

Adjustable Precision Shunt Regulation

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

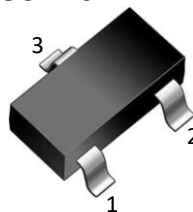
● Features

- > Programmable Output Voltage to 40V
- > Guaranteed 0.5% Reference Voltage Tolerance
- > Low Dynamic Output Impedance 0.2Ω (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 / TO-92 package
- > ESD Tolerance (human body model) 2000V
- > Operating Temperature Range -60 ~ +125°C

● Applications

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

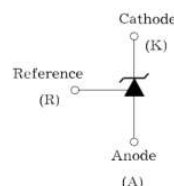
● Outline SOT-23



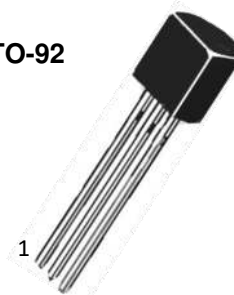
"H431LK" PN = Marking Code

Pin Assignment	
1	R
2	K
3	A

● Symbol



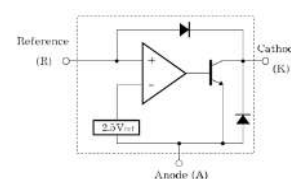
TO-92



"H431LKA" PN = Marking Code

Pin Assignment	
1	R
2	A
3	K

● Functional block diagram



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

Symbol	Parameter	Rating	Unit
V_{KA}	Cathode Voltage	42	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 TO-92 Package	0.2 0.6	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}	-	40	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	$V_{KA} = V_{REF}$, $I_K = 10\text{mA}$	2.483	2.495	2.507	V
$V_{REF(\text{dev})}$	Deviation of Reference Input Voltage Over Full Temperature Range	$T_{\text{min}} \leq T_a \leq T_{\text{max}}$	-	3	17	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{KA} = 10\text{V} - V_{REF}$ $\Delta V_{KA} = 40\text{V} - 10\text{V}$	-	-1.4 -1.0	-2.7 -2.0	mV/V
I_{REF}	Reference Input Current	$R_1 = 10\text{k}\Omega$, $R_2 = \infty$	-	1.8	4	μA
$I_{REF(\text{dev})}$	Deviation of Reference Input Current Over Full Temperature Range	$R_1 = 10\text{k}\Omega$, $R_2 = \infty$	-	0.4	1.2	μA
$I_{K(\text{min})}$	Minimum Cathode Current for Regulation		-	-	0.5	mA
$I_{K(\text{off})}$	Off-State Cathode Current	$V_{KA} = 40\text{V}$, $I_{REF} = 0$	-	0.17	0.9	μA
Z_{KA}	Dynamic Impedance	$I_K = 1\text{mA}$ to 100mA , $f \leq 1.0\text{kHz}$	-	0.27	0.5	Ω

● **Test Circuits**

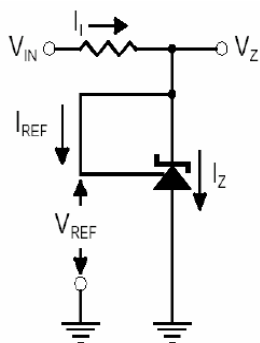


Fig1. Test Circuit for $V_z = V_{REF}$

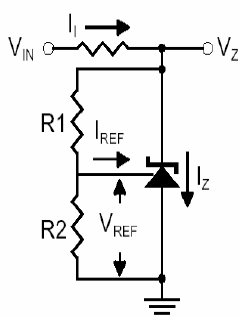


Fig2. Test Circuit for $V_z > V_{REF}$
Note: $V_z = V_{REF}(1 + R_1/R_2) + I_{REF} \times R_1$

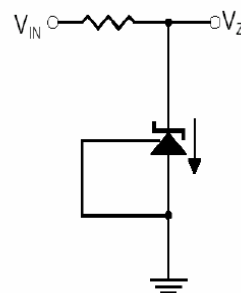
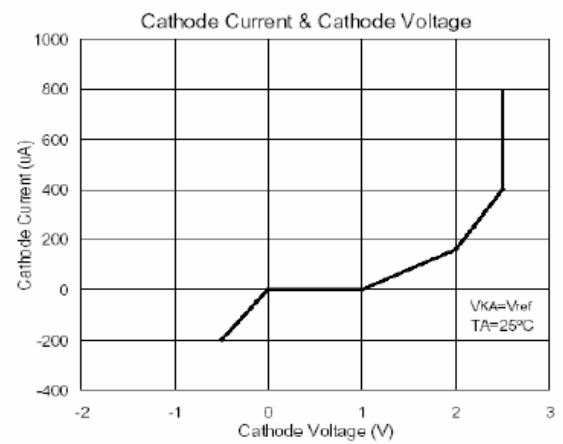
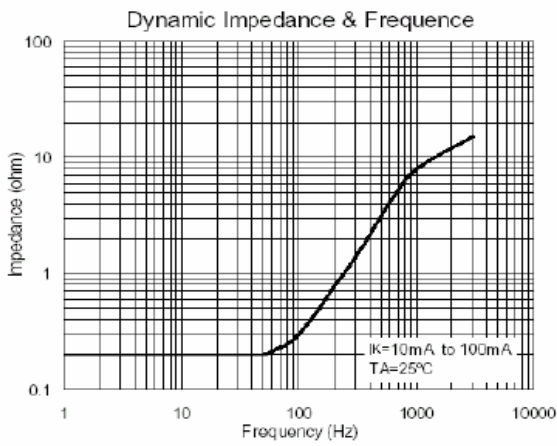
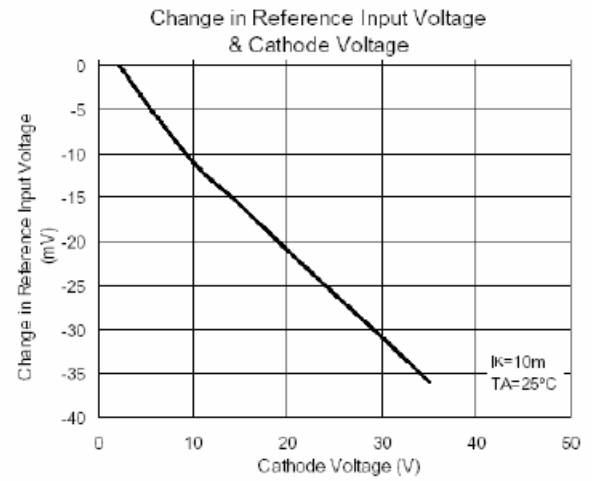
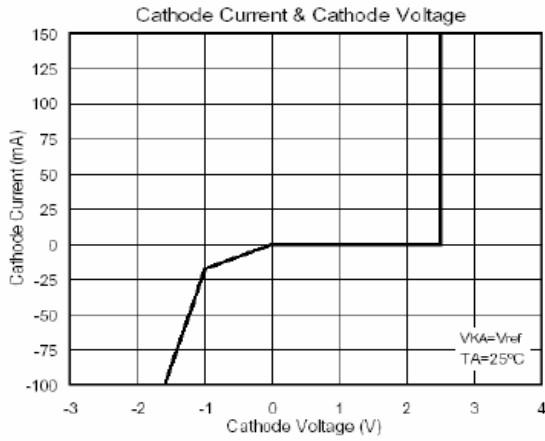


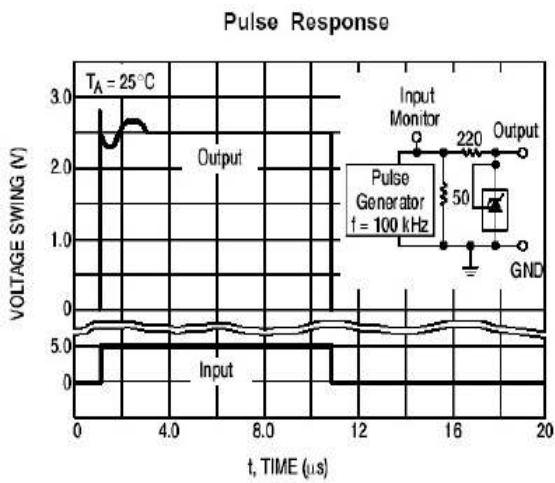
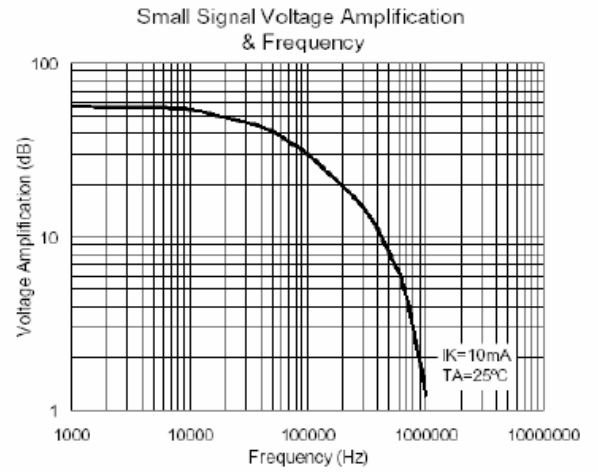
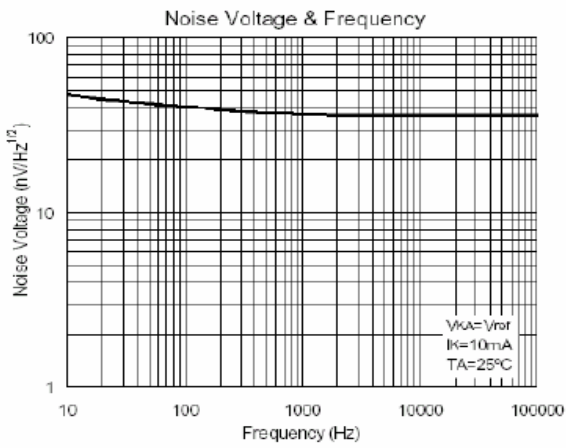
Fig3. Test Circuit for Off-State Current



●Electrical characteristic curves



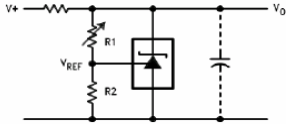
●Electrical characteristic curves





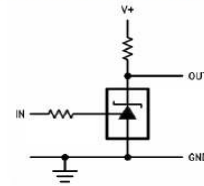
● Typical Application

Shunt Regulator



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

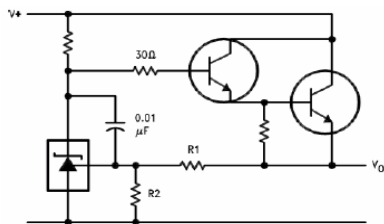
Single Supply Comparator with Temperature Compensated Threshold



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

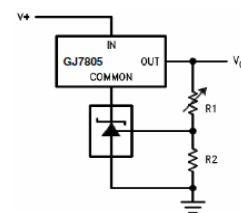
$$V_{ON} \approx 2V, V_{OFF} = V^+$$

Series Regulator



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

Output Control of a Three Terminal Fixed Regulator

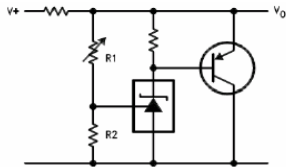


$$V_o \approx \left(1 + \frac{R_1}{R_2} \right) V_{REF}$$

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

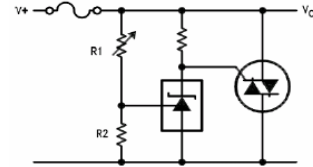
● Typical Application

Higher Current Shunt Regulator



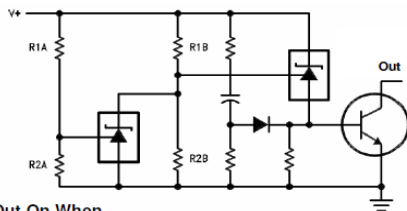
$$V_o \approx \left(1 + \frac{R_1}{R_2} \right) V_{REF}$$

Crow Bar



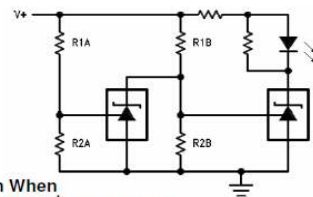
$$V_{Limit} \approx \left(1 + \frac{R_1}{R_2} \right) V_{REF}$$

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 $\approx V_{REF} \left(1 + \frac{R_{1A}}{R_{2A}} \right)$

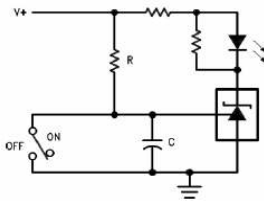
Voltage Monitor



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

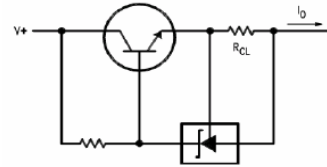
● Typical Application

Delay Timer



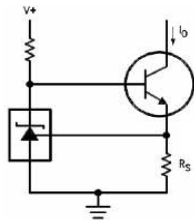
$$\text{Delay} = R \cdot C \cdot \ln \frac{V^+}{(V^+) - V_{REF}}$$

Current Limiter or Current Source



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

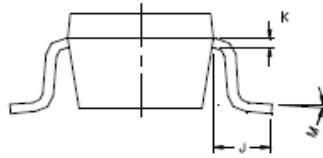
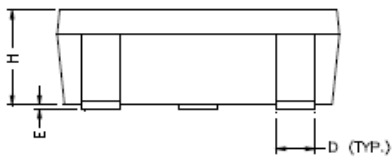
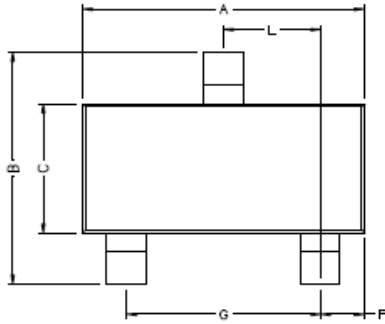
Constant Current Sink



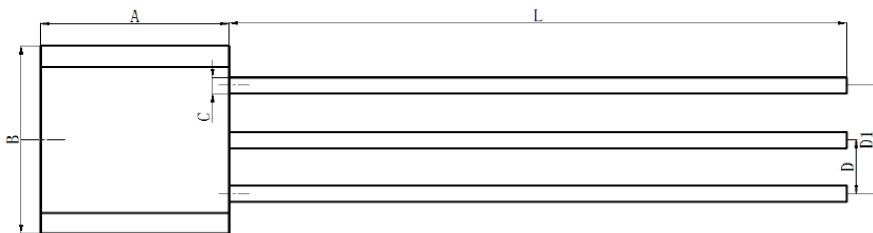
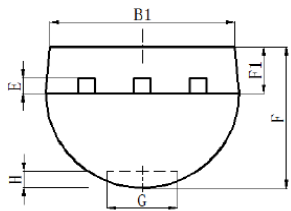
$$I_o = \frac{V_{REF}}{R_S}$$



● Package Dimensions



SOT-23 Package		
Dim	Min	Max
A	2.70	3.10
B	2.40	2.80
C	1.40	1.60
D	0.35	0.50
E	0.00	0.10
F	0.45	0.55
G	1.90 REF.	
H	1.00	1.30
K	0.10	0.20
J	0.40	-
L	0.85	1.15
M	0°	10°
All Dimensions in mm		



TO-92 Package		
Dim	Min	Max
A	4.10	4.40
B	4.40	4.70
B1	4.30	4.40
C	0.41	0.51
D	1.27 REF.	
D1	2.44	2.64
E	0.29	0.31
F	3.30	3.70
F1	1.20	1.30
G	1.00	2.00
H	0.38 REF.	
L	13.80	14.80
All Dimensions in mm		



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