

Adjustable Precision Shunt Regulator

FEATURES

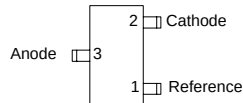
- Low voltage operation (2.5V)
- Adjustable output voltage from $V_O = V_{REF}$ to 18V
- Wide operating current range from 0.4mA to 100mA
- Low dynamic output impedance 0.5 Ω max.
- ESD rating is 5.5kV (per MIL-STD 883D)
- Pb-free lead finish available.**

APPLICATIONS

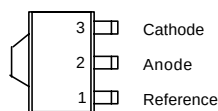
- Linear Regulators
- Adjustable Supplies
- Switching Power Supplies
- Battery Operated Computers
- Instrumentation
- Computer Disk Drives

PIN CONFIGURATION

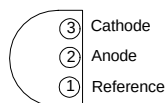
SOT-23 (Top view)



SOT-89 (Top view)



TO-92 (Top view)

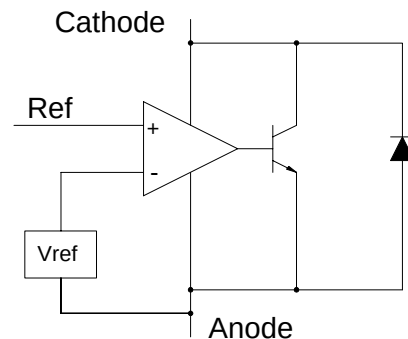


DESCRIPTION

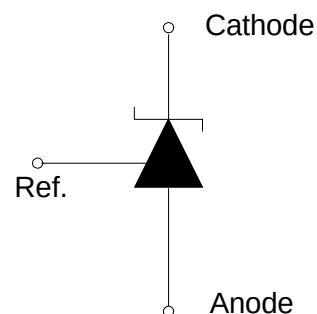
The SS431 is a low-voltage three-terminal adjustable shunt regulator with a guaranteed thermal stability over the applicable temperature range. The output voltage can be set to any value between V_{REF} (approximately 2.5V) to 18V with two external resistors (see application circuit). This device has a typical output impedance of 0.2 ohms. Active output circuitry provides very sharp turn-on characteristics, making this device an excellent replacement for Zener diodes in many applications.

The SS431 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. **The SS431 is available with a Pb-free lead finish - order as SS431Gxx.**

BLOCK DIAGRAM



SYMBOL



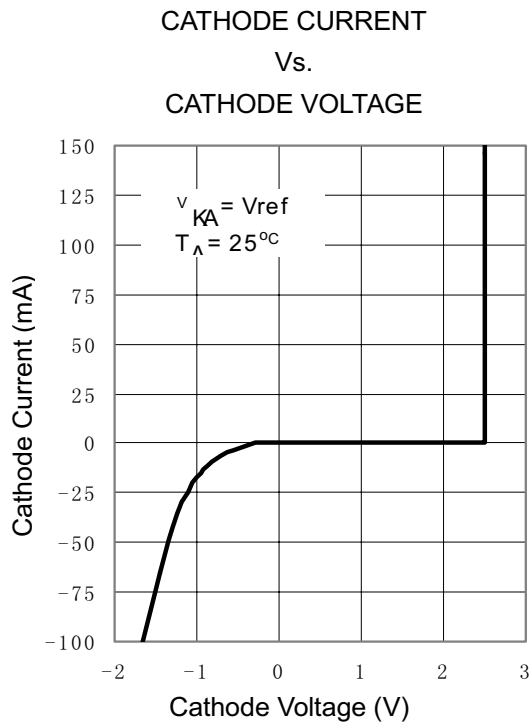
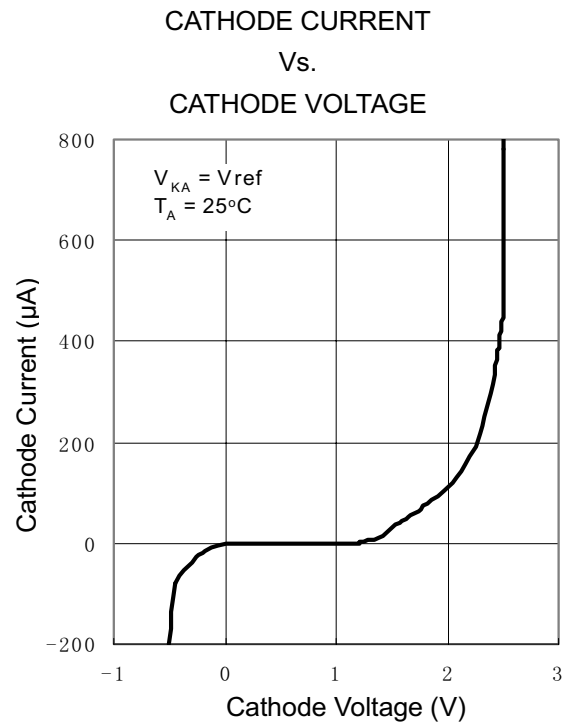
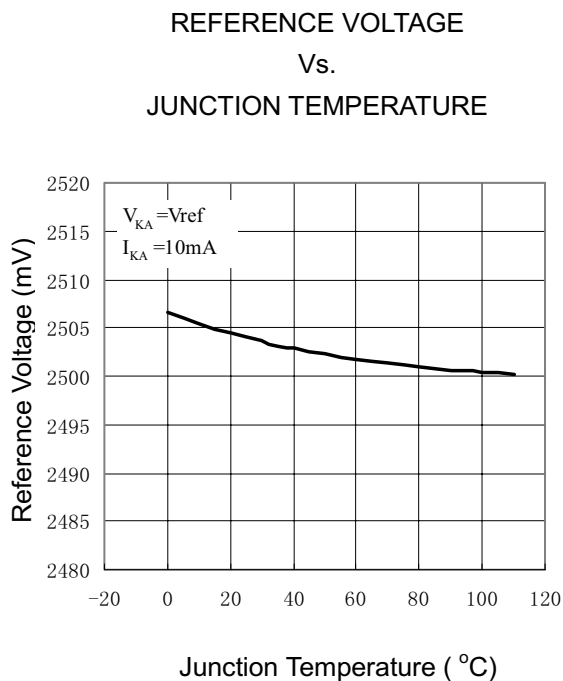
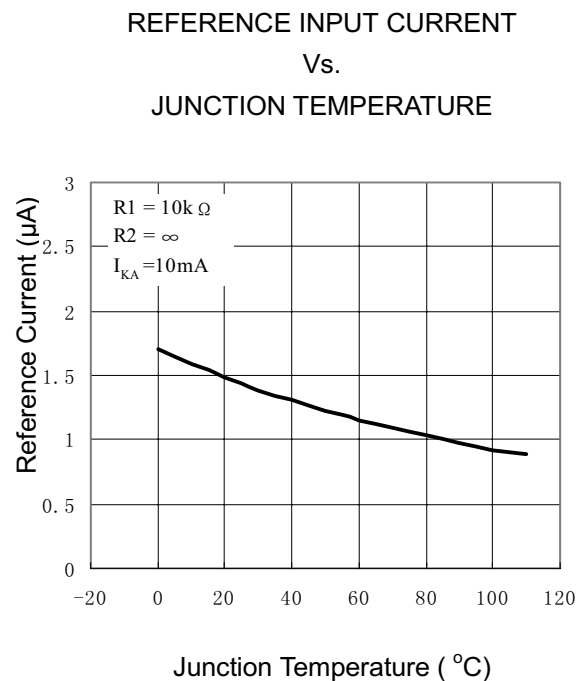
ABSOLUTE MAXIMUM RATINGS over ambient temp.range.

Parameter	Symbol	Maximum	Units
Cathode Voltage	V_{KA}	18	V
Continuous Cathode Current	I_{KA}	150	mA
Reference Current	I_{REF}	10	mA
Operating Junction Temperature	T_J	125	°C
Storage Temperature Range	T_{STG}	-65 to 150	°C
Thermal Resistance	θ_{JA}	156	°C/W
Lead Temperature (Soldering) 10 seconds	T_{LEAD}	260	°C

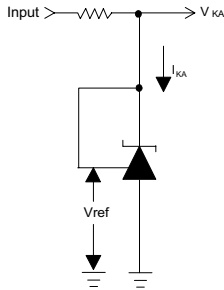
ELECTRICAL CHARACTERISTICS
 $T_A = 25^\circ\text{C}$

PARAMETER			TEST CIRCUIT	TEST CONDITIONS				UNIT
					MIN	TYP	MAX	
Reference voltage	1%	V_{ref}	1	$V_{KA} = V_{ref}$ $I_{KA} = 10\text{mA}$	2470	2495	2520	mV
Deviation of reference voltage Over full temperature range		$V_{I(dev)}$	1	$V_{KA} = V_{ref}$, $I_{KA} = 10\text{mA}$ $T_A = \text{full range}$		4	25	mV
Ratio of change in reference voltage to the change in cathode voltage	$\frac{\Delta V_{ref}}{\Delta V_{KA}}$		2	$I_{KA} = 10\text{mA}$ $\Delta V_{KA} = 10\text{V} - V_{ref}$		-1.4	-2.7	mV/V
Reference current	I_{ref}		2	$I_{KA} = 10\text{mA}$, $R1=10k\Omega$, $R2 = \infty$		2	4	μA
Deviation of Reference current over full temperature range	$I_{I(dev)}$		2	$I_{KA} = 10\text{mA}$, $R1=10k\Omega$, $R2 = \infty$ $T_A = \text{full range}$		0.4	1.2	μA
Minimum cathode current for regulation	I_{min}		1	$V_{KA} = V_{ref}$		0.4	1	mA
Off-state cathode current	I_{off}		3	$V_{KA} = 18\text{V}$, $V_{ref} = 0$		0.1	1	μA
Dynamic impedance	r_z		1	$I_{KA} = 1\text{mA}$ to 100mA , $V_{KA} = V_{ref}$ $f \leq 1\text{kHz}$		0.2	0.5	Ω

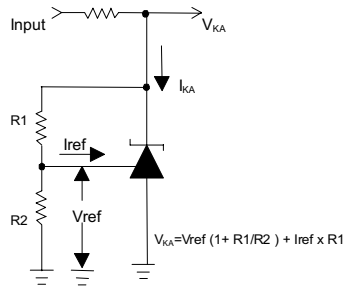
TYPICAL PERFORMANCE CHARACTERISTICS



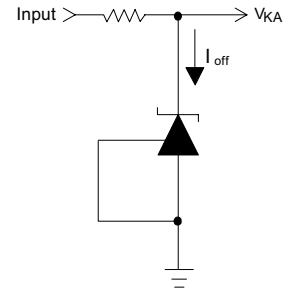
TEST CIRCUITS



Test Circuit 1:
 $V_{KA} = V_{ref}$

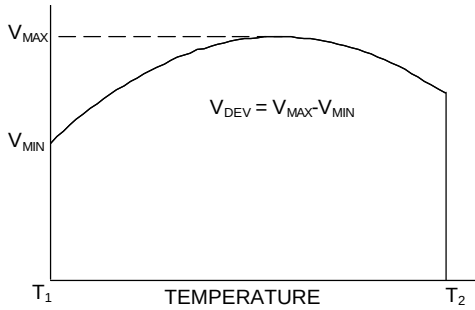


Test Circuit 2:
 $V_{KA} > V_{ref}$



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:

$$\Delta V_{REF} \frac{\text{ppm}}{^{\circ}\text{C}} = \frac{\pm \left[\frac{V_{MAX} - V_{MIN}}{V_{REF}(\text{at } 25^{\circ}\text{C})} \right] 10^6}{T_2 - T_1} = \frac{\pm \left[\frac{V_{DEV}}{V_{REF}(\text{at } 25^{\circ}\text{C})} \right] 10^6}{T_2 - T_1}$$

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: $V_{DEV} = 7.0\text{mV}$, $V_{REF} = 2495\text{mV}$,
 $T_2 - T_1 = 105^{\circ}\text{C}$, slope is negative.

$$\alpha V_{REF} = \frac{\left[\frac{7.0\text{mV}}{2495\text{mV}} \right] 10^6}{105^{\circ}\text{C}} = -27\text{ppm}/^{\circ}\text{C}$$

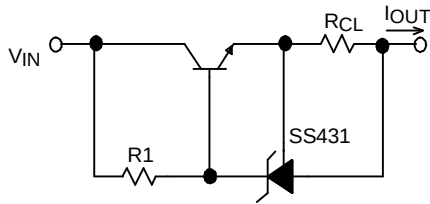
Note 4. The dynamic output impedance, R_Z , is defined as:

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

When the device is programmed with two external resistors, R_1 and R_2 , (see Fig. 2), the dynamic output impedance of the overall circuit, is defined as:

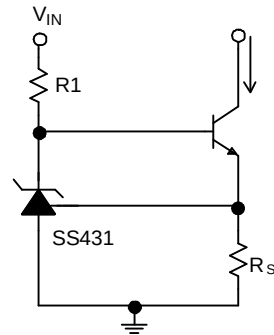
$$r_z = \frac{\Delta V}{\Delta I} \cong R_Z \left[1 + \frac{R_1}{R_2} \right]$$

APPLICATION EXAMPLES



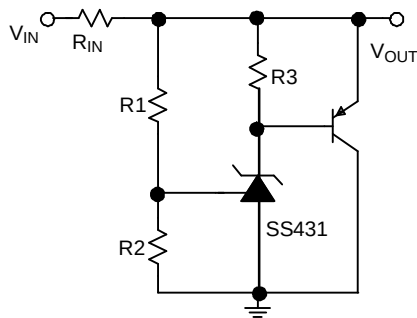
$$I_{OUT} = V_{REF} / R_{CL}$$

Current Limiter or Current Source



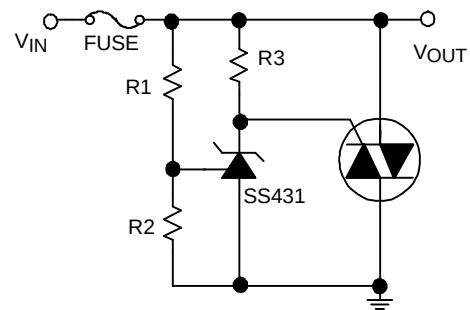
$$I_{OUT} = V_{REF} / R_S$$

Constant-Current Sink



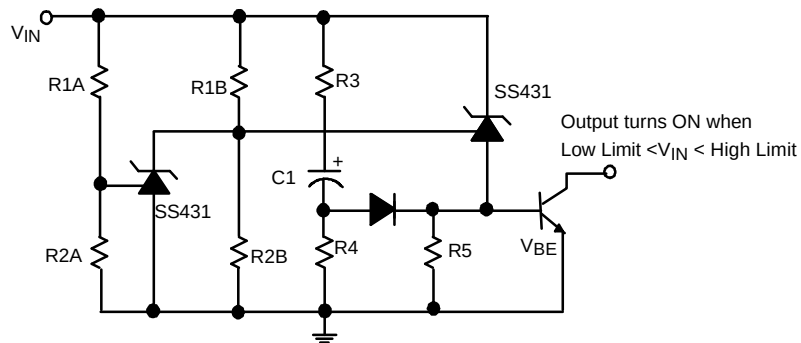
$$V_{OUT} \cong (1 + R_1/R_2) \times V_{REF}$$

Higher-Current Shunt Regulator



$$V_{LIMIT} \cong (1 + R_1/R_2) \times V_{REF}$$

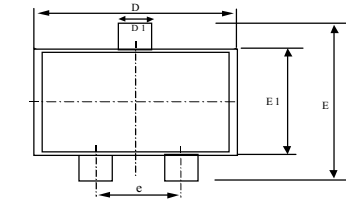
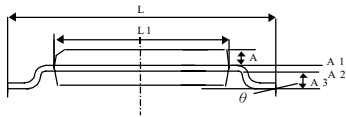
Crow Bar



$$\text{Low Limit} \cong V_{REF} (1 + R_{1B}/R_{2B}) + V_{BE}$$

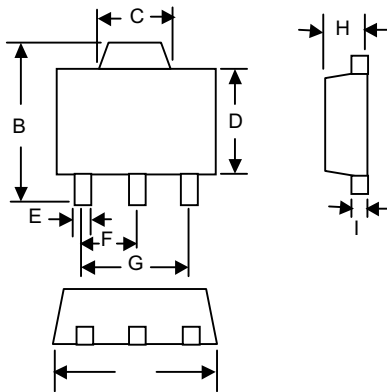
$$\text{High Limit} \cong V_{REF} (1 + R_{1A}/R_{2A})$$

Over-Voltage/Under-Voltage Protection Circuit

PHYSICAL DIMENSIONS SOT-23


SYMBOL	MIN	NOM	MAX
A	0.20	0.30	0.40
A1	—	0.00	—
A2	—	0.10	—
A3	0.70	0.80	0.90
D1	0.30	0.40	0.50
e	1.70	2.00	2.30
D	2.80	2.90	3.00
E	2.25	2.50	2.75
E1	1.40	1.50	1.60
L	2.25	2.50	2.75
L1	1.40	1.50	1.60
θ	—	2°	—

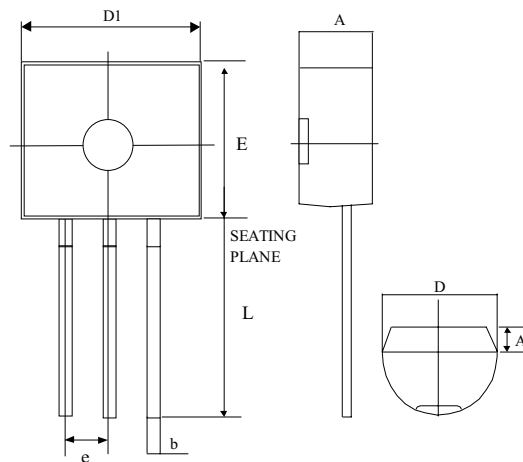
Unit: :mm

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

Unit: :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

Unit: mm

ORDERING INFORMATION

SS431(G)xBxx

TR: Tape and Reel Packing

Bandgap tolerance
B = 1%

Package type
N = SOT-23-3
T = TO-92
G = SOT-89

Lead finish option: G for Pb-free lead finish

Example: SS431GNBTR

SS431 with 1% tolerance in SOT-23-3 with pb-free lead
finish shipped on tape and reel

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.