047	0.055
E	1.778	2.032	0.070	0.080
H	2.083	2.489	0.082	0.098
L	0.102	0.305	0.004	0.012
S	0.432	0.559	0.017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



Profile Feature	Sn-Pb Eutectic Assembly		Pb-Free Assembly	
	Large Body **Pkg. thickness ≥2.5mm or Pkg. volume ≥350mm³**	**Small Body** **Pkg. thickness <2.5mm or Pkg. volume <350mm³**	**Large Body** **Pkg. thickness ≥2.5mm or Pkg. volume ≥350mm³**	**Small Body** **Pkg. thickness ≥2.5mm or Pkg. volume ≥350mm³**
Average ramp-up rate (T_L to T_P)	3°C/second max.		3°C/second max.	
Preheat -Temperature Min(Tsmin) -Temperature Max (Tsmax) -Time (min to max)(ts)	 100°C 150°C 60-120 seconds		 150°C 200°C 60-180 seconds	
Tsmax to T_L -Ramp-up Rate			3°C/second max.	
Time maintained above: -Temperature (T_L) -Time (t_L)	 183°C 60-150 seconds		 217°C 60-150 seconds	
Peak Temperature(T_P)	225+0/-5°C	240+0/-5°C	245+0/-5°C	250+0/-5°C
Time within 5°C of actual Peak Temperature (t_P)	10-30 seconds	10-30 seconds	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max.		3°C/second max.	
Time 25°C to Peak Temperature	6 minutes max.		8 minutes max.	

***All temperatures refer to topside of the package, measured on the package body surface.**