



## Adjustable Precision Shunt Regulation

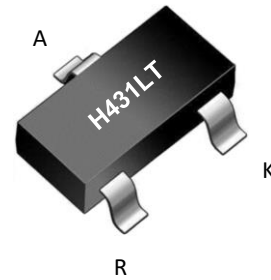
Output Voltage to 40V ,  
Reference Voltage Tolerance  $\pm 0.5\%$ 

## ● Features

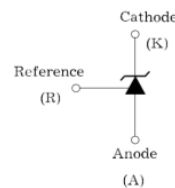
- > Programmable Output Voltage to 40V
- > Guaranteed 0.5% Reference Voltage Tolerance
- > Low Dynamic Output Impedance  $0.2\Omega$  (Typ)
- > Cathode Current Range (Continuous) -100 ~ 150 mA
- > Equivalent Full-Range Temperature Coefficient of 50 ppm/°C
- > Temperature Compensated for Operation over Full Rated Operating Temperature Range
- > Low Output Noise Voltage
- > Fast Turn on Response
- > SOT-23 packages
- > ESD Tolerance (human body model) 2000V
- > Operating Temperature Range -60 ~ +125°C

## ● Applications

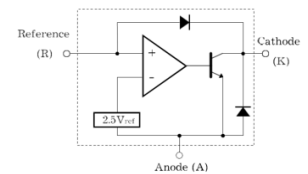
- > Switching Mode Power Supply
- > Voltage Monitoring
- > Adjustable Voltage and Current Referencing

● Outline  
SOT-23

## ● Symbol



## ● Functional block diagram

● Absolute Maximum Ratings ( $T_J=25^\circ\text{C}$  Unless Otherwise Noted)

Symbol	Parameter	Rating	Unit
$V_{KA}$	Cathode Voltage	40	V
$I_K$	Cathode Current Range (Continuous)	-100 ~ 150	mA
$I_{REF}$	Reference Input Current Range	-0.05 ~ +10	mA
$P_D$	Power Dissipation at 25°C: SOT – 23 Package ( $\theta_{JA} = 625^\circ\text{C/W}$ )	0.2	W
$T_J$	Junction Temperature Range	0 ~ 150	°C
$T_{OPER}$	Operating Temperature Range	-60 ~ +125	°C
$T_{STG}$	Storage Temperature Range	-65 ~ +150	°C

## ● Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{KA}$	Cathode Voltage	$V_{REF}$	-	37	V
$I_K$	Cathode Current	0.5		100	mA

● **Electrical Characteristics** ( $T_a = 25^\circ\text{C}$ ,  $V_{KA} = V_{REF}$ ,  $I_K = 10\text{mA}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{REF}$	Reference Input Voltage	$V_{KA} = V_{REF}$ , $I_K = 10\text{mA}$	2.485	2.495	2.506	V
$V_{REF(dev)}$	Deviation of Reference Input Voltage Over Full Temperature Range	$T_{min} \leq T_a \leq T_{max}$	-	3	17	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{KA} = 10\text{V} - V_{REF}$ $\Delta V_{KA} = 37\text{V} - 10\text{V}$	-	0.6 0.4	2.7 2.0	mV/V
$I_{REF}$	Reference Input Current	$R_1 = 10\text{K}\Omega$ , $R_2 = \infty$	-	0.2	4	$\mu\text{A}$
$I_{REF(dev)}$	Deviation of Reference Input Current Over Full Temperature Range	$R_1 = 10\text{K}\Omega$ , $R_2 = \infty$	-	0.4	1.2	$\mu\text{A}$
$I_{K(min)}$	Minimum Cathode Current for Regulation		-	-	0.5	mA
$I_{K(off)}$	Off-State Cathode Current	$V_{KA} = 37\text{V}$ , $I_{REF} = 0$	-	0.01	0.9	$\mu\text{A}$
$Z_{KA}$	Dynamic Impedance	$I_K = 1\text{mA}$ to $100\text{mA}$ , $f \leq 1.0\text{KHz}$	-	0.27	0.5	$\Omega$

● **Test Circuits**

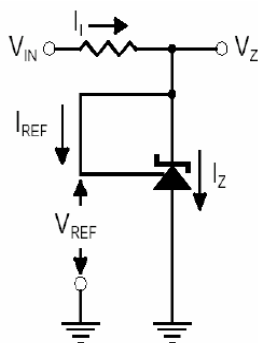


Fig1. Test Circuit for  $V_Z = V_{REF}$

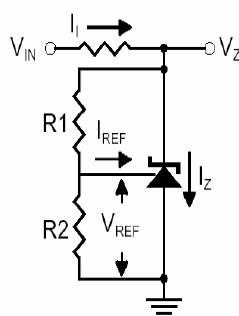


Fig2. Test Circuit for  $V_Z > V_{REF}$   
Note:  $V_Z = V_{REF}(1 + R_1/R_2) + I_{REF} \times R_1$

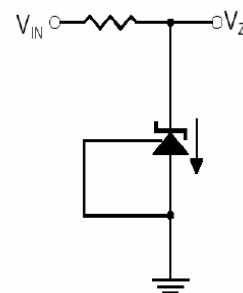
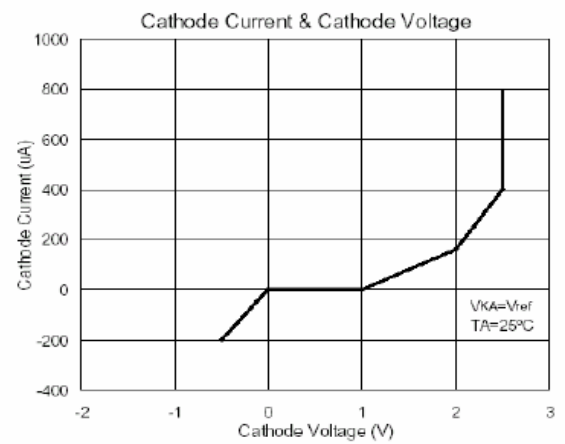
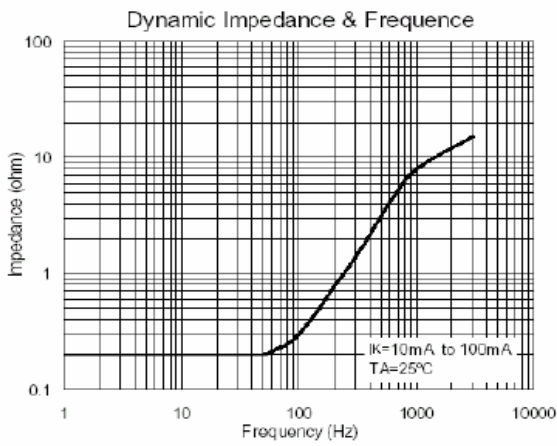
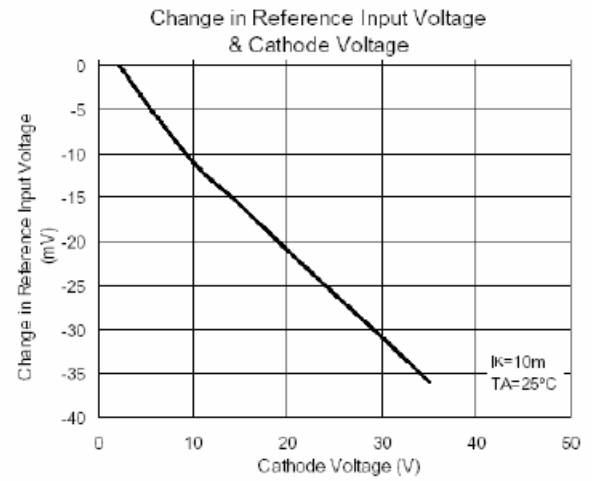
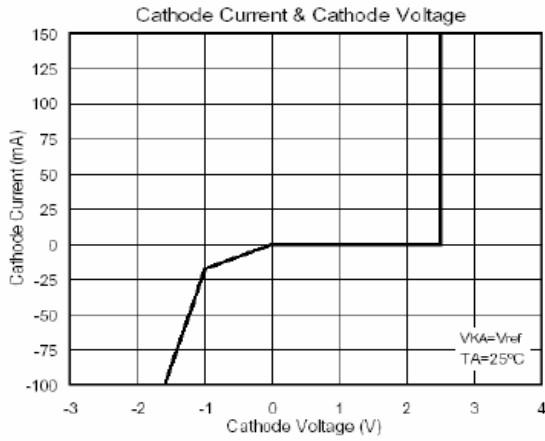


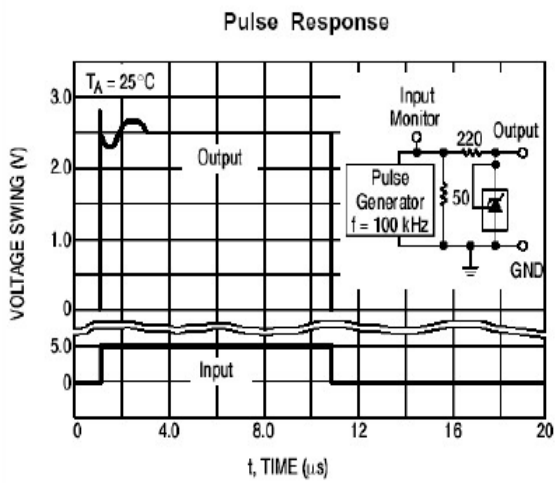
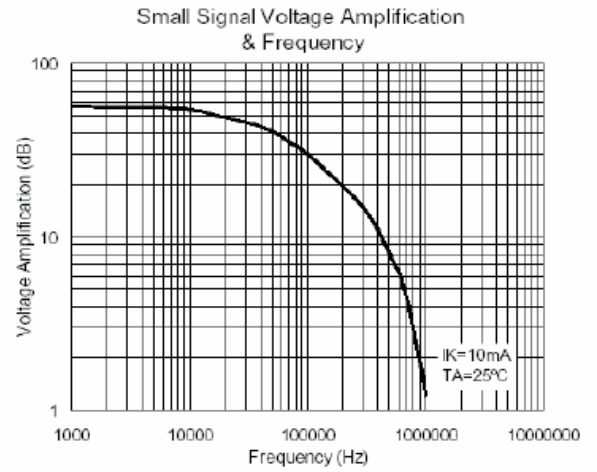
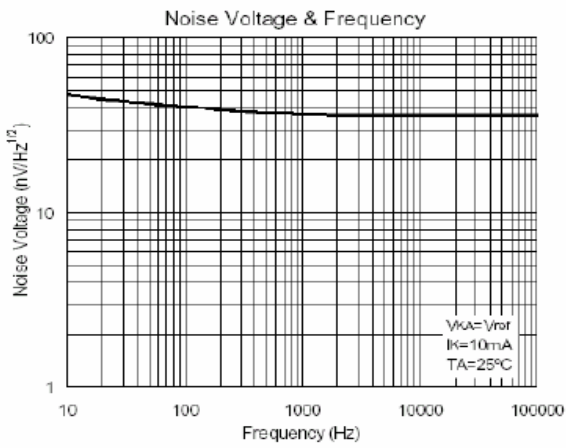
Fig3. Test Circuit for Off-State Current



## ●Electrical characteristic curves



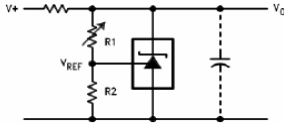
## ●Electrical characteristic curves





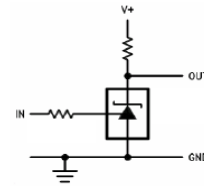
## ● Typical Application

### Shunt Regulator



$$V_o \approx \left( 1 + \frac{R_1}{R_2} \right) V_{REF}$$

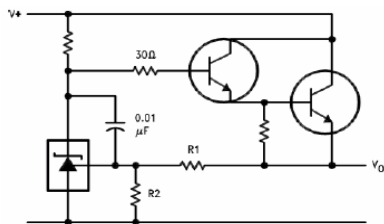
### Single Supply Comparator with Temperature Compensated Threshold



$$V_{TH} \approx 2.5V$$

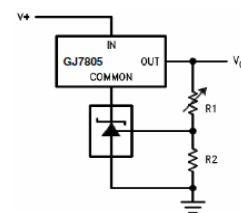
$$V_{ON} \approx 2V, V_{OFF} = V^+$$

### Series Regulator



$$V_o \approx \left( 1 + \frac{R_1}{R_2} \right) V_{REF}$$

### Output Control of a Three Terminal Fixed Regulator



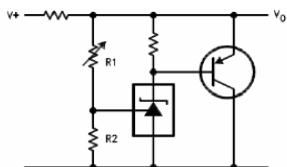
$$V_o \approx \left( 1 + \frac{R_1}{R_2} \right) V_{REF}$$

$$V_o \text{ MIN} \approx V_{REF} + 5V$$



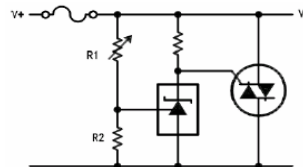
## ● Typical Application

### Higher Current Shunt Regulator



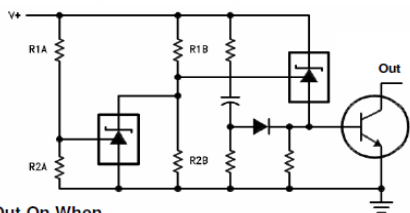
$$V_o \approx \left( 1 + \frac{R_1}{R_2} \right) V_{REF}$$

### Crow Bar



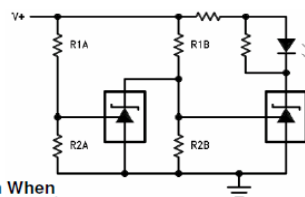
$$V_{Limit} \approx \left( 1 + \frac{R_1}{R_2} \right) V_{REF}$$

### Over Voltage/under Voltage Protection Circuit



Out On When  
 Low Limit <  $V^+$  < High Limit  
 Low Limit  $\approx V_{REF} \left( 1 + \frac{R_{1B}}{R_{2B}} \right) + V_{BE}$   
 High Limit  $\approx V_{REF} \left( 1 + \frac{R_{1A}}{R_{2A}} \right)$

### Voltage Monitor

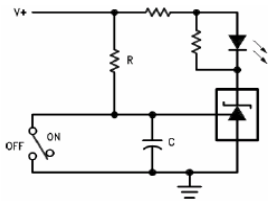


LED On When  
 Low Limit <  $V^+$  < High Limit  
 Low Limit  $\approx V_{REF} \left( 1 + \frac{R_{1B}}{R_{2B}} \right)$   
 High Limit  $\approx V_{REF} \left( 1 + \frac{R_{1A}}{R_{2A}} \right)$



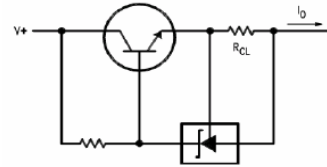
## ● Typical Application

Delay Timer



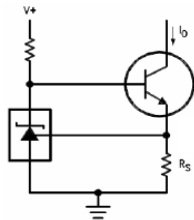
$$\text{Delay} = R \cdot C \cdot \ln \frac{V^+}{(V^+) - V_{REF}}$$

Current Limiter or Current Source



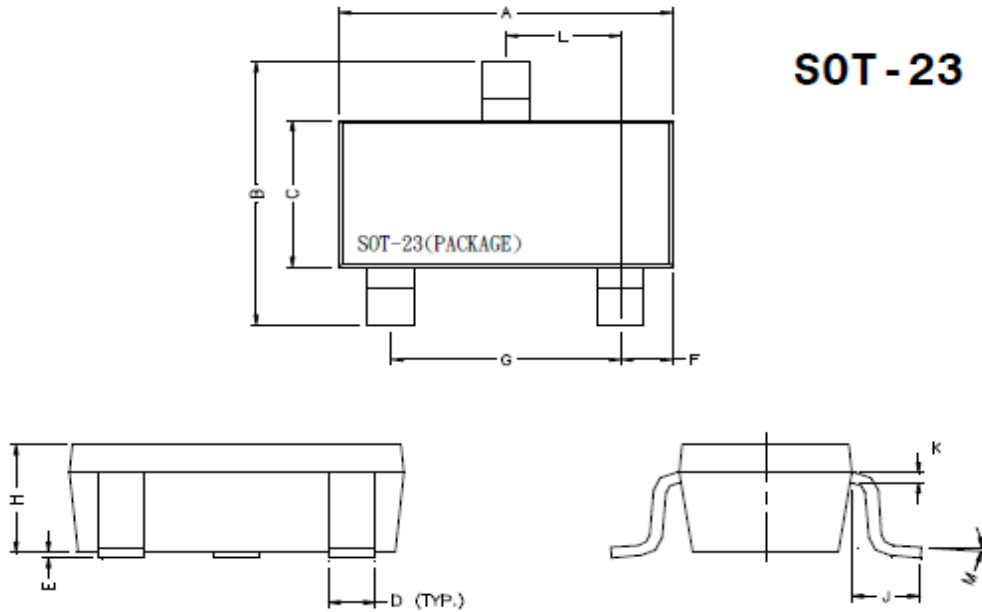
$$I_o = \frac{V_{REF}}{R_{CL}}$$

Constant Current Sink



$$I_o = \frac{V_{REF}}{R_S}$$

## ● Package Dimensions



**SOT - 23**

REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	2.70	3.10	G	1.90	REF.
B	2.40	2.80	H	1.00	1.30
C	1.40	1.60	K	0.10	0.20
D	0.35	0.50	J	0.40	-
E	0	0.10	L	0.85	1.15
F	0.45	0.55	M	0°	10°





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