

## RS431 Series

### Adjustable Precision Shunt Regulator

#### Description

The RS431 series are three-terminal adjustable regulators with guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between  $V_{REF}$  (approximately 2.5 volts) and 36 volts with two external resistors. These devices have a typical dynamic output impedance of  $0.2\Omega$ . Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications.

#### Features

- Programmable Precise Output Voltage from 2.5V to 36V
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Dynamic Output Resistance:  $0.2\Omega$  Typical
- Sink Current Capacity from 1mA to 100 mA
- Low Output Noise
- Wide Operating Range of  $-40$  to  $125^\circ\text{C}$
- Low Equivalent Full-range Temperature Coefficient with 20PPM/ $^\circ\text{C}$  Typical

#### Absolute Maximum Ratings

(Operating temperature range applies unless otherwise specified)

Characteristics	Symbol	Value		Unit
Cathode Voltage	$V_{KA}$	40		V
Cathode Current Range (Continuous)	$I_K$	-100~+150		mA
Reference Input Current Range	$I_{REF}$	0.05~+10		mA
Power Dissipation	$P_D$	SOT-23	370	mW
		TO-92	770	
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		--	--	
Operating Temperature Range (Max.)	$T_{opr}$	$-40\sim+125^*$		$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	$-65\sim+150$		$^\circ\text{C}$

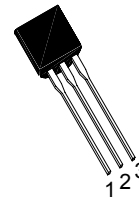
#### Operating Conditions

Characteristics	Symbol	Min.	Max.	Unit
Cathode Voltage	$V_{KA}$	$V_{REF}$	36	V
Cathode Current Range (Continuous)	$I_K$	1	100	mA
Operating Ambient Temperature Range		-40	125	$^\circ\text{C}$

#### RS431 Series Pin Assignment

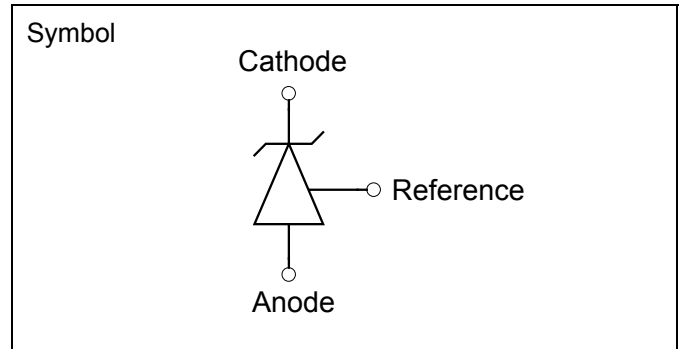
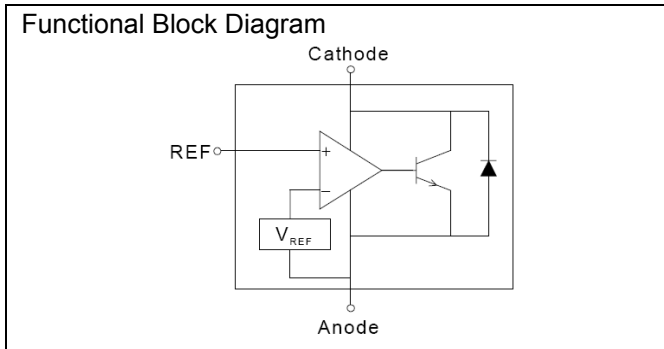


3-Lead Plastic **SOT-23**  
 Package Code: N  
 Pin 1: Reference  
 Pin 2: Cathode  
 Pin 3: Anode

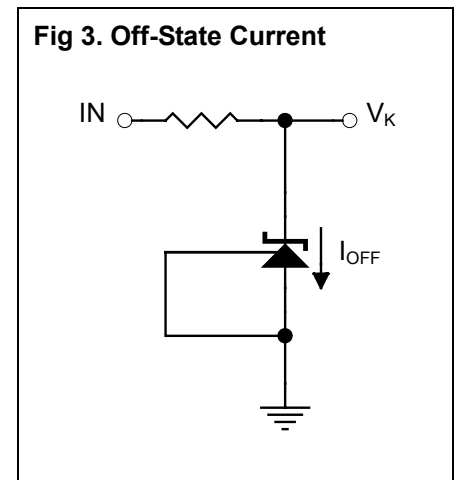
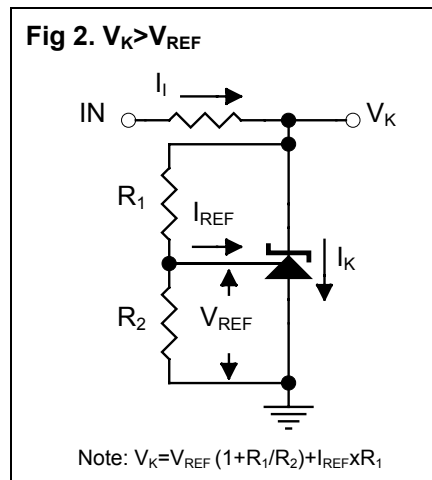
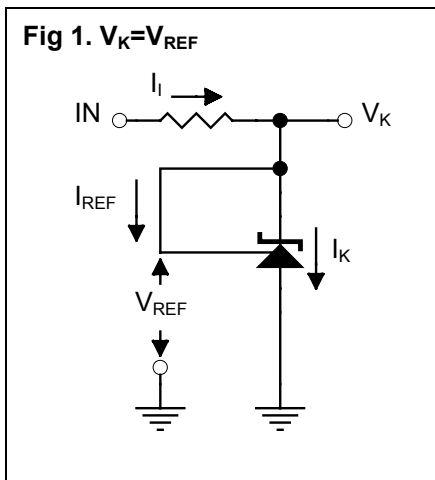


3-Lead Plastic **TO-92**  
 Package Code: A  
 Pin 1: Reference  
 Pin 2: Anode  
 Pin 3: Cathode

## Functional Block Diagram & Symbol



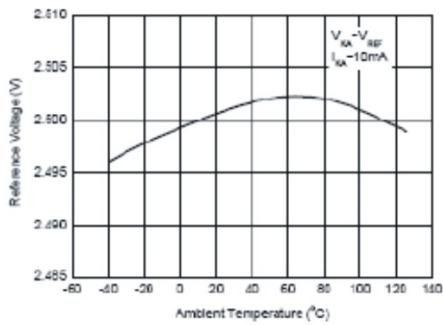
## Test Circuits



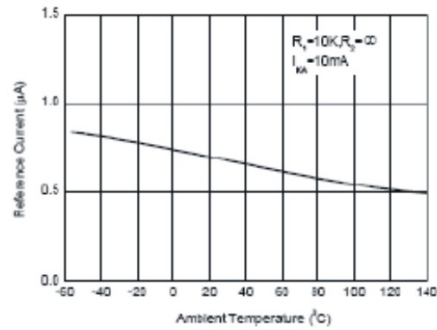
## Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
Reference Input Voltage (Fig1)	$V_{REF}$	$V_K = V_{REF}$ , $I_K = 10\text{mA}$	0.4%	2.49	2.51	V
			0.8%	2.48	2.52	
Deviation of Reference Input Voltage Over-Temperature (Fig1)	$V_{REF(\text{dev})}$	$V_K = V_{REF}$ , $I_K = 10\text{mA}$ $T_{\text{min}} \leq T_a \leq T_{\text{max}}$ ( $-40 \sim +125^\circ\text{C}$ )	-	4.5	16	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage (Fig2)	$\Delta V_{REF} / \Delta V_K$	$I_K = 10\text{mA}$ , $\Delta V_K = 10\text{V}$ to $V_{REF}$	-	1.0	2.7	mV/V
		$I_K = 10\text{mA}$ , $\Delta V_K = 36\text{V}$ to $10\text{V}$	-	0.5	2.0	mV/V
Reference Input Current (Fig2)	$I_{REF}$	$I_K = 10\text{mA}$ , $R_1 = 10\text{k}\Omega$ , $R_2 = \infty$	-	0.7	4	$\mu\text{A}$
Deviation of Reference Input Current Over Full Temperature Range (Fig2)	$I_{REF(\text{dev})}$	$I_K = 10\text{mA}$ , $R_1 = 10\text{k}\Omega$ , $R_2 = \infty$ , $T_a = -40 \sim +125^\circ\text{C}$	-	0.4	1.2	$\mu\text{A}$
Minimum Cathode Current for Regulation (Fig1)	$I_{K(\text{min})}$	$V_K = V_{REF}$	-	0.4	1.0	mA
Off-State Cathode Current (Fig3)	$I_{K(\text{off})}$	$V_K = 36\text{V}$ , $V_{REF} = 0$	-	0.05	1.0	$\mu\text{A}$
Dynamic Output Impedance (Fig1)	$Z_K$	$V_K = V_{REF}$ , $f \leq 1\text{kHz}$ $I_K = 1$ to $100\text{mA}$	-	0.15	0.5	$\Omega$

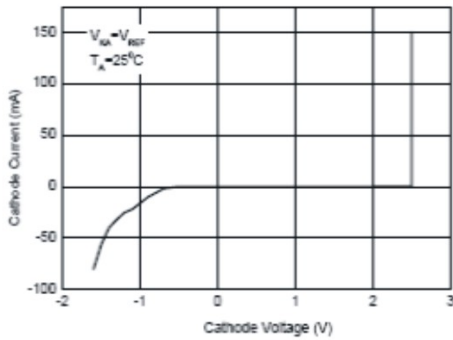
## Typical Performance Characteristics



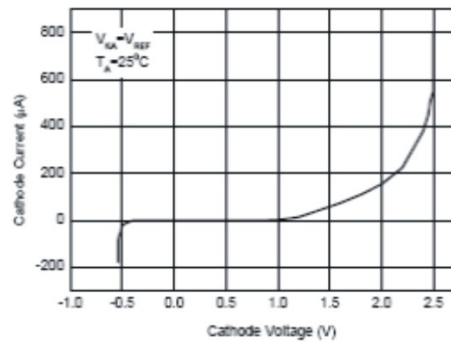
**Figure5** Reference Voltage vs. Ambient Temperature



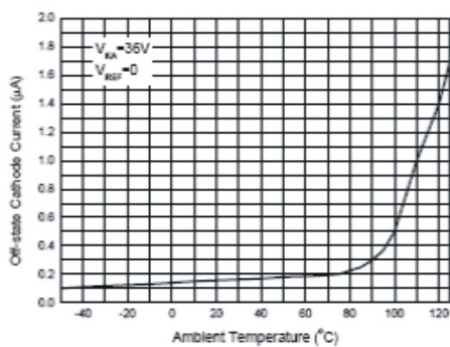
**Figure6** Reference Current vs. Ambient Temperature



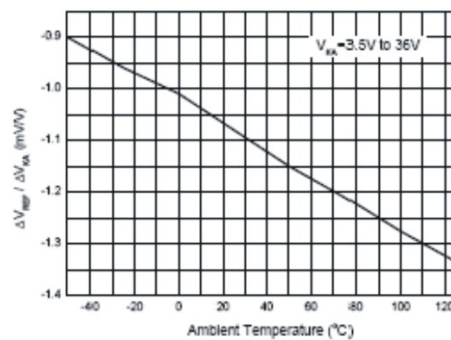
**Figure7** Cathode Current vs. Cathode Voltage



**Figure8** Cathode Current vs. Cathode Voltage



**Figure9** Off-state Cathode Current vs. Ambient Temperature



**Figure10** Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

## Typical Performance Characteristics (Continued)

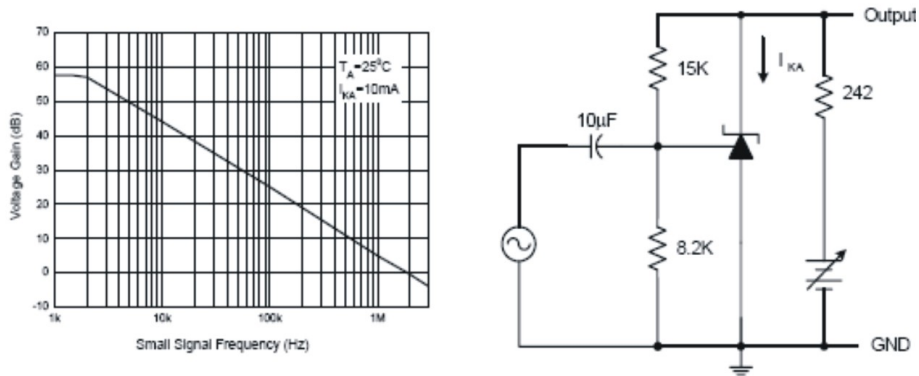


Figure11 Small Signal Voltage Gain vs. Frequency

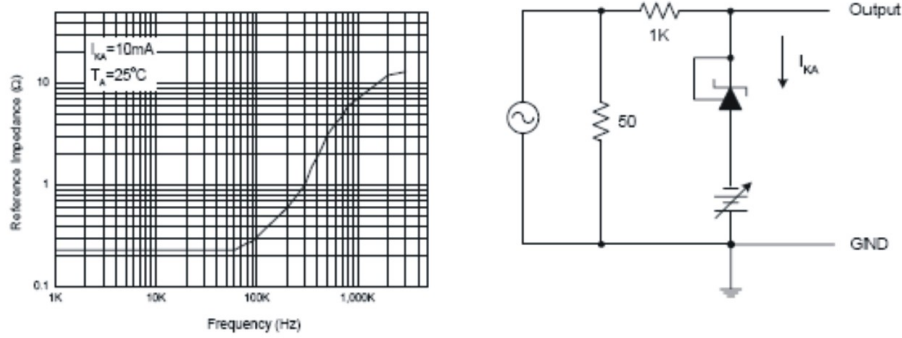


Figure12 Reference Impedance vs. Frequency

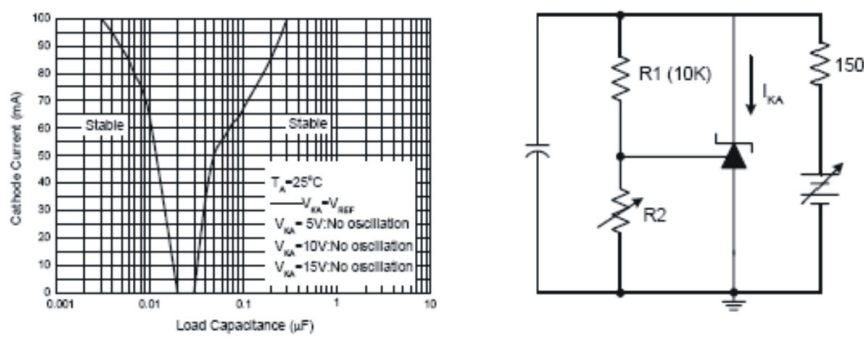
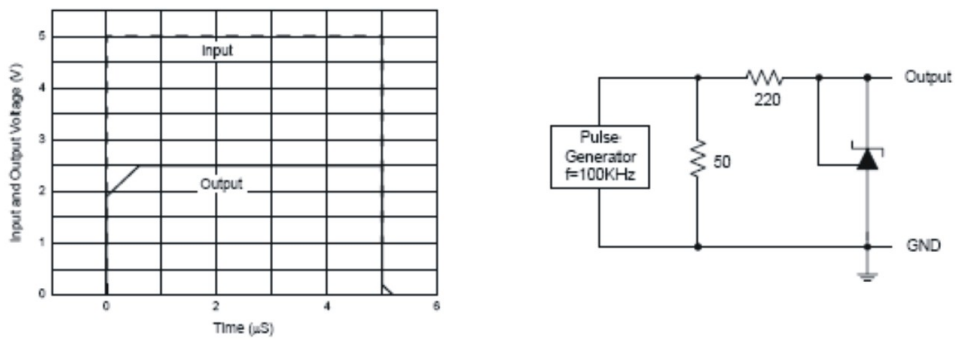


Figure13 Stability Boundary Conditions vs. Load Capacitance

## Typical Performance Characteristics (Continued)



**Figure14** Pulse Response of Input and Output Voltage

## SOT-23 Dimension

3-Lead SOT-23 Plastic Surface Mounted Package  
Package Code: N

Marking:

Pb Free Mark  
Pb-Free: "●" (Note)  
Normal: None

Note: Pb-free product can distinguish by the green label or the extra description on the right side of the label.

Pin Style: 1.Reference 2.Cathode 3.Anode

Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	2.80	3.04
B	1.20	1.60
C	0.89	1.30
D	0.30	0.50
G	1.70	2.30
H	0.013	0.10
J	0.085	0.177
K	0.32	0.67
L	0.85	1.15
S	2.10	2.75
V	0.25	0.65

\*: Typical, Unit: mm

## TO-92 Dimension

3-Lead TO-92 Plastic Package  
Package Code: A

Marking:

Pb Free Mark  
Pb-Free: "●" (Note)  
Normal: None

Date Code      Control Code

Note: Green label is used for pb-free packing

Pin Style: 1.Reference 2.Anode 3.Cathode

Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	4.33	4.83
B	4.33	4.83
C	12.70	-
D	0.36	0.56
E	-	*1.27
F	3.36	3.76
G	0.36	0.56
H	-	*2.54
I	-	*1.27
α1	-	*5°
α2	-	*2°
α3	-	*2°

\*: Typical, Unit: mm

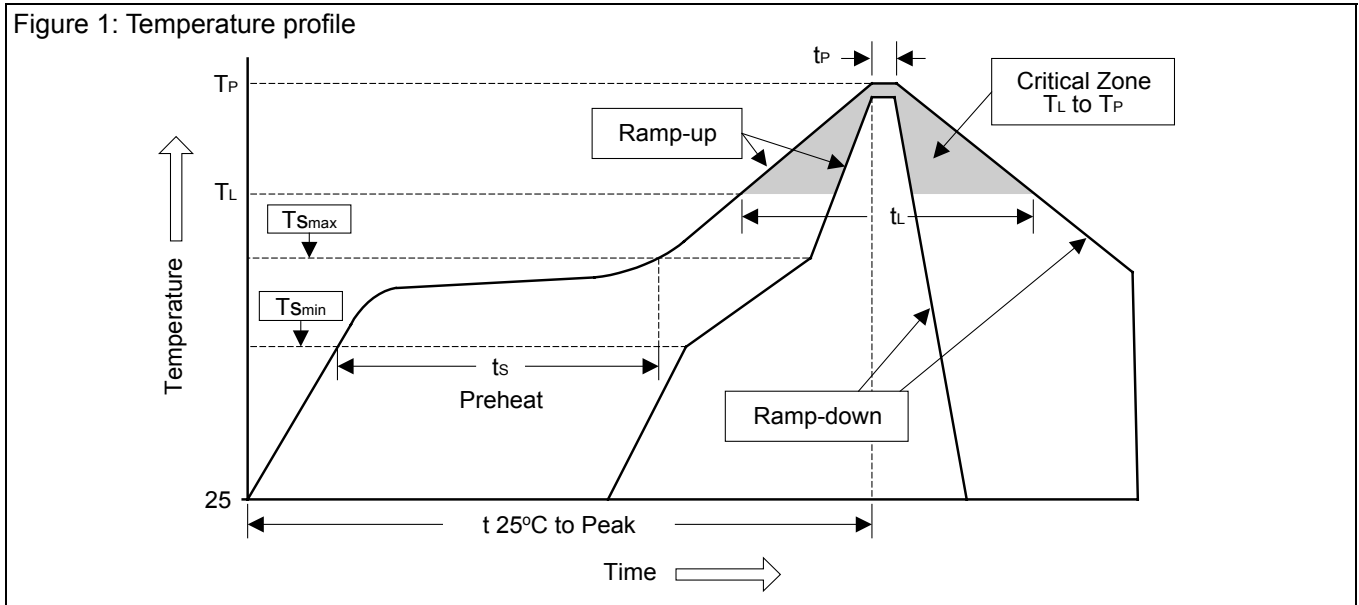
## Ordering Information

Package	V <sub>REF</sub> : 2.5±0.8%	V <sub>REF</sub> : 2.5±0.4%
SOT-23	RS431BN	RS431AN
TO-92	RS431BA	RS431AA

## Soldering Methods for Orister's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T <sub>L</sub> to T <sub>P</sub> )	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min (T <sub>Smin</sub> )	100°C	150°C
- Temperature Max (T <sub>Smax</sub> )	150°C	200°C
- Time (min to max) (ts)	60~120 sec	60~180 sec
T <sub>Smax</sub> to T <sub>L</sub>		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature (T <sub>L</sub> )	183°C	217°C
- Time (t <sub>L</sub> )	60~150 sec	60~150 sec
Peak Temperature (T <sub>P</sub> )	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t <sub>P</sub> )	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec

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