

ADJUSTABLE PRECISION SHUNT REGULATORS

概述 General Description

The FL431 is a three-terminal adjustable shunt regulator with guaranteed thermal stability over a full operation range. It features sharp turn-on characteristics, low temperature coefficient and low output impedance, which make it ideal substitute for Zenner diode in applications such as switching power supply, charger and other adjustable regulators.

The output voltage of FL431 can be set to any value between $V_{ref}(2.5V)$ and the corresponding maximum cathode voltage(36V).

The FL431 is offered in two grade initial voltage tolerance at 25°C, 0.5% and 1%.

This IC is available in 3 packages: TO-92, and SOT-23.

FL431是三端可調的，全溫度範圍穩定的並聯調整器。具有快速啟動、低溫漂和低輸出阻抗的特性，在開關電源、充電和其他可調調整器應用中是齊納二極體的理想替代器件。

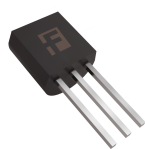
輸出電壓範圍為 $V_{ref}(2.5V)$ 到最大陰極電壓36V。0.5%和1%兩種精度(25 ° C)。

封裝:TO-92和SOT-23。

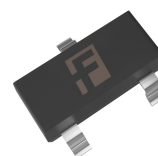
特點 Features

- 可編程精確的輸出電壓:2.5V-36V
Programmable Precise Output Voltage from 2.5V to 36V
- 容性負載下高度穩定
High Stability Under Capacitive Load
- 低陰極電流，典型值400 μA
Low Minimum Cathode Current for Regulation : 400u A(Typ.)
- 低溫漂，典型值5mV
Low Temperature Deviation: 5mv Typical
- 電流能力: 1mA-100mA
Sink Current Capacity from 1mA to 100mA
- 寬工作溫度範圍:-25 ° C-125 ° C
Wide Operating Range : -25 ° C to 125 ° C

引腳排列 Pin Configuration



TO-92(Bulk Packing)



SOT-23

Figure 1. Package Type of FL431

N Package (SOT-23)

Z Package (TO-92 (Bulk Package))

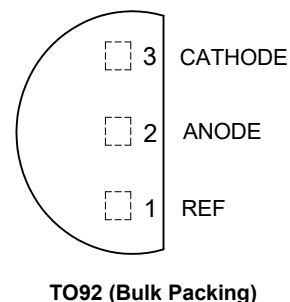
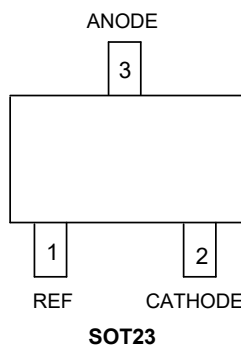


Figure 2. Pin Configuration of FL431(Top View)

應用領域 Applications

- 充電器Charger
- 電壓適配器Voltage Adapter
- 開關電源Switching Power Supply
- 圖形卡Graphic Card
- 精確電壓基準Precision Voltage Reference

ADJUSTABLE PRECISION SHUNT REGULATORS

電路功能框圖Functional Block Diagram

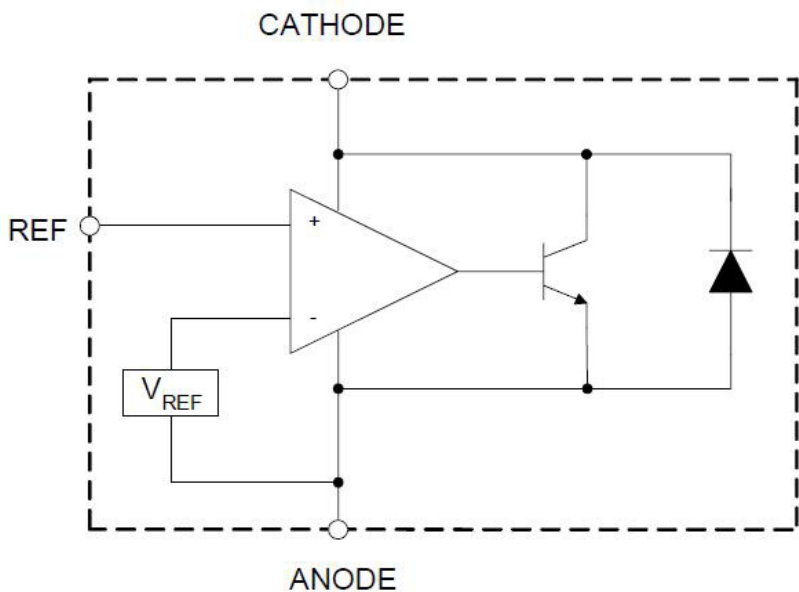


Figure 3. Functional Block Diagram of FL431

絕對最大額定值Absolute Maximum Rating(Note 1)

Symbol 符號	Parameter 參數說明	Value 數值範圍	Unit 單位
V_{KA}	Cathode Voltage 陰極電壓	36	V
I_{KA}	Cathode Current Range (Continuous) 陰極電流範圍	-100 to 150	mA
I_{REF}	Reference Input Current Range 參考輸入電流範圍	10	mA
T_J	Junction Temperature 結溫	+150	°C
T_{STG}	Storage Temperature Range 存儲溫度	-65 to +150	°C
ESD	ESD (Human Body Model) 人體模型	6000	V
ESD	ESD (Machine Model) 機器模型	400	V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

備註1：超過“絕對最大額定值”的應力可能會造成器件永久損壞。這些僅是應力額定值，器件工作在上述條件以及超出“建議工作條件”的情況是不可取的。長期處於“絕對最大額定值”可能影響器件的可靠性。

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環境溫度下的額定功耗 Dissipation Rating-Free-air Temperature(Note 2)

Package	Ta=25℃ Power Rating	Derating Factor Above Ta=25℃	Ta=70℃ Power Rating	Ta=85℃ Power Rating
TO-92	700mW	6.2mW/℃	491mW	398mW
SOT-23	230mW	1.8mW/℃	149mW	122mW

Note 2: The safe-work power dissipation of FL431 is under 0.25W while the package is TO-92 which is the ordinary transistor package. Above the power dissipation, the package should be changed to SO or DIP and the dissipation can be to 0.5W. The margin of power should be enough large because the reference voltage will falls as large power dissipation and high temperature rising. FL431 only is a reference voltage source. It is used to output a stable reference voltage, not large power.

備註2:FL431的安全使用功率一般設計在0.25W以下(TO-92封裝,也就是普通小三極管封裝),如果要較大的功率,你可以考慮一下SO封裝或DIP封裝的,這兩種封裝的功率設計為0.5W也很穩定。給FLA431留的功率餘量較大,是考慮到FL431在大功率,高溫升的情況下穩壓進度會下降。FL431只是一種基準電壓源,它的最大作用是提供穩定的基準電壓,而不是輸出大功率。

推薦工作條件 Recommended Operating Conditions

Symbol 符號	Parameter 參數	Min 最小值	Max 最大值	Unit 單位
V _{KA}	Cathode Voltage 陰極電壓	V _{REF}	36	V
I _{KA}	Cathode Current 陰極電流	0.3	100	mA
T _A	Operating Ambient Temperature Range 工作環境溫度	-25	+125	℃

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電特性表 Electrical Characteristics

Operating Conditions: $T_A = 25^\circ\text{C}$, unless otherwise specified

工作條件：除非特指，環境溫度為 25°C

Symbol 符號	Test Circuit 測試電路	Parameter 參數	Conditions 測試條件	Min 最小值	Typ 典型值	Max 最大值	Unit 單位
V_{REF}	4	Reference Voltage 參考電壓	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$	2.487	2.500	2.513	V
ΔV_{REF}	4	Deviation of Reference Voltage Over Full Temperature Range 基準電壓溫漂	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$ -20 to $+110^\circ\text{C}$	—	5	10	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	5	Ratio of Change in Reference Voltage to the Change in Cathode Voltage 基準電壓的線性調整率	$I_{KA} = 10\text{mA}$ $\Delta V_{KA} = 10\text{V to } V_{REF}$ $\Delta V_{KA} = 36\text{V to } 10\text{V}$	— —	+0.4 -0.4	— —	mV/V
I_{REF}	5	Reference Current 基準電流	$I_{KA} = 10\text{mA}$, $R1 = 10\text{k}\Omega$, $R2 = \infty$	—	1.0	2.5	μA
ΔI_{REF}	5	Deviation of Reference Current Over Full Temperature Range 基準電流溫漂	$I_{KA} = 10\text{mA}$, $R1 = 10\text{k}\Omega$ $R2 = \infty$, $T_A = -10$ to $+85^\circ\text{C}$	—	0.2	0.4	μA
$I_{KA}(\text{Min})$	4	Minimum Cathode Current for Regulation 最小陰極電流	$V_{KA} = V_{REF}$	—	400	700	μA
$I_{KA}(\text{Off})$	6	Off-state Cathode Current 夾斷陰極電流	$V_{KA} = 36\text{V}$, $V_{REF} = 0$	—	0.8	1.0	μA
Z_{KA}	4	Dynamic Impedance 動態阻抗	$V_{KA} = V_{REF}$, $I_{KA} = 1$ to 100mA , $f \leq 1.0\text{kHz}$	—	0.15	0.5	Ω
θ_{JC}	—	Thermal Resistance 熱阻	SOT23	—	113	—	$^\circ\text{C/W}$
	—		TO92	—	68	—	
	—		SOT89	—	70	—	

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電特性表(續) Electrical Characteristics(cont.)

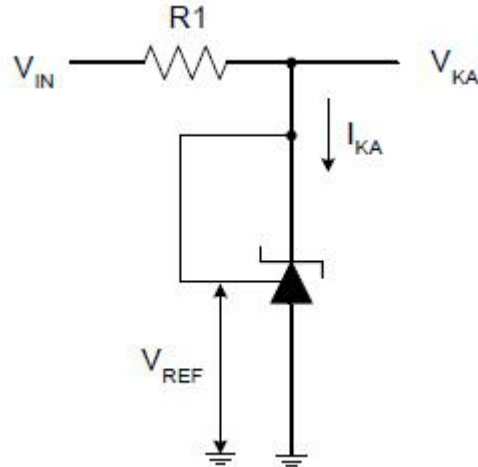


Figure 4. Test Circuit 4 for $V_{KA}=V_{REF}$

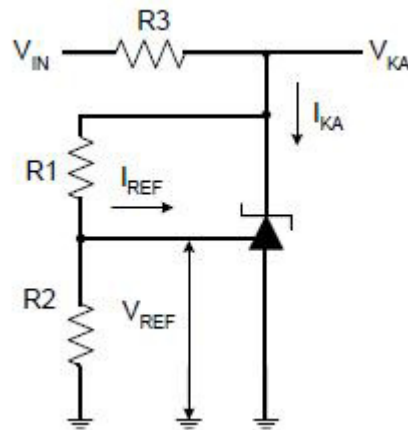


Figure 5. Test Circuit 5 for $V_{KA}=V_{REF} (1+R_1/R_2)+I_{REF} * R_1$

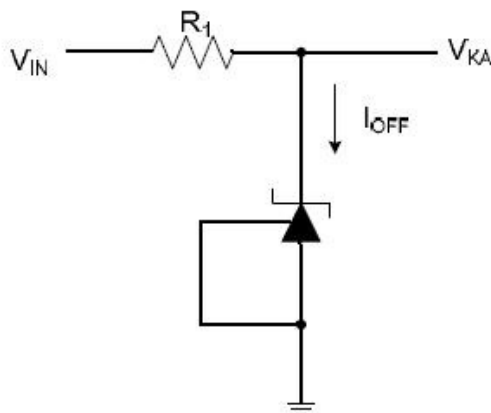


Figure 6. Test Circuit 6 for I_{OFF}

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典型性能 Typical Performance Characteristics

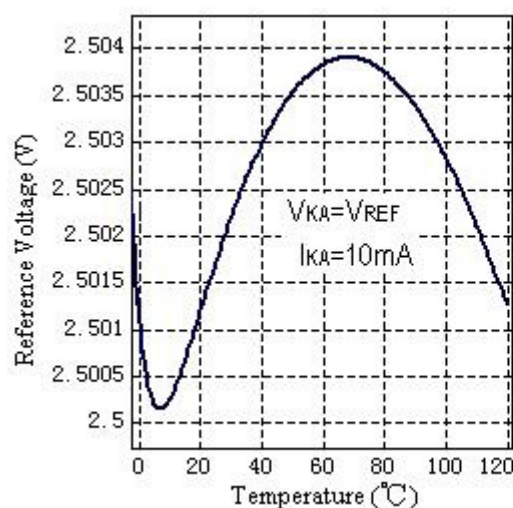


Figure 7. Reference Voltage vs. Ambient Temperature

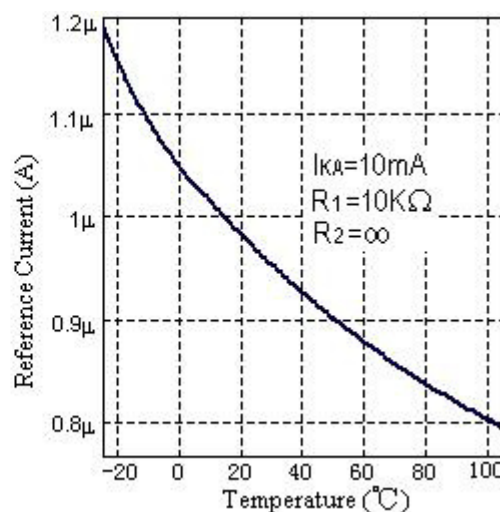


Figure 8. Reference Current vs. Ambient Temperature

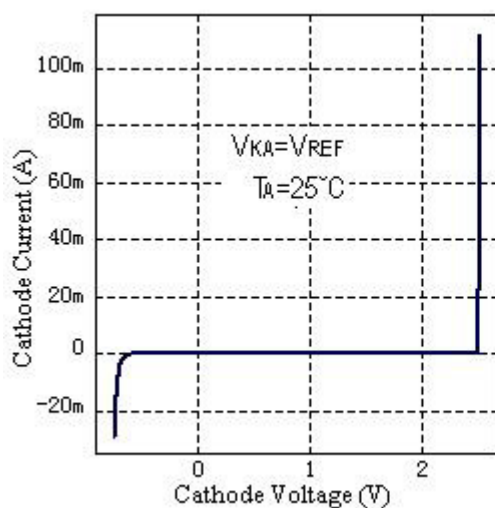


Figure 9. Cathode Current vs. Cathode Voltage

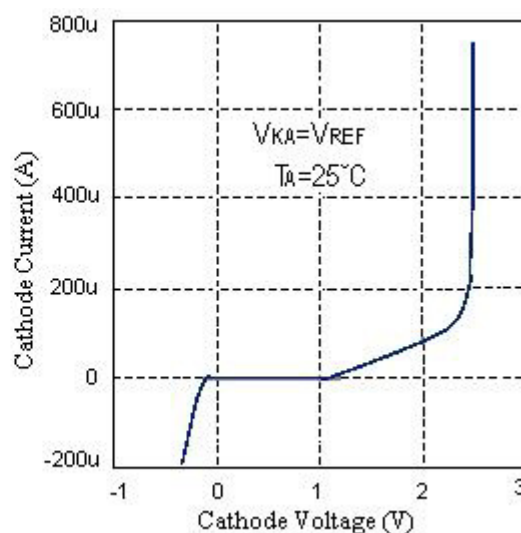


Figure 10. Cathode Current vs. Cathode Voltage

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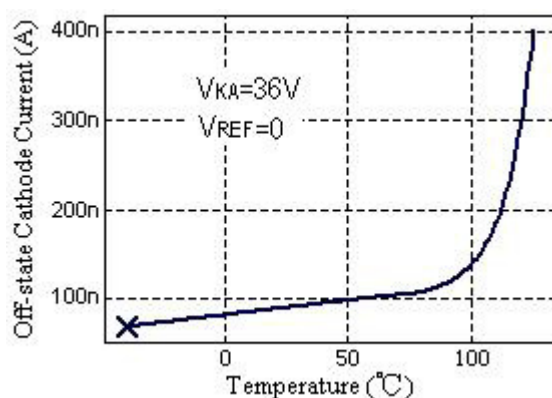


Figure 11. Off-state Cathode Current vs. Ambient Temperature

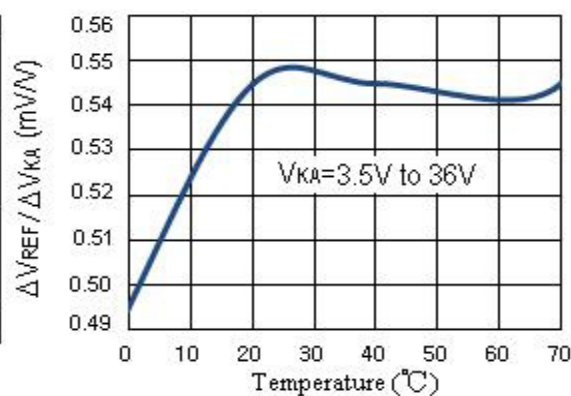


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

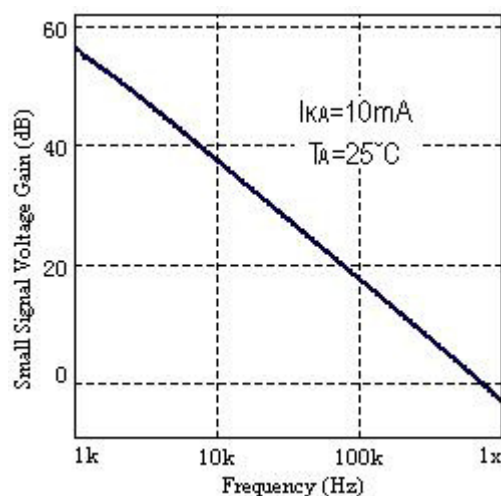
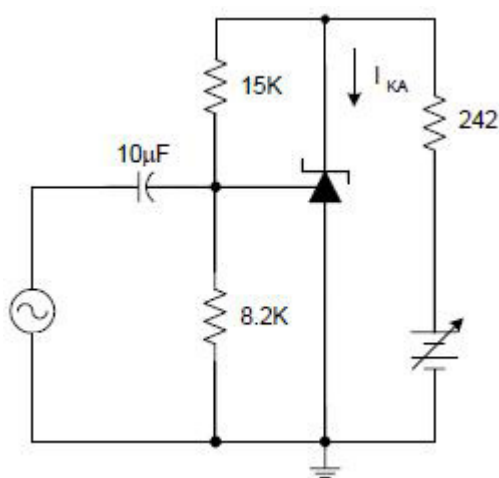


Figure 13. Small Signal Voltage Gain vs. Frequency

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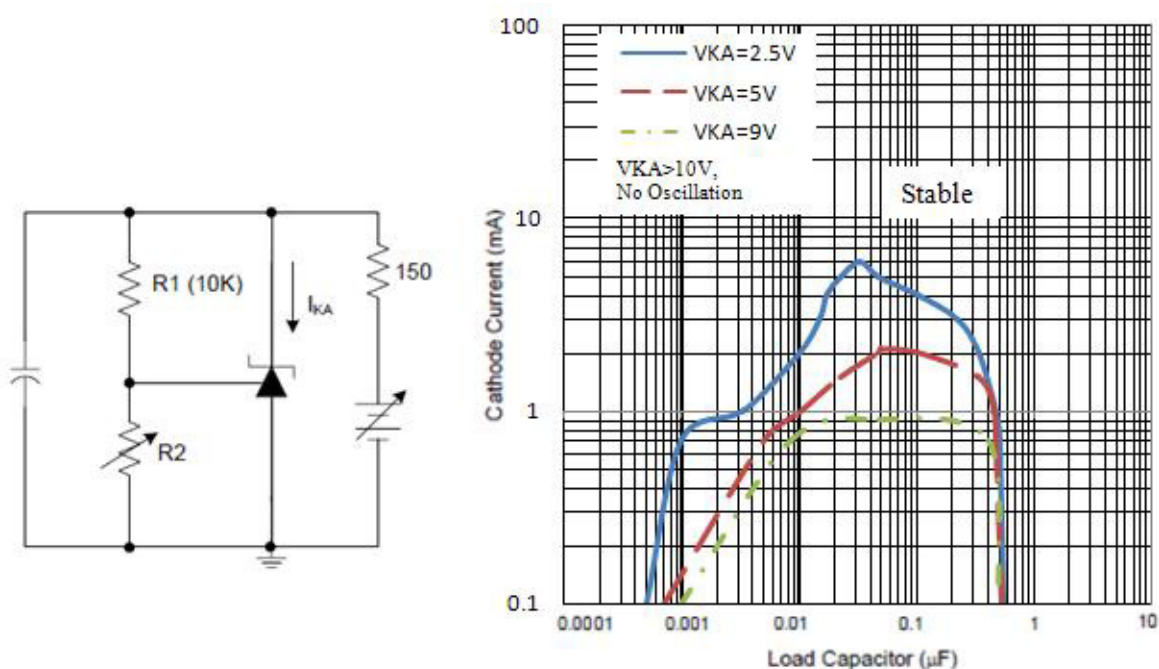


Figure 14. Stability Boundary Conditions vs. Capacitance

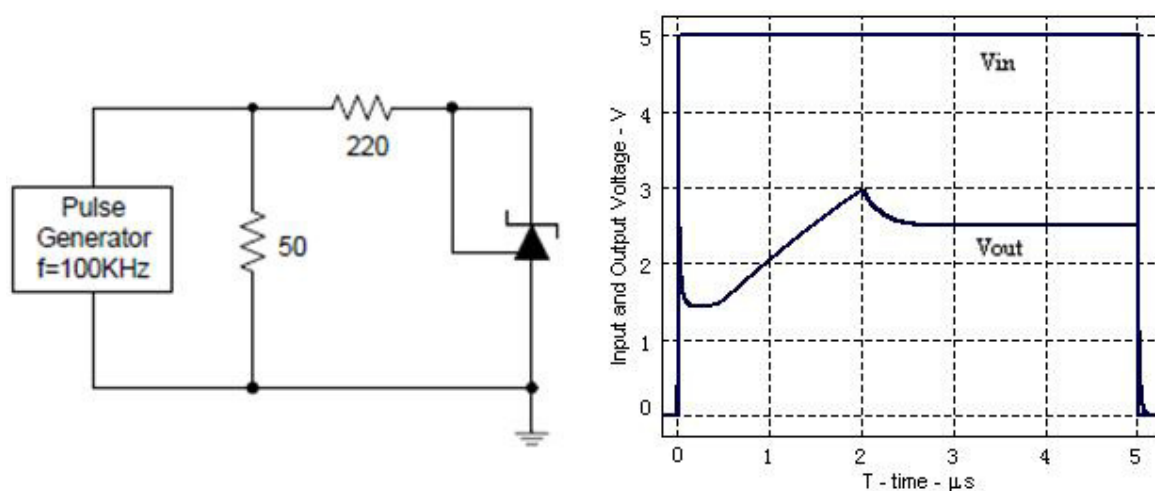


Figure 15. Pulse Response of Input and Output Voltage

ADJUSTABLE PRECISION SHUNT REGULATORS

典型應用 Typical Application

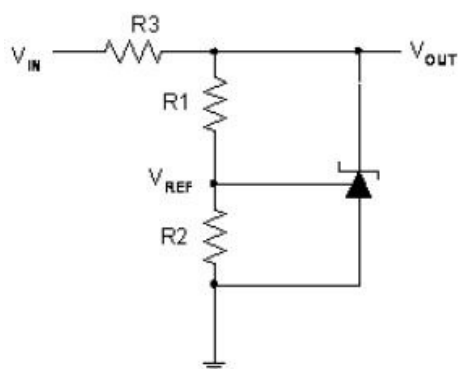


Figure 16. Shunt Regulator

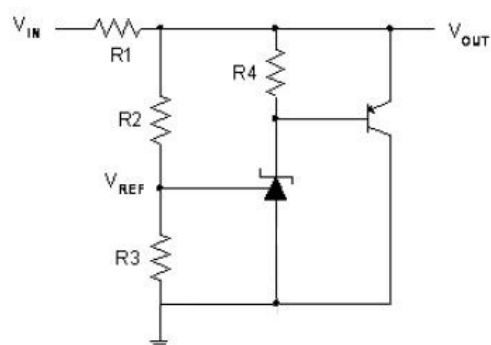


Figure 17. High Current Shunt Regulator

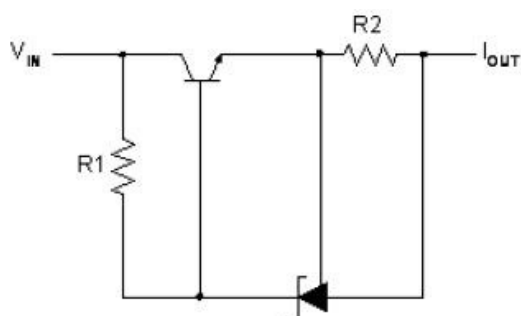


Figure 18. Current Source or Current Limit

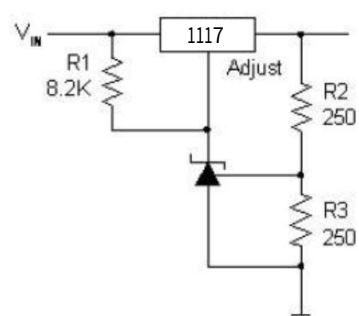


Figure 19. Precision 5V 1A Regulator

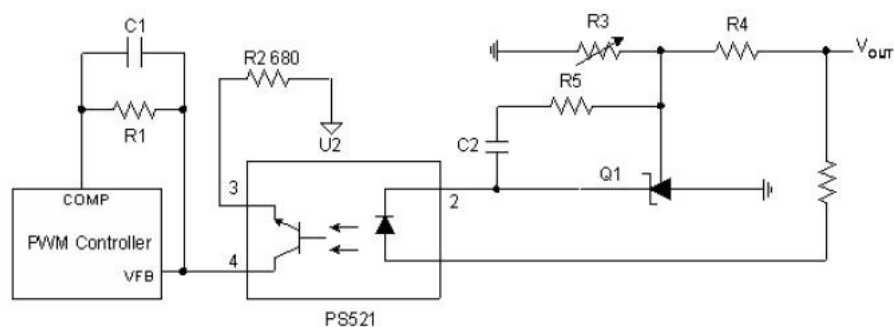
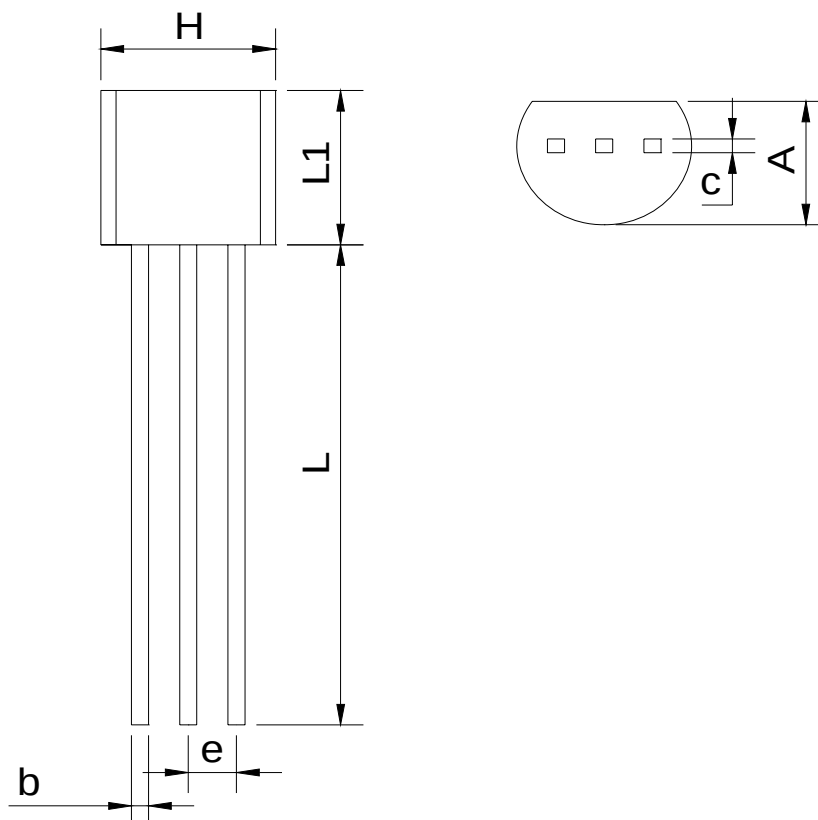


Figure 20. PWM Converter with Reference

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封裝外形及尺寸圖

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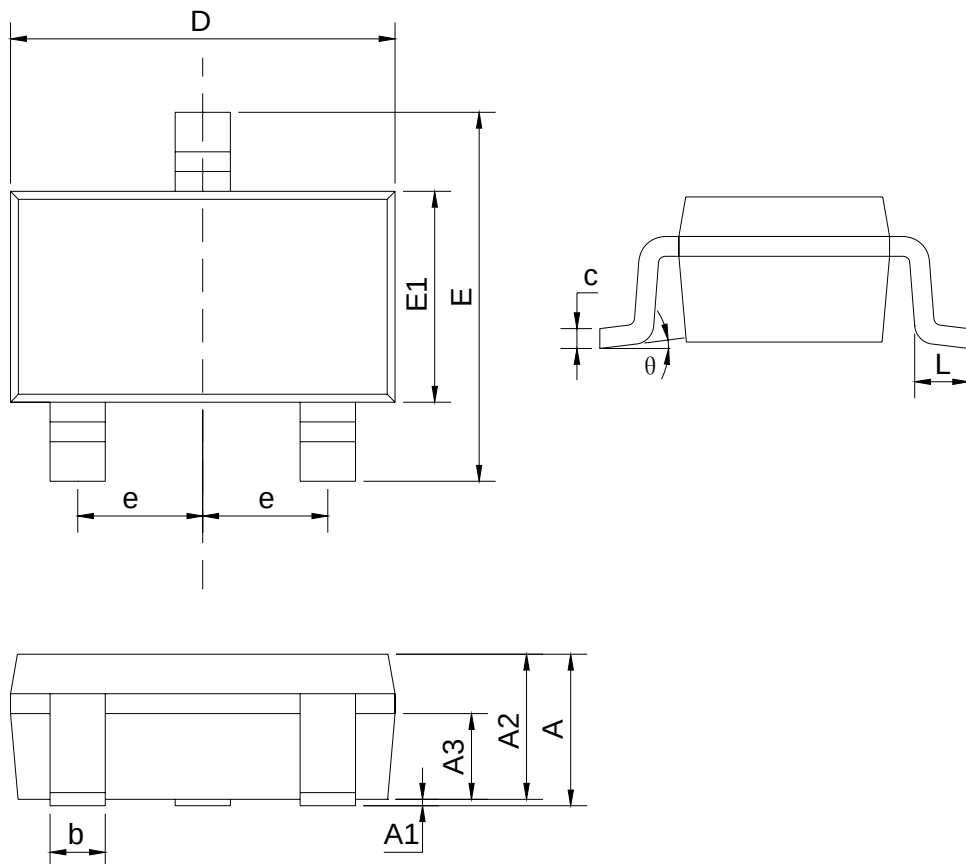


SYMBOL	mm	
	min	max
A	3.40	3.80
b	0.40	0.50
c	0.35	0.45
e	1.27BSC	
H	4.40	4.80
L	13.00	15.00
L1	4.30	4.70

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封裝外形及尺寸圖

SOT23



SYMBOL	mm	
	min	max
A		1.35
A1	0.04	0.15
A2	1.00	1.20
A3	0.55	0.75
b	0.38	0.48
c	0.10	0.25
D	2.72	3.12
E	2.60	3.00
E1	1.40	1.80
e	0.95BSC	
L	0.30	0.60
θ	0	8°