Adjustable Precision Shunt Regulator

FEATURES

- Low voltage operation (1.24V)
- Adjustable output voltage from $V_O = V_{REF}$ to 12V
- Wide operating current range from 55µ A to 100mA
- Low dynamic output impedance 0.25Ω typ.
- ESD rating is 6kV (per MIL-STD 883D)
- **Pb-free, RoHS compliant.**

APPLICATIONS

- Linear Regulators
- Adjustable Supplies
- Switching Power Supplies
- Battery Operated Computers
- Instrumentation

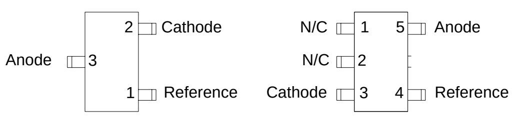
DESCRIPTION

The SS432G is a low-voltage three-terminal adjustable shunt regulator with guaranteed thermal stability over the applicable temperature range. The output voltage can be set to any value between V_{REF} (approximately 1.24V) and 12V using two external resistors (see application circuit). This device has a typical output impedance of 0.25 ohms. Active output circuitry provides very sharp turn-on characteristics, making this device an excellent alternative to Zener diodes in many applications.

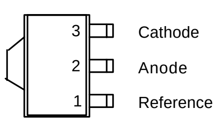
The SS432G is characterized for operation from 0°C to 105°C, and four package options (SOT-23-3, SOT-23-5, SOT-89, TO-92) allow the designer the opportunity to select the proper package for the application.

PIN CONFIGURATION

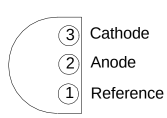
SOT-23-3 (Top view) SOT-23-5



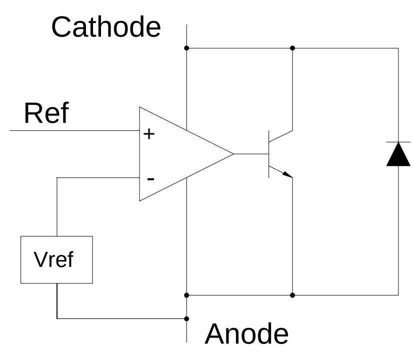
SOT-89 (Top view)



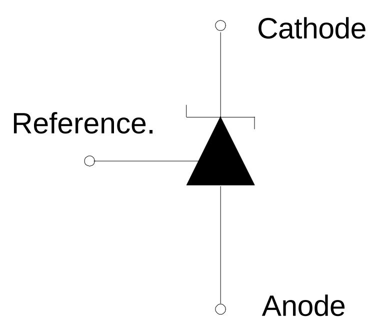
TO-92 (Top view)



BLOCK DIAGRAM



SYMBOL



ORDERING INFORMATION

SS432GxB TR

Package type:

GN = SOT-23-3, RoHS compliant
GT = TO-92, RoHS compliant
GG = SOT-89, RoHS compliant
GV = SOT-23-5, RoHS compliant

Example: SS432GNB TR

-> SS432G in RoHS-compliant SOT-23-3 shipped on tape and reel

ABSOLUTE MAXIMUM RATINGS over ambient temp. range.

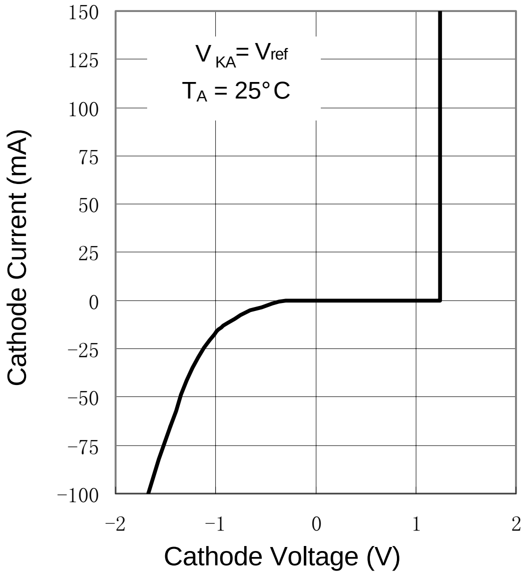
Parameter	Symbol	Maximum	Units
Cathode Voltage	V_{KA}	12	V
Continuous Cathode Current	I_{KA}	150	mA
Reference Current	I_{REF}	3	mA
Operating Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{STG}	-45 to +150	°C
Thermal Resistance	θ_{JA}	160	°C/W
Lead Temperature (Soldering - std.lead finish)	T_{LEAD}	260°C/10 sec.	

ELECTRICAL CHARACTERISTICS (T_A =25°C)

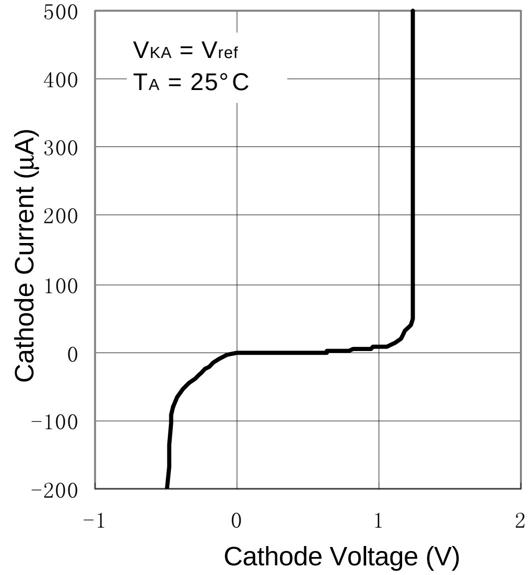
PARAMETER	SYMBOL	TEST CIRCUIT	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference voltage 1%	V_{ref}	1	$V_{KA} = V_{ref}$ I_{KA} = 10mA	1.228	1.240	1.252	V
Deviation of reference voltage over full temperature range	$V_{I(dev)}$	1	$V_{KA} = V_{ref}$, I_{KA} = 10mA T_A = full range		4	12	mV
Ratio of change in reference voltage to the change in cathode voltage	$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	2	I_{KA} = 10mA, $\Delta V_{KA} = V_{ref}$ to 12V		-1.5	-2.7	mV/V
Reference current	Iref	2	I_{KA} = 10mA, R1 = 10kΩ, R2 = ∞		0.15	0.5	µA
Deviation of reference current over full temperature range	$I_{I(dev)}$	2	I_{KA} = 10mA, R1 = 10kW, R2 = ∞ TA = full range		0.05	0.30	µA
Minimum cathode current for regulation	I_{min}	1	$V_{KA} = V_{ref}$		55	80	µA
Off-state cathode current	I_{off}	3	V_{KA} = 12V, V_{ref} = 0		0.001	0.1	µA
Dynamic impedance	$\|Z_{KA}\|$	1	I_{KA} = 100µA to 100mA, $V_{KA} = V_{ref}$ f ≤ 1kHz		0.25	0.4	Ω

TYPICAL PEFORMANCE CHARACTERISTICS

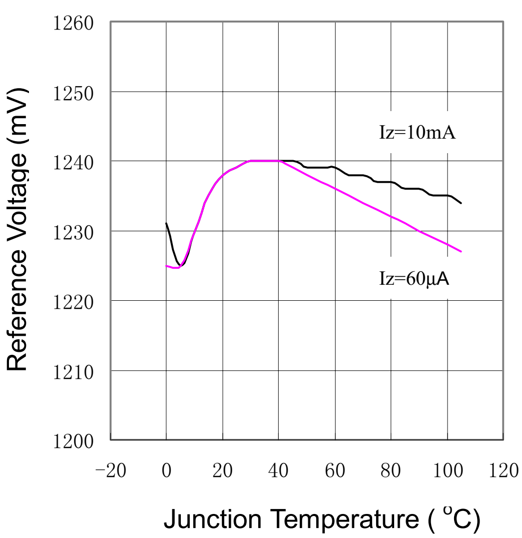
CATHODE CURRENT
Vs.
CATHODE VOLTAGE



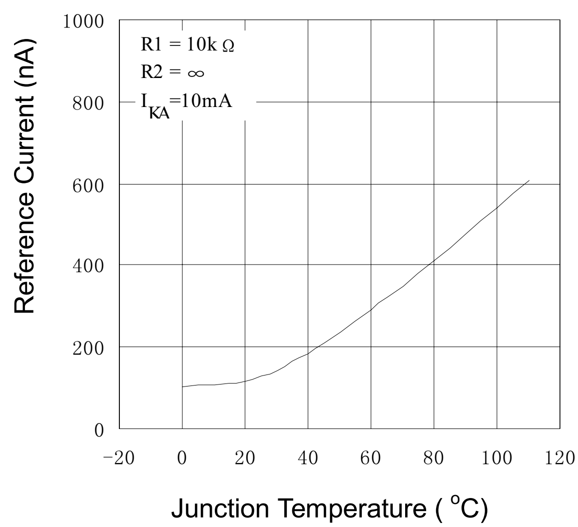
CATHODE CURRENT
Vs.
CATHODE VOLTAGE



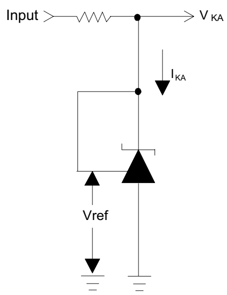
REFERENCE VOLTAGE
Vs.
JUNCTION TEMPERATURE



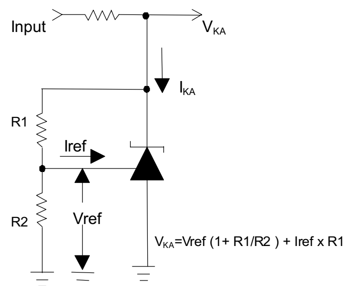
REFERENCE INPUT CURRENT
Vs.
JUNCTION TEMPERATURE



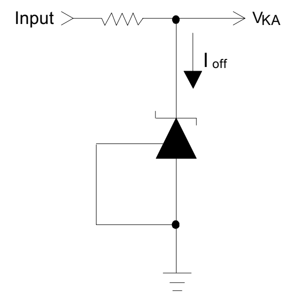
TEST CIRCUITS



Test Circuit 1:
V_{KA} = Vref

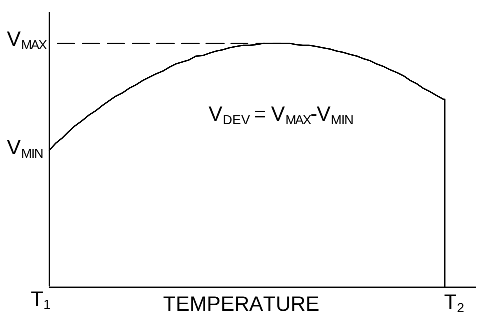


Test Circuit 2:
V_{KA} > Vref



Test Circuit 3:
Off State Current

APPLICATION INFORMATION



Deviation of reference input voltage, V_{DEV}, is defined as the maximum variation of the reference input voltage over the full temperature range.

The average temperature coefficient of the reference input voltage, αV_{REF} is defined as:

$$\Delta V_{REF}\frac{ppm}{^\circ C} = \frac{\pm\left[\frac{V_{MAX} - V_{MIN}}{V_{REF}(at\ 25^\circ C)}\right]10^6}{T2 - T1} = \frac{\pm\left[\frac{V_{DEV}}{V_{REF}(at\ 25^\circ C)}\right]10^6}{T2 - T1}$$

Where:
T_2–T_1=full temperature change.
αV_{REF} can be positive or negative depending on whether the slope is positive or negative.
Example: V_{DEV}= 12.0mV, V_{REF}= 1240mV, T_2–T_1= 105°C, slope is negative.

$$aV_{REF} = \frac{\left[\frac{12.0mV}{1240mV}\right]10^6}{105^\circ C} = -92ppm/^\circ C$$

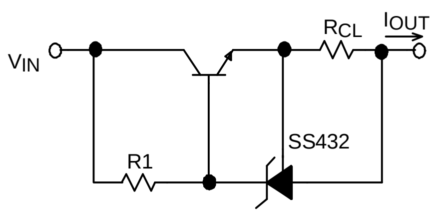
Note 4. The dynamic output impedance, R_Z, is defined as:

$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

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

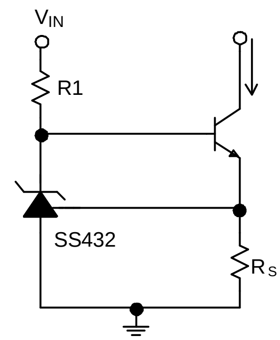
$$r_Z = \frac{\Delta V}{\Delta I} \cong R_Z\left[1 + \frac{R1}{R2}\right]$$

APPLICATION EXAMPLES



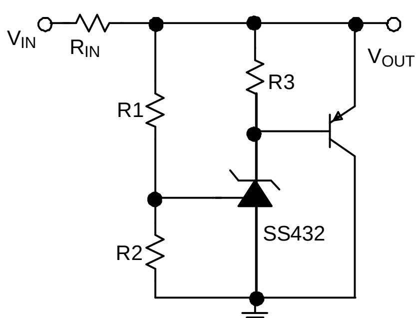
$I_{OUT}=V_{REF}/R_{CL}$

Current Limiter or Current Source



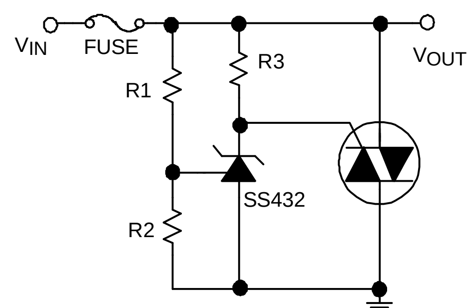
$I_{OUT}=V_{REF}/R_S$

Constant-Current Sink



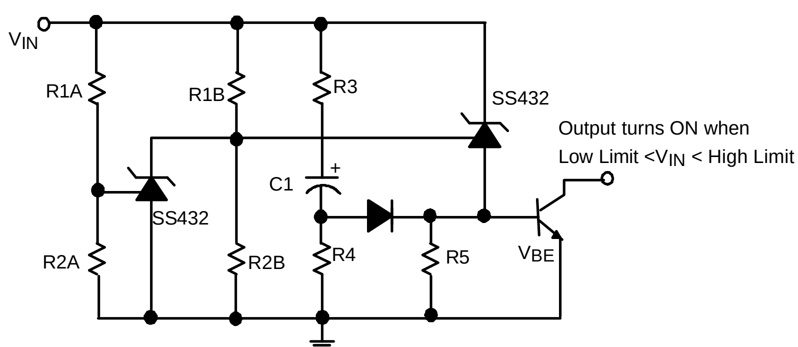
$V_{OUT} \cong (1+R1/R2) \times V_{REF}$

Higher Current Shunt Regulator



$V_{LIMIT} \cong (1+R1/R2) \times V_{REF}$

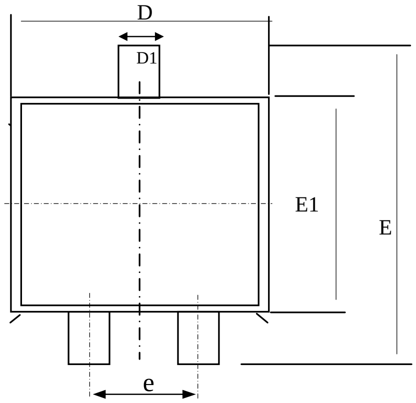
Crow Bar



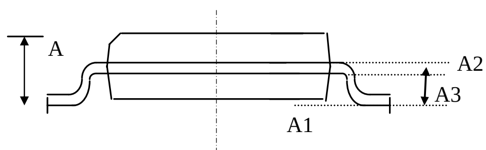
Low Limit $\cong V_{REF}$ (1+ R1B/ R2B)+ V_{BE}
High Limit $\cong V_{REF}$ (1+ R1A/ R2A)

Over-Voltage/Under-Voltage Protection Circuit

PHYSICAL DIMENSIONS SOT-23-3



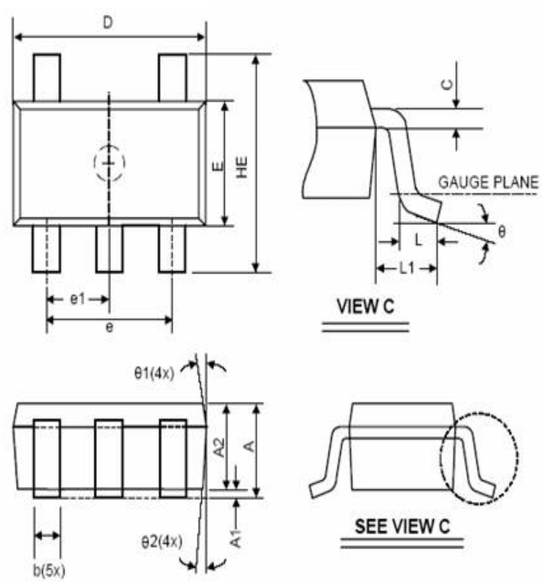
SYMBOL	MIN	NOM	MAX
A	0.88	1.10	1.30
A1	0.00	----	0.10
D1	0.30	0.40	0.51
e	1.70	2.00	2.30
D	2.80	2.90	3.04
E	2.10	2.50	2.90
E1	1.20	1.40	1.60



Units : mm

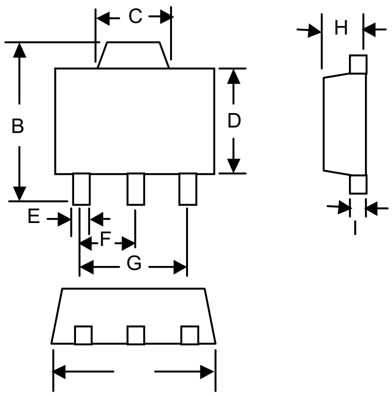
Dimensions do not include mold protrusions.

SOT-23-5



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.05	-	1.35	0.041	-	0.053
A1	0.05	-	0.15	0.002	-	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.25	-	0.50	0.010	-	0.020
C	0.08	-	0.20	0.003	-	0.008
D	2.70	2.90	3.00	0.106	0.114	0.118
E	1.50	1.60	1.70	0.059	0.063	0.067
HE	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	-	0.60	0.012	-	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e	1.80	1.90	2.00	0.071	0.075	0.079
e1	0.85	0.95	1.05	0.033	0.037	0.041
θ	0°	5°	10°	0°	5°	10°
θ1	3°	5°	7°	3°	5°	7°
θ2	6°	8°	10°	6°	8°	10°

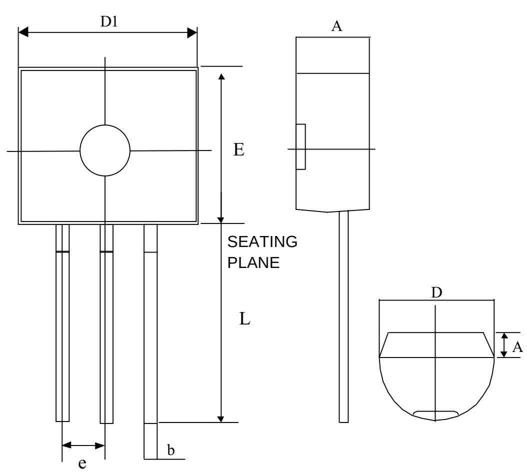
PHYSICAL DIMENSIONS SOT-89



SYMBOL	MIN	MAX
A	4.40	4.60
B	4.05	4.25
C	1.50	1.70
D	2.40	2.60
E	0.31	0.46
F	1.48	1.52
G	2.96	3.04
H	1.40	1.60
I	0.35	0.41

Units: mm.

PHYSICAL DIMENSIONS TO-92



Symbol	Min	Nom	Max
A	3.45	3.56	3.66
A1	1.22	1.3	1.37
b	-	0.38	-
D1	4.27	4.52	4.78
D	4.14	4.29	4.45
E	4.32	4.57	4.83
e	-	1.27	-
L	12.98	13.49	14.00

Information furnished by Silicon Standard Corporation is believed to be accurate and reliable. However, Silicon Standard Corporation makes no guarantee or warranty, express or implied, as to the reliability, accuracy, timeliness or completeness of such information and assumes no responsibility for its use, or for infringement of any patent or other intellectual property rights of third parties that may result from its use. Silicon Standard reserves the right to make changes as it deems necessary to any products described herein for any reason, including without limitation enhancement in reliability, functionality or design. No license is granted, whether expressly or by implication, in relation to the use of any products described herein or to the use of any information provided herein, under any patent or other intellectual property rights of Silicon Standard Corporation or any third parties.