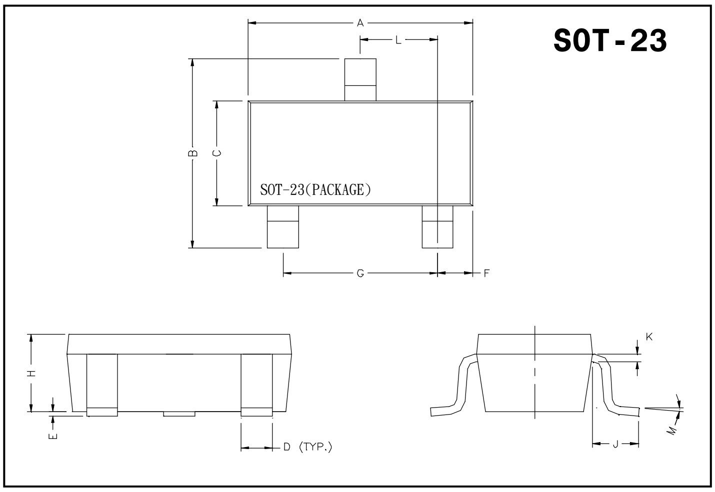
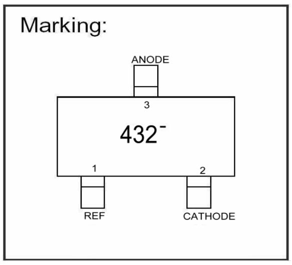
G432 Adjustable Shunt Regulator

Description
The G432 series are three-terminal adjustable precision shunt regulators with guaranteed stable temperature over the applicable extended commercial temperature range. The output voltage may be set at any level greater than 1.24V (V_{REF}) up to 20V merely by selecting two external resistors that act as a voltage divider network. These devices have a typical output impedance of 0.2Ω. Active output circuitry provides very sharp turn-on characteristics, making these devices excellent improved replacements for Zener diodes in many applications.
The precise +/- 2% reference voltage tolerance of G432 make it possible in many applications to avoid the use of a variable resistor, consequently saving cost and eliminating drift and reliability problems associated with it.

Features
*Precision reference voltage
A Rank: 1.24V ±0.5% ,
B Rank: 1.24V ±1% ,
C Rank: 1.24V ±2.0%
*Sink current capability: 200 mA.
*Minimum cathode current for regulation: 150 μA.
*Equivalent full-range temp coefficient: 30 ppm/℃.
*Fast turn-on Response.
*Low dynamic output impedance: 0.2Ω.
*Programmable output voltage to 20V.
*Low output noise.

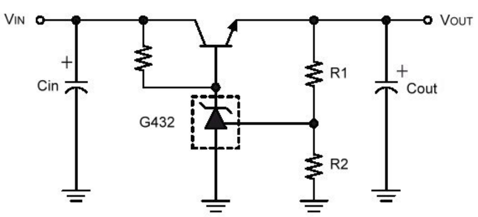
Package Dimensions





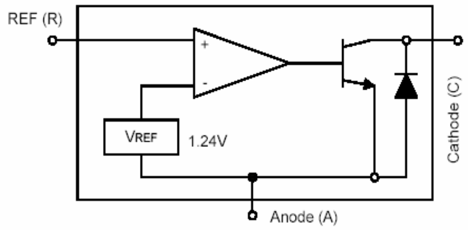
REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	2.70	3.10	G	1.90	REF.
B	2.40	2.80	H	1.00	1.30
C	1.40	1.60	K	0.10	0.20
D	0.35	0.50	J	0.40	-
E	0	0.10	L	0.85	1.15
F	0.45	0.55	M	0°	10°

Typical Application Circuit

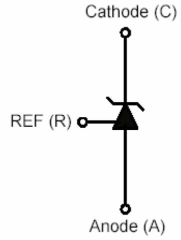


$V_{OUT} = (1+R1/R2)V_{REF}$
Precision Regulator

Block Diagram



Symbol

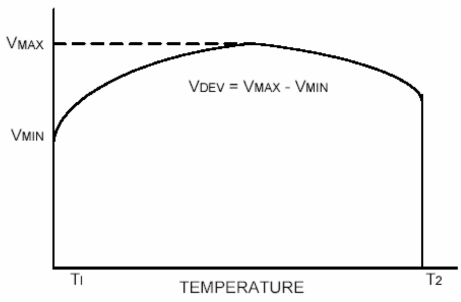


Absolute Maximum Ratings at Ta = 25℃

Parameter	Symbol	Ratings	Unit
Junction Temperature	Tj	+150	℃
Storage Temperature	Tstg	-65 ~ +150	℃
Cathode Voltage	V_{KA}	20	V
Continuous Cathode Current	I_{KA}	-10~+250	mA
Reference Input Current Range	I_{REF}	-0.05~+10	mA
Total Power Dissipation	P_D	225	mW

Electrical Characteristics (Ta = 25℃, unless otherwise specified.)

Parameter	Symbol	Min	Typ.	Max.	Unit	Test Conditions
Reference Voltage G432C	V_{REF}	1.215	1.24	1.265	V	V_{KA}= V_{REF} , I_K=10mA (Fig.1)
G432B		1.228	1.24	1.252		
G432A		1.234	1.24	1.246		
Deviation of reference Input Voltage Over temperature(note1)	$\Delta V_{REF}/\Delta T$	-	3.0	20	mV	V_{KA}= V_{REF} , I_K=10mA Ta=Full range (Fig.1)
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	-	-1.4	-2.0	mV/V	I_K=10mA (Fig.2) / ΔV_{KA}=20V~V_{REF}
Reference Input Current	I_{REF}	-	1.4	3.5	uA	I_K=10mA,R1=10KΩ,R2=∞ (Fig.2)
Deviation of reference Input Current Over Temperature Range	αI_{REF}	-	0.4	1.2	uA	I_K=10mA,R1=10KΩ,R2=∞ Ta=Full range(Fig.2)
Minimum Cathode Current for Regulation	I_{KA}(min)	-	0.15	0.3	mA	V_{KA}=V_{REF}(Fig.1)
Off-State Cathode Current	$I_{KA(off)}$	-	0.1	1.0	uA	V_{KA}=20V,V_{REF}=0 (Fig.3)
Dynamic Output Impedance (note2)	$\lvert Z_{KA}\rvert$	-	0.2	0.5	Ω	V_{KA}=V_{REF}, I_K=1 ~100mA F≤1.0KHz(Fig.1)



Note1. Deviation of reference input voltage, VDEV, is defined as the maximum variation of the reference over the full temperature range.

The average temperature coefficient of the reference input voltage α VREF is defined as:

$$|\alpha V_{REF}| = \frac{\left(\frac{V_{DEV}}{V_{REF}(25°C)}\right)\times 10^6}{T_2 - T_1} \quad \ldots\ldots\ldots\ldots \left(ppm/°C\right)$$

Where:

T2 – T1 = full temperature change.

α VREF can be positive or negative depending on whether the slope is positive or negative.

Note2. The dynamic output impedance, RZ, is defined as:

$$|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$$

When the device is programmed with two external resistors R1 and R2 (see figure 2.), the dynamic output impedance of the overall circuit, is defined as:

$$|Z_{KA}'| = \frac{\Delta v}{\Delta i} > |Z_{KA}| \quad (1+\frac{R1}{R2})$$

Test Circuits

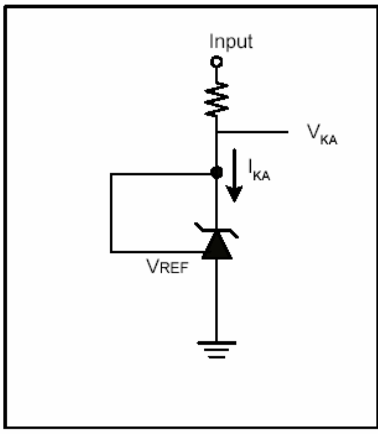


Fig1. Test Circuit for V_{KA}= V_{REF}

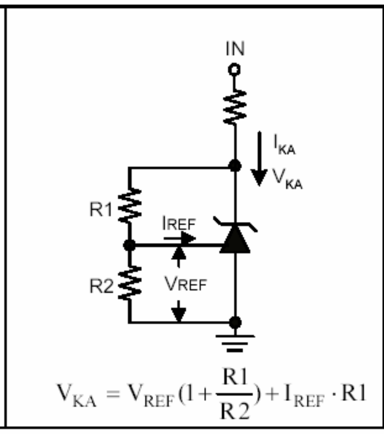


Fig2. Test circuit for V_{KA}> V_{REF}

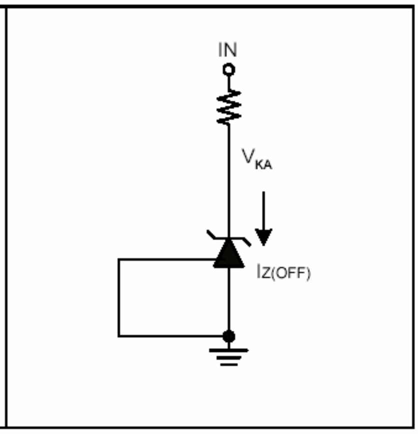
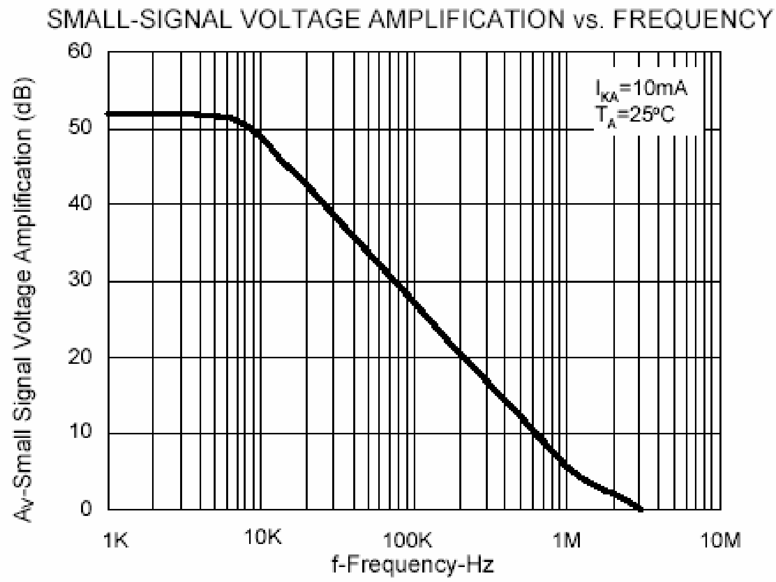
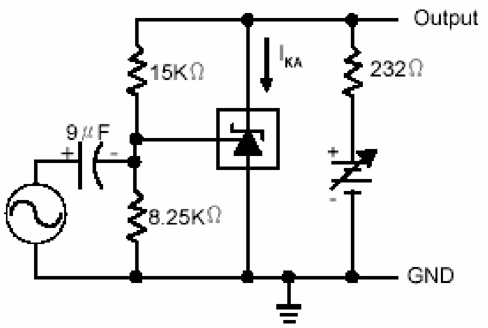


Fig3. Test Circuit for off-state Current

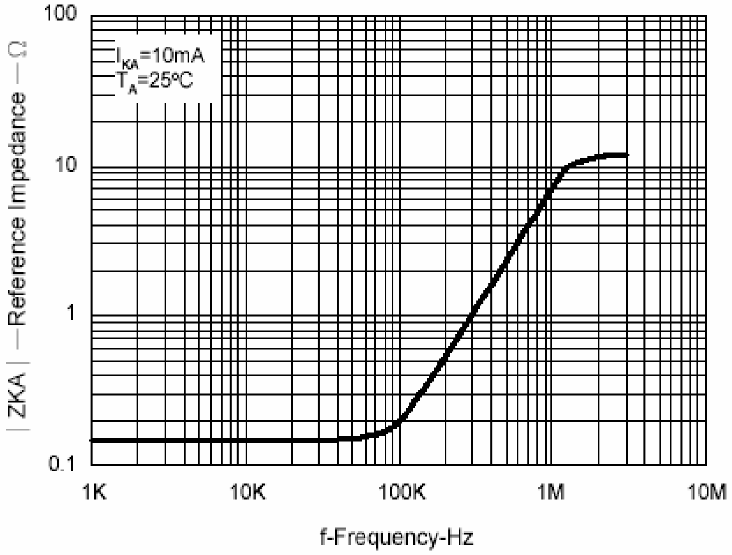
Typical Performance Characteristics

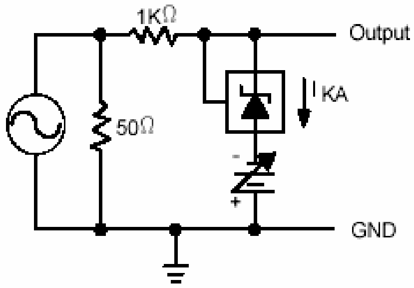




TEST CIRCUIT FOR VOLTAGE AMPLIFICATION

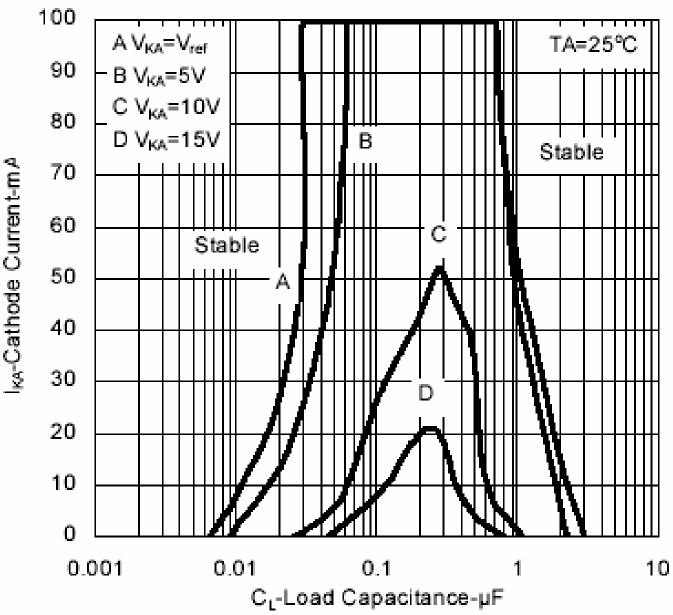
REFERENCE IMPEDANCE vs. FREQUENCY

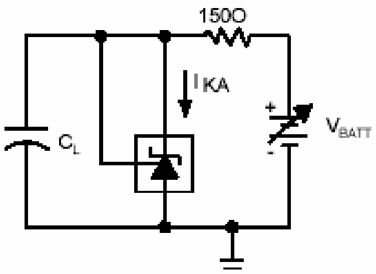




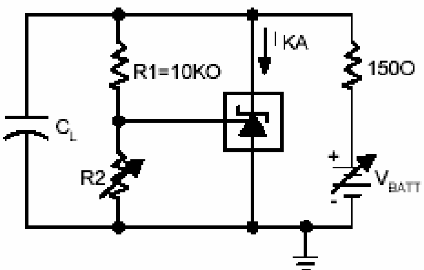
TEST CIRCUIT FOR REFERENCE IMPEDANCE

STABILITY BOUNDARY CONDITIONS†





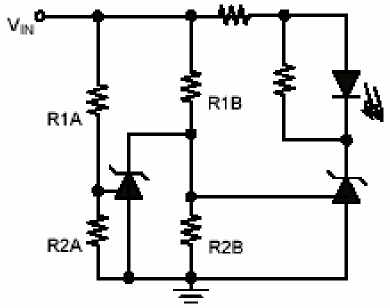
TEST CIRCUIT FOR CURVE A



TEST CIRCUIT FOR CURVE B, C, AND D

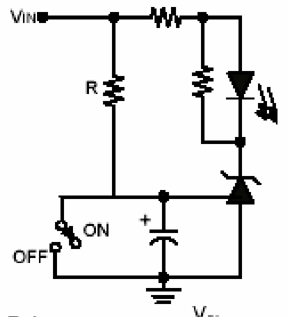
†The areas under the curves represent conditions that may cause the device to oscillate. For curves B, C, and D, R2 and V+ were adjusted to establish the initial V_{KA} and I_{KA} conditions with C_L=0.V_{BATT} and C_L were then adjusted to determine the ranges of stability.

Application Examples



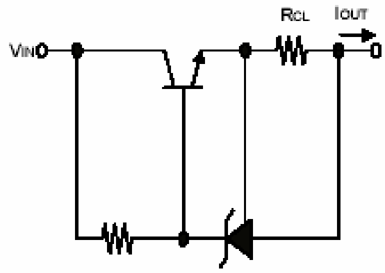
LED on when Low Limit < V_{IN} < High Limit
Low Limit ≈ V_{REF} (1+R1B/R2B)
High Limit ≈ V_{REF} (1+R1A/R2A)

Fig.4 Voltage Monitor



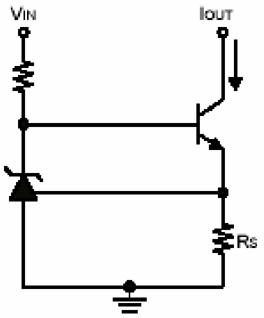
$$\text{Delay} = RC \times \ln\left(\frac{V_{IN}}{V_{IN} - V_{REF}}\right)$$

Fig.5 Delay Timer



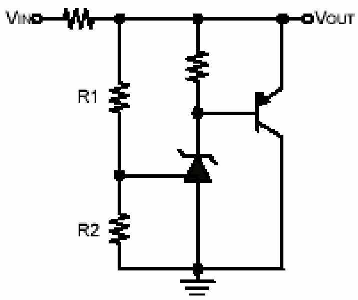
$I_{OUT} = V_{REF} / R_{CL}$

Fig.6 Current Limiter or Current Source



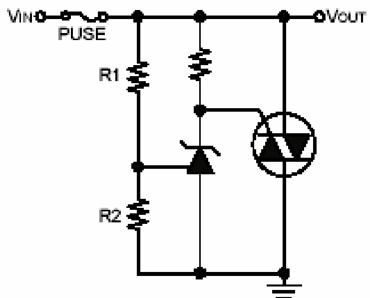
$I_{OUT} = V_{REF} / R_S$

Fig.7 Constant-Current Sink



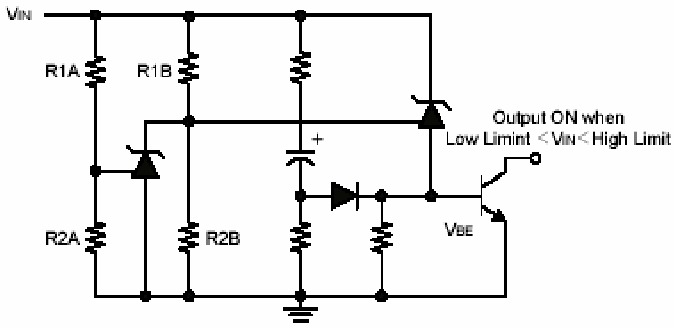
$V_{OUT} = (1 + R1/R2) \times V_{REF}$

Fig.8 Higher-Current Shunt Regulator



LIMIT ≈ (1 + R1/R2) × V_{REF}

Fig.9 Crow Bar



Low Limit ≈ V_{REF}(1 + R1B/R2B) +V_{BE}
High Limit ≈ V_{REF}(1 + R1A/R2A)

Fig.10 Over-Voltage / Under-Voltage Protection Circuit

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