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
- Computer Disk Drives

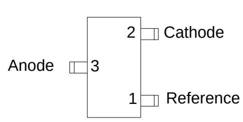
DESCRIPTION

The SS432G is a low-voltage three-terminal adjustable shunt regulator with a guaranteed thermal stability over the applicable temperature range. The output voltage can be set to any value between V_{REF} (approximately 1.24V) to 12V with 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 replacement for Zener diodes in many applications.

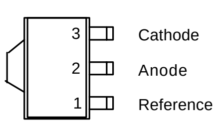
The SS432G is characterized for operation from 0°C to 105°C, and three package options (SOT-23, SOT-89, and TO-92) allow the designer the opportunity to select the proper package for his application.

PIN CONFIGURATION

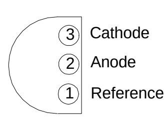
SOT-23 (Top view)



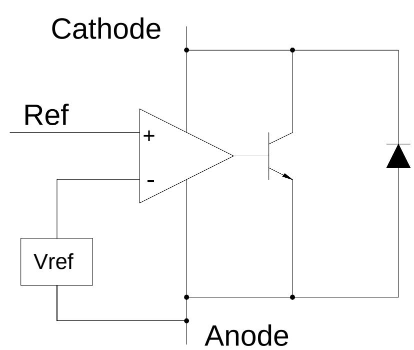
SOT-89 (Top view)



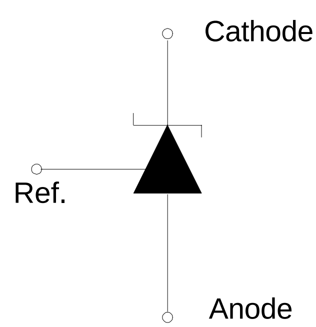
TO-92 (Top view)



BLOCK DIAGRAM



SYMBOL



ABSOLUTE MAXIMUM RATINGS over ambient temp. range.

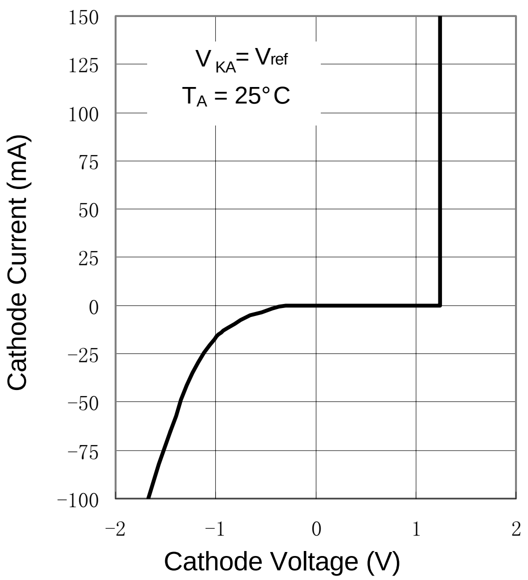
Parameter	Symbol	Maximum	Units
Cathode Voltage	V_{KA}	12	V
Continuous Cathode Current	I_{KA}	150	mA
Reference Current	I_{REF}	3	mA
Operating Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{STG}	-45 to +150	°C
Thermal Resistance	θ_{JA}	160	°C/W
Lead Temperature (Soldering - std.lead finish)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

ELECTRICAL CHARACTERISTICS (T_A =25°C)

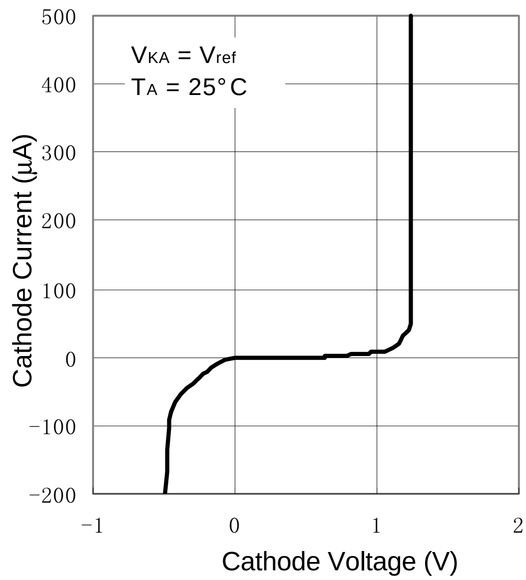
PARAMETER	SYMBOL	TEST CIRCUIT	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference voltage 1%	V_{ref}	1	$V_{KA} = V_{ref}$ I_{KA} = 10mA	1.228	1.240	1.252	V
Deviation of reference voltage over full temperature range	$V_{I(dev)}$	1	$V_{KA} = V_{ref}$, I_{KA} = 10mA T_A = full range		4	12	mV
Ratio of change in reference 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

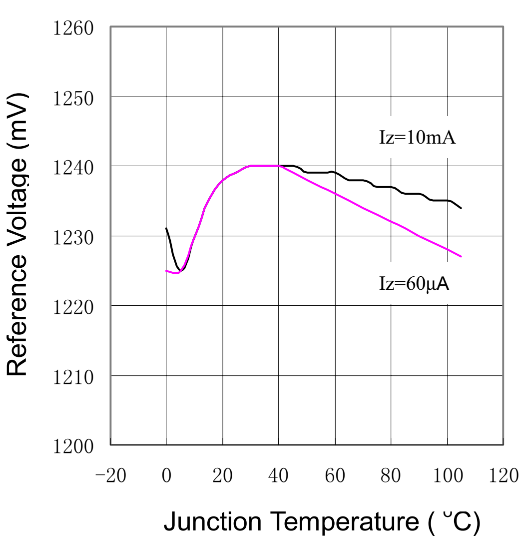
CATHODE CURRENT
Vs.
CATHODE VOLTAGE



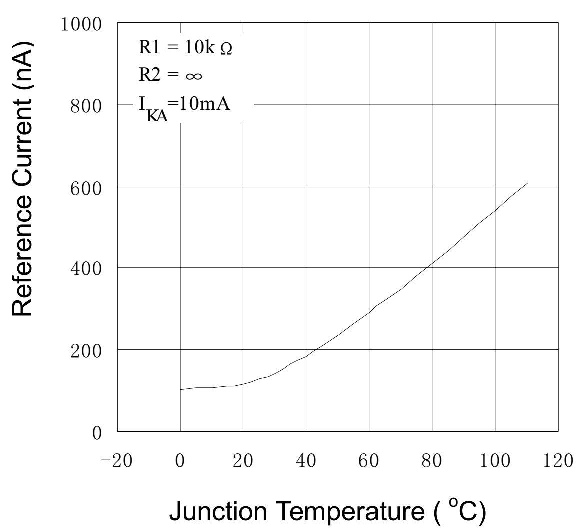
CATHODE CURRENT
Vs.
CATHODE VOLTAGE



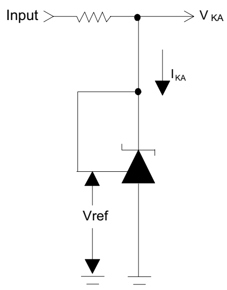
REFERENCE VOLTAGE
Vs.
JUNCTION TEMPERATURE



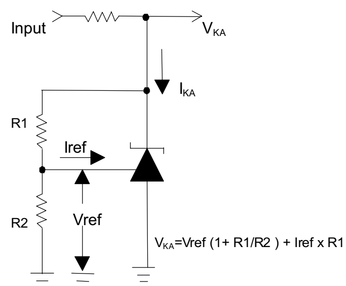
REFERENCE INPUT CURRENT
Vs.
JUNCTION TEMPERATURE



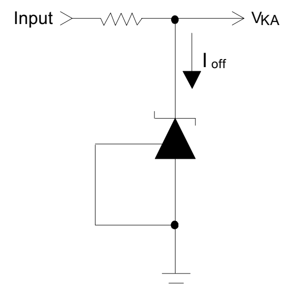
TEST CIRCUITS



Test Circuit 1:
V_{KA} **= Vref**

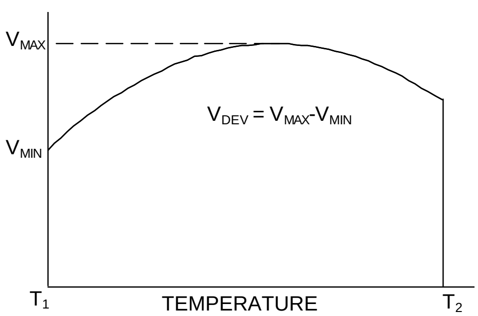


Test Circuit 2:
V_{KA} **> Vref**



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.

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

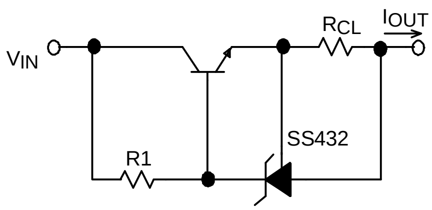
Note 4. The dynamic output impedance, R_Z, is defined as:

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

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:

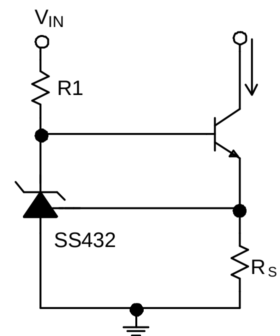
$$r_Z=\frac{\Delta V}{\Delta I}\cong R_Z\left[1+\frac{R1}{R2}\right]$$

APPLICATION EXAMPLES



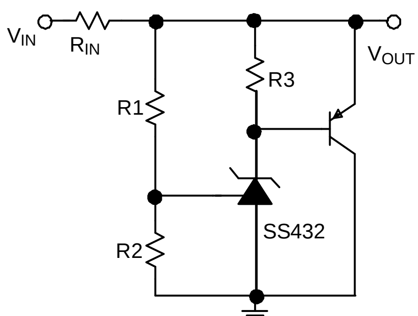
$I_{OUT}=V_{REF}/R_{CL}$

Current Limiter or Current Source



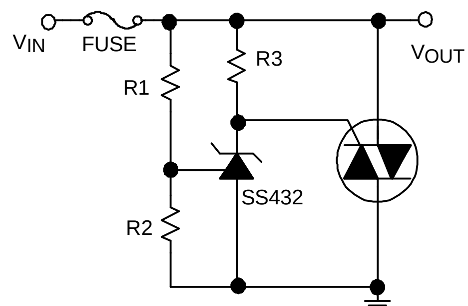
$I_{OUT}=V_{REF}/R_S$

Constant-Current Sink



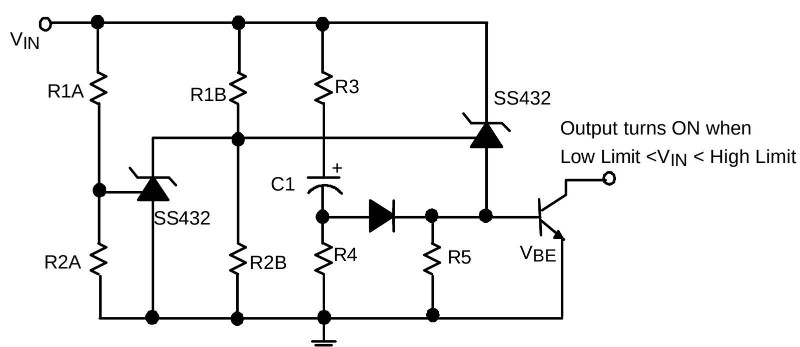
$V_{OUT} \cong (1+R1/R2) \times V_{REF}$

Higher-Current Shunt Regulator



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

Crow Bar

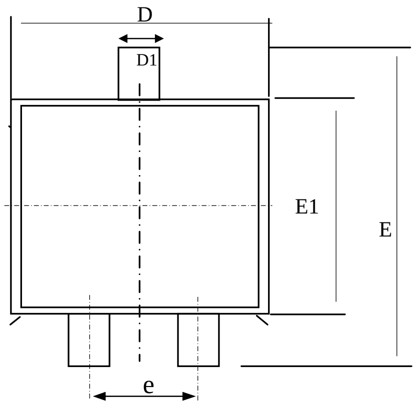


Low Limit $\cong V_{REF}$ (1+ R1B/ R2B)+ V_{BE}

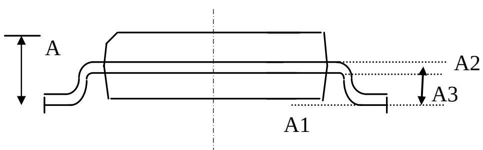
High Limit $\cong V_{REF}$ (1+ R1A/ R2A)

Over-Voltage/Under-Voltage Protection Circuit

PHYSICAL DIMENSIONS SOT-23



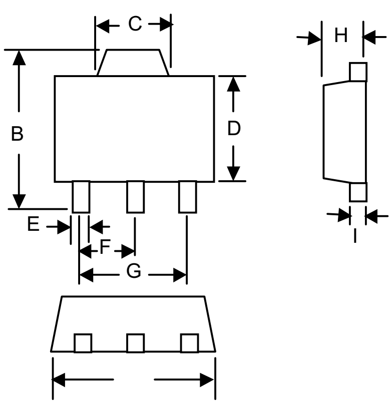
SYMBOL	MIN	NOM	MAX
A	0.88	1.10	1.30
A1	0.00	----	0.10
D1	0.30	0.40	0.51
e	1.70	2.00	2.30
D	2.80	2.90	3.04
E	2.10	2.50	2.90
E1	1.20	1.40	1.60



Units : mm

Dimensions do not include mold protrusions.

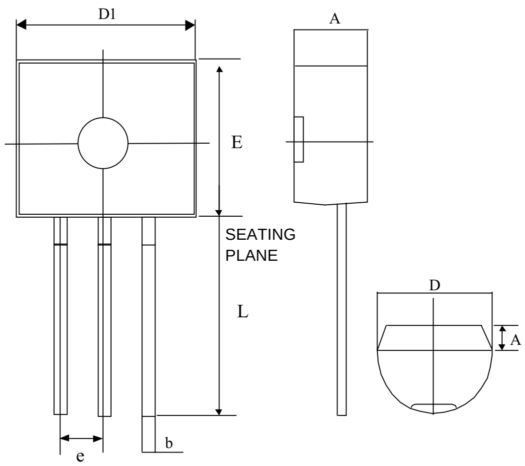
SOT-89



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

Units: mm.

ORDERING INFORMATION

SS432GxB xx

- TR: Tape and Reel Packing
- Bandgap tolerance
  - B = 1%
- Package type
  - GN = SOT-23-3, RoHS compliant
  - GT = TO-92, RoHS compliant
  - GG = SOT-89, RoHS compliant

Example: SS432GNB TR

SS432 with 1% tolerance in SOT-23-3 with pb-free lead finish shipped on tape and reel