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

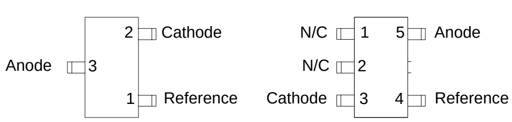
DESCRIPTION

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.

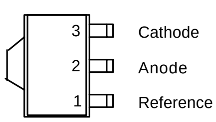
The SS432G is characterized for operation from 0°C to 105°C, and four package options (SOT-23-3, SOT-23-5, SOT-89, TO-92) allow the designer the opportunity to select the proper package for the application.

PIN CONFIGURATION

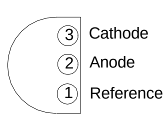
SOT-23-3 (Top view) SOT-23-5



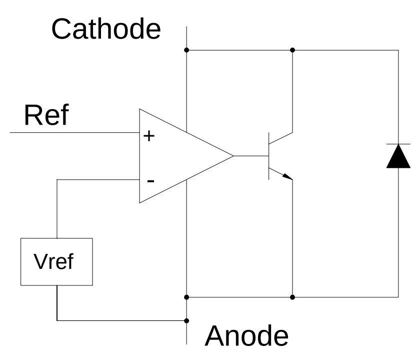
SOT-89 (Top view)



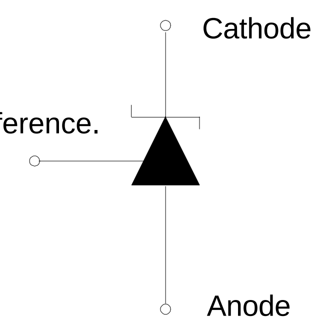
TO-92 (Top view)



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.

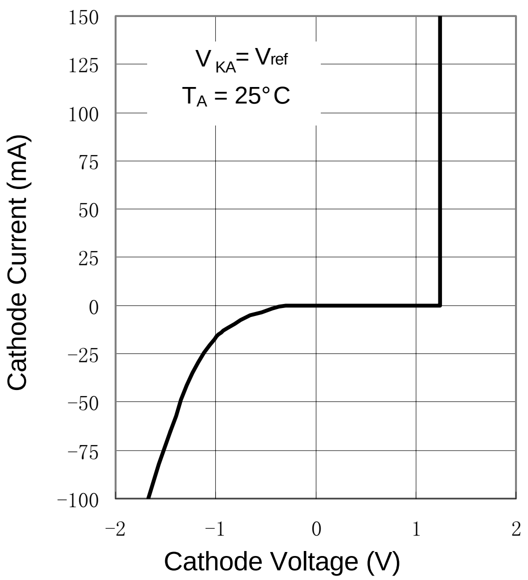
Parameter	Symbol	Maximum	Units
Cathode Voltage	V_{KA}	12	V
Continuous Cathode Current	I_{KA}	150	mA
Reference Current	I_{REF}	3	mA
Operating Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{STG}	-45 to +150	°C
Thermal Resistance	θ_{JA}	160	°C/W
Lead Temperature (Soldering - std.lead finish)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

ELECTRICAL CHARACTERISTICS (T_A =25°C)

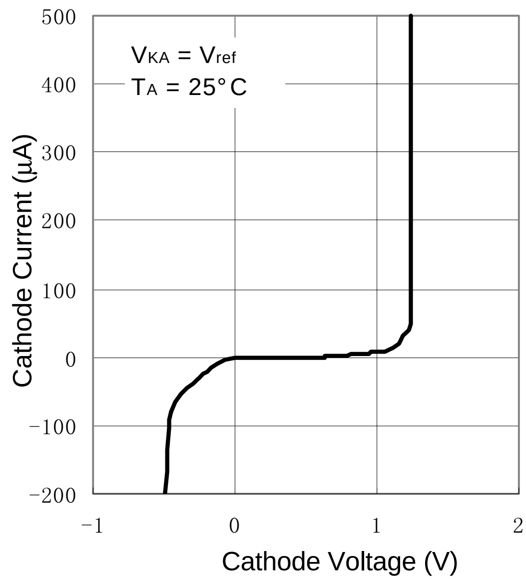
PARAMETER	SYMBOL	TEST CIRCUIT	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference voltage 1%	V_{ref}	1	$V_{KA} = V_{ref}$ I_{KA} = 10mA	1.228	1.240	1.252	V
Deviation of reference voltage over full temperature range	$V_{I(dev)}$	1	$V_{KA} = V_{ref}$, I_{KA} = 10mA T_A = full range		4	12	mV
Ratio of change in reference 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	$\lvert Z_{KA} \rvert$	1	I_{KA} = 100µA to 100mA, $V_{KA} = V_{ref}$ f ≤ 1kHz		0.25	0.4	Ω

TYPICAL PEFORMANCE CHARACTERISTICS

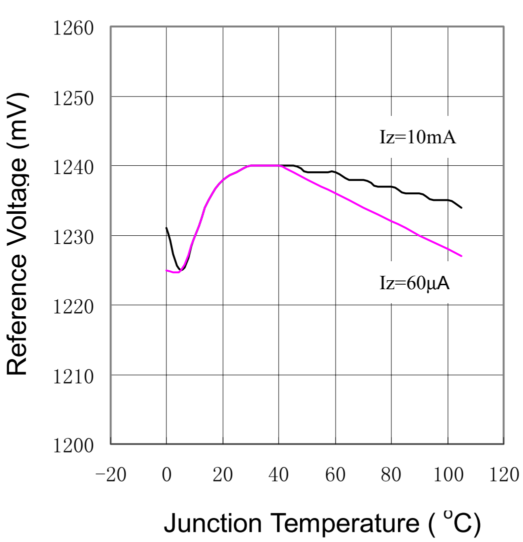
CATHODE CURRENT
Vs.
CATHODE VOLTAGE



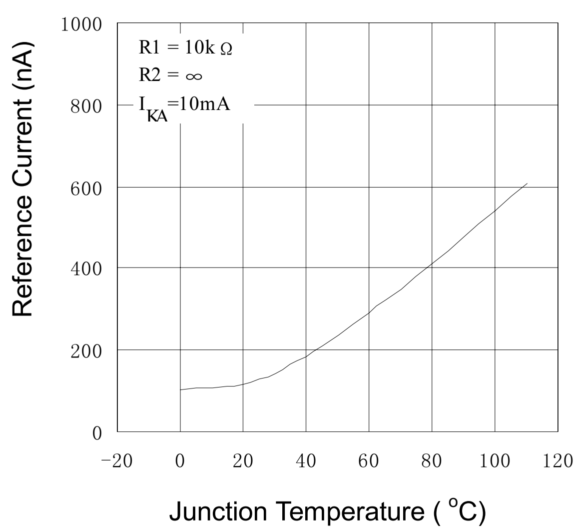
CATHODE CURRENT
Vs.
CATHODE VOLTAGE



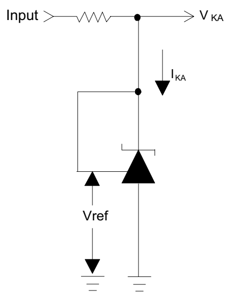
REFERENCE VOLTAGE
Vs.
JUNCTION TEMPERATURE

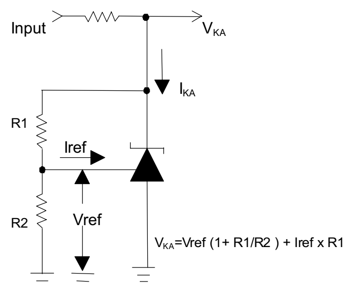


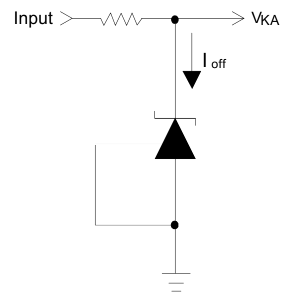
REFERENCE INPUT CURRENT
Vs.
JUNCTION TEMPERATURE



TEST CIRCUITS





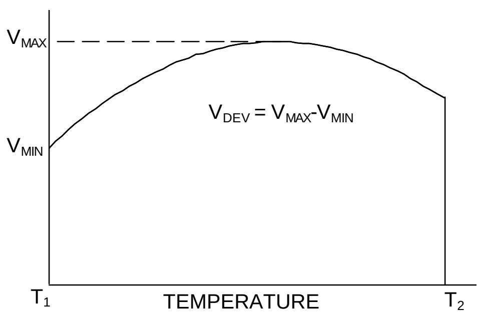


Test Circuit 1:
V_{KA} = Vref

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:

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

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.

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

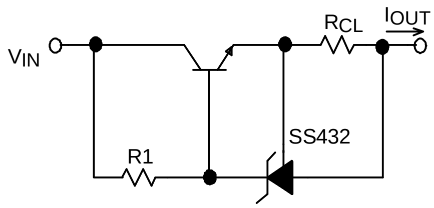
Note 4. The dynamic output impedance, R_Z, is defined as:

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

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:

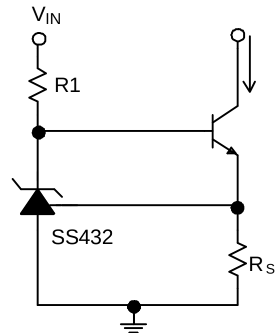
$$r_Z = \frac{\Delta V}{\Delta I} \cong R_Z\left[1+\frac{R1}{R2}\right]$$

APPLICATION EXAMPLES



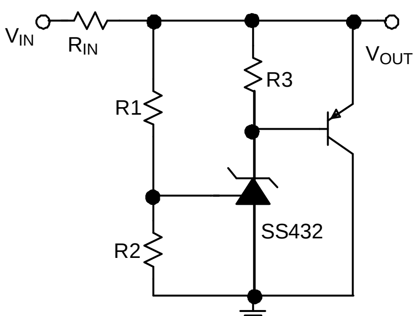
$I_{OUT}=V_{REF}/R_{CL}$

Current Limiter or Current Source



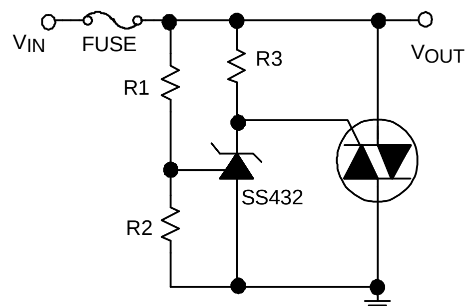
$I_{OUT}=V_{REF}/R_S$

Constant-Current Sink



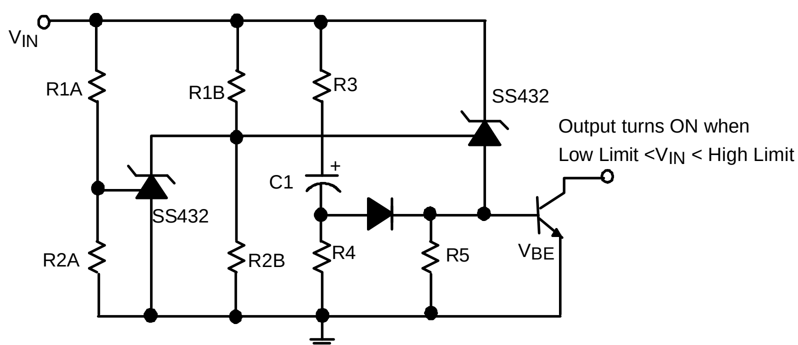
$V_{OUT} \cong (1+R1/R2) \times V_{REF}$

Higher Current Shunt Regulator



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

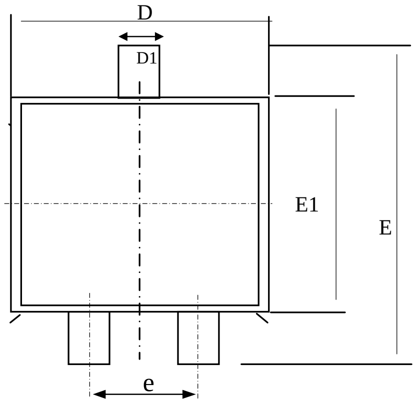
Crow Bar



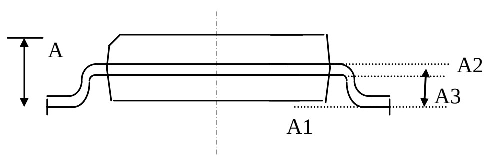
Low Limit $\cong V_{REF}$ (1+ R1B/ R2B)+ V_{BE}
High Limit $\cong V_{REF}$ (1+ R1A/ R2A)

Over-Voltage/Under-Voltage Protection Circuit

PHYSICAL DIMENSIONS SOT-23-3



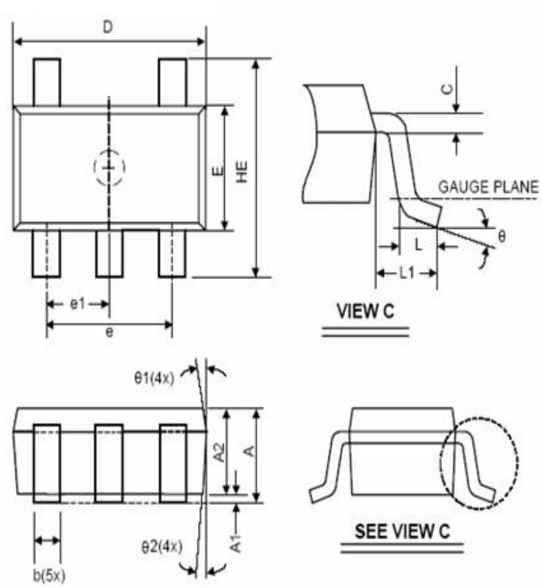
SYMBOL	MIN	NOM	MAX
A	0.88	1.10	1.30
A1	0.00	----	0.10
D1	0.30	0.40	0.51
e	1.70	2.00	2.30
D	2.80	2.90	3.04
E	2.10	2.50	2.90
E1	1.20	1.40	1.60



Units : mm

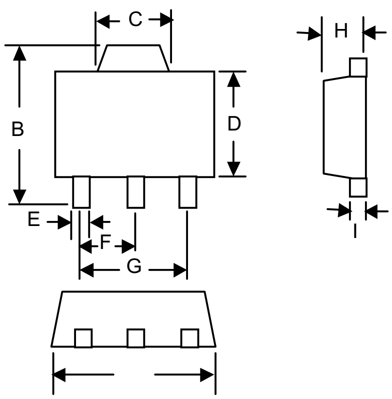
Dimensions do not include mold protrusions.

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°

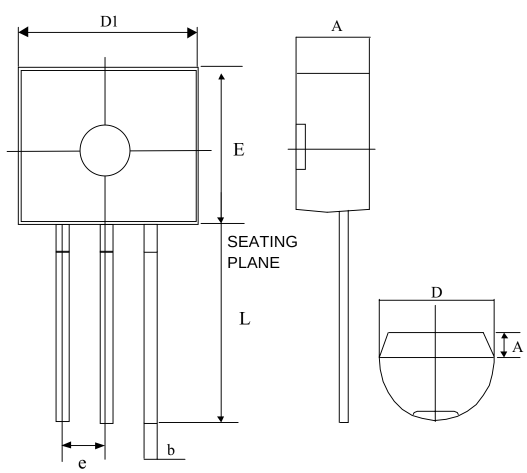
PHYSICAL DIMENSIONS SOT-89



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