

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 0.2Ω . 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: 0.2Ω Typical
- Sink Current Capacity from 1mA to 100 mA
- Low Output Noise
- Wide Operating Range of -40 to 125°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	$-100 \sim +150$		mA
Reference Input Current Range	I_{REF}	$0.05 \sim +10$		mA
Power Dissipation	P_D	SOT-23	370	mW
		TO-92	770	
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Operating Temperature Range (Max.)	T_{opr}	$-40 \sim +125^{\circ}$		$^{\circ}\text{C}$
Storage Temperature Range	T_{stg}	$-65 \sim +150$		$^{\circ}\text{C}$

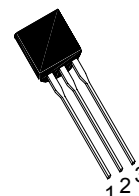
Operating Conditions

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

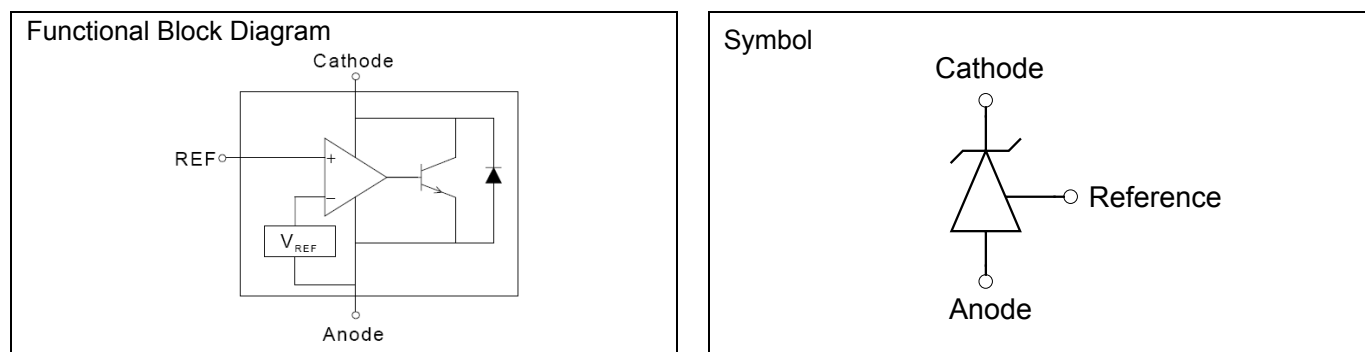


3-Lead Plastic **SOT-23**
Package Code: N
Pin 1: Reference
Pin 2: Cathode
Pin 3: Anode

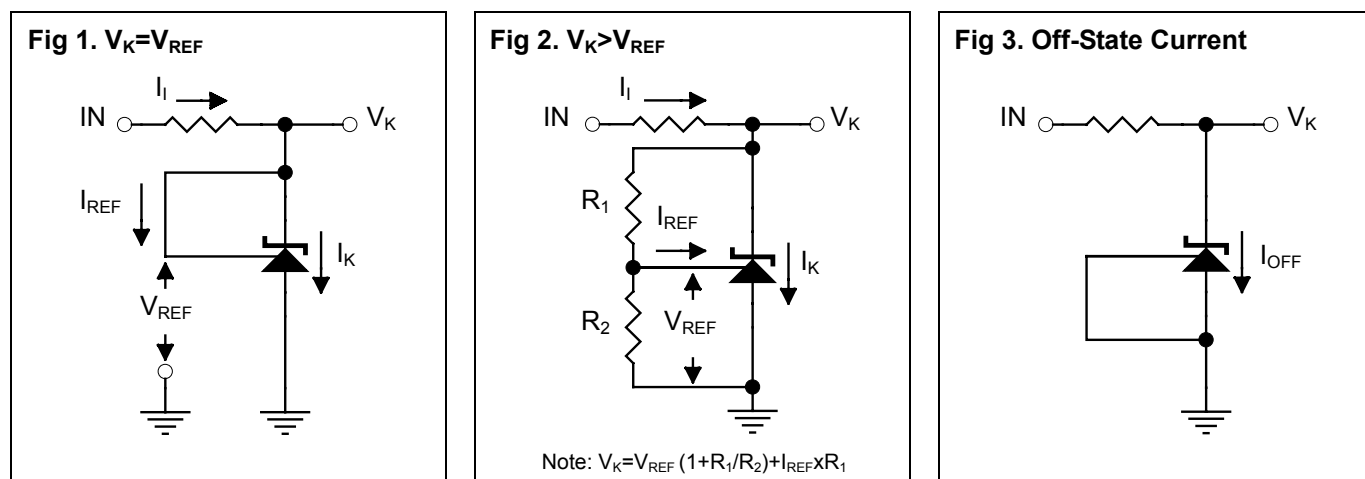


3-Lead Plastic **TO-92**
Package Code: A
Pin 1: Reference
Pin 2: Anode
Pin 3: Cathode

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}	$V_K = V_{REF}$, $I_K = 10\text{mA}$	2.49	2.50	2.51	V
			2.48	2.50	2.52	
Deviation of Reference Input Voltage Over-Temperature (Fig1)	$V_{REF(\text{dev})}$	$V_K = V_{REF}$, $I_K = 10\text{mA}$ $T_{\min} \leq T_A \leq T_{\max} (-40 \sim +125^\circ\text{C})$	-	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	μA
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	μA
Minimum Cathode Current for Regulation (Fig1)	$I_{K(\min)}$	$V_K = V_{REF}$	-	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	μA
Dynamic Output Impedance (Fig1)	Z_K	$V_K = V_{REF}$, $f \leq 1\text{kHz}$ $I_K = 1 \text{ to } 100\text{mA}$	-	0.15	0.5	Ω

Typical Performance Characteristics

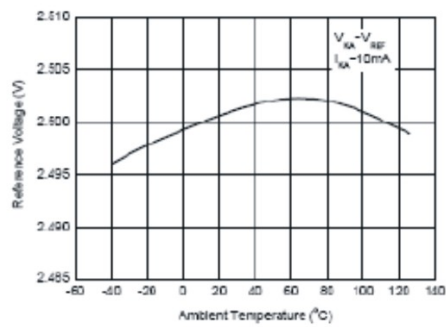


Figure5 Reference Voltage vs. Ambient Temperature

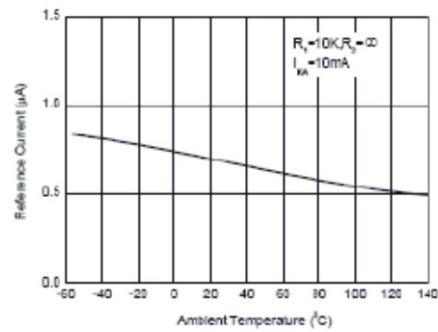


Figure6 Reference Current vs. Ambient Temperature

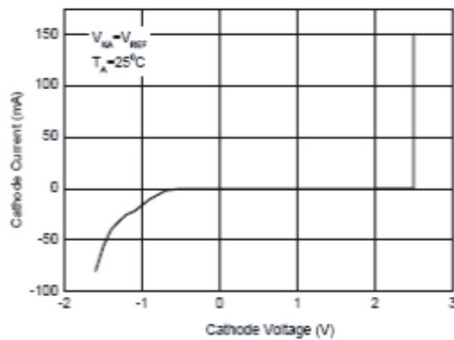


Figure7 Cathode Current vs. Cathode Voltage

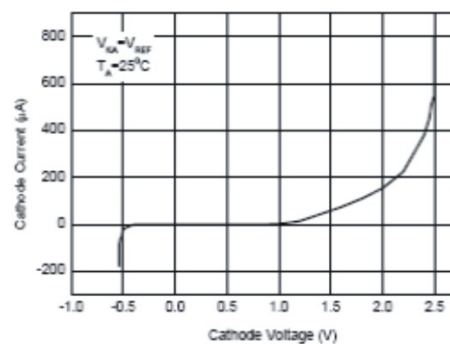


Figure8 Cathode Current vs. Cathode Voltage

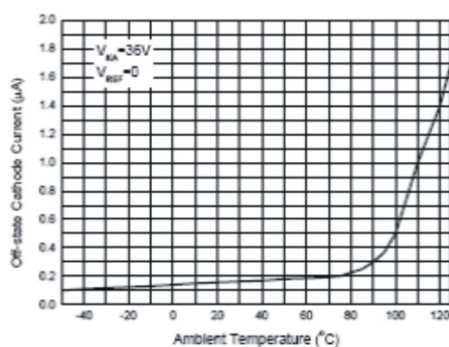


Figure9 Off-state Cathode Current vs. Ambient Temperature

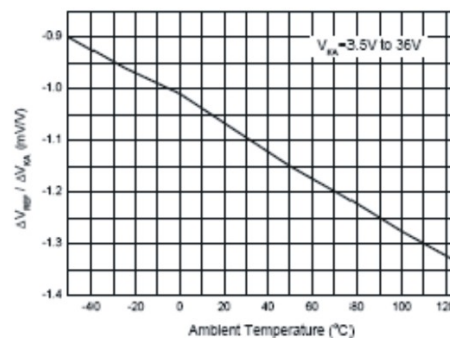


Figure10 Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

Typical Performance Characteristics (Continued)

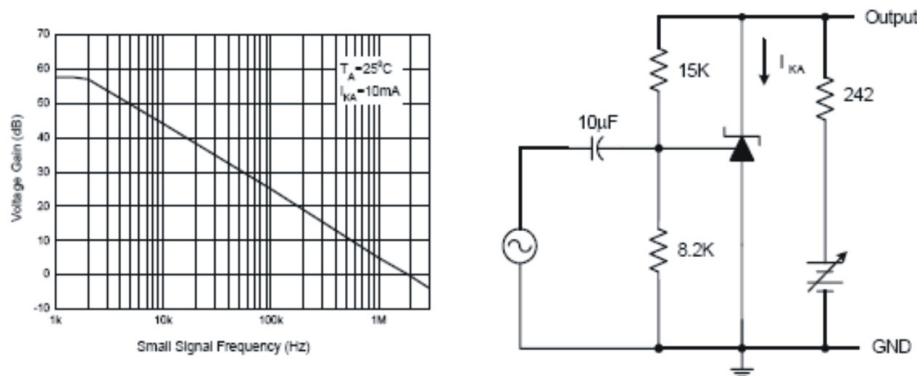


Figure11 Small Signal Voltage Gain vs. Frequency

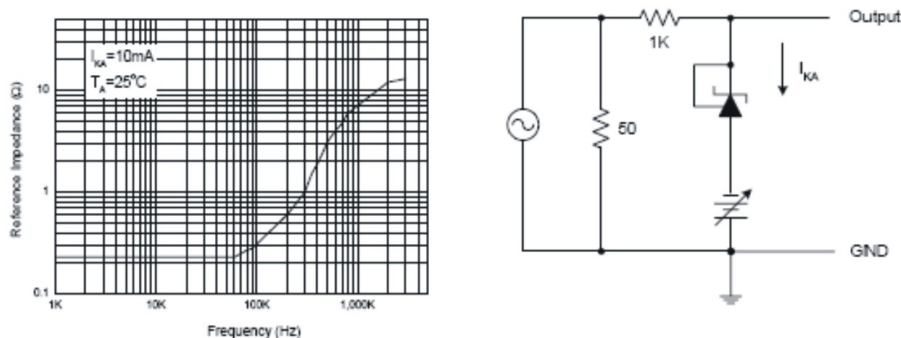


Figure12 Reference Impedance vs. Frequency

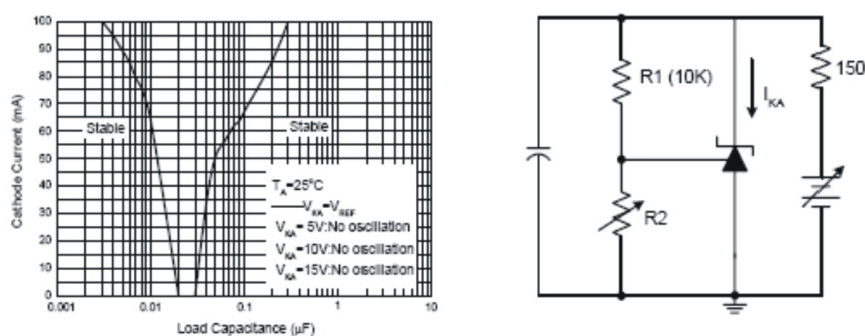


Figure13 Stability Boundary Conditions vs. Load Capacitance

Typical Performance Characteristics (Continued)

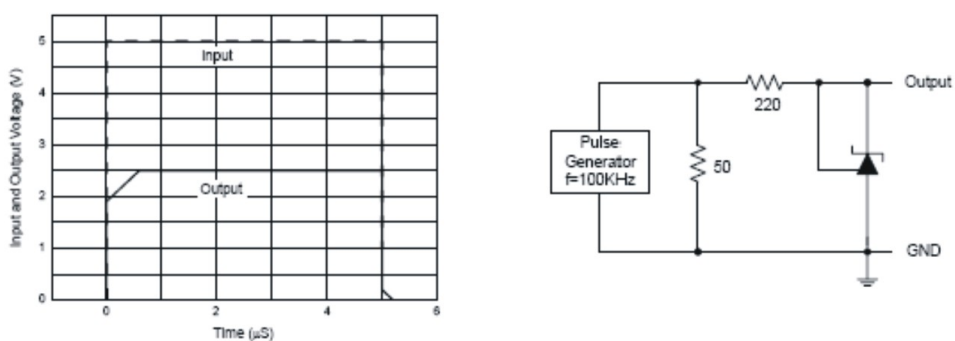
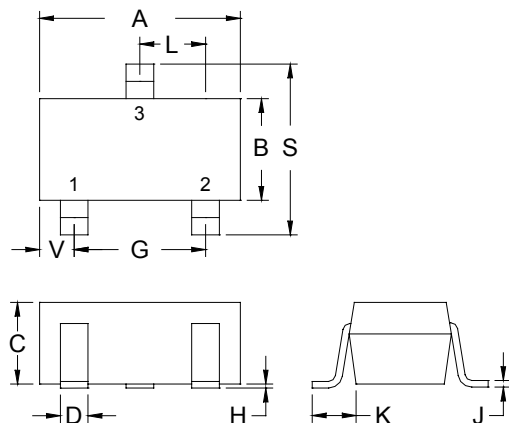


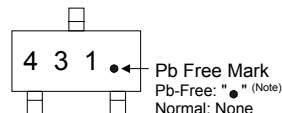
Figure14 Pulse Response of Input and Output Voltage

SOT-23 Dimension



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

Marking:



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

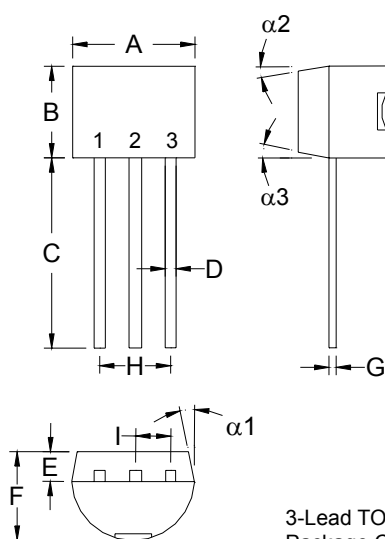
Material:

- 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

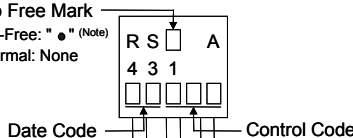
TO-92 Dimension



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

Marking:

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



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
$\alpha 1$	-	*5°
$\alpha 2$	-	*2°
$\alpha 3$	-	*2°

*: Typical, Unit: mm

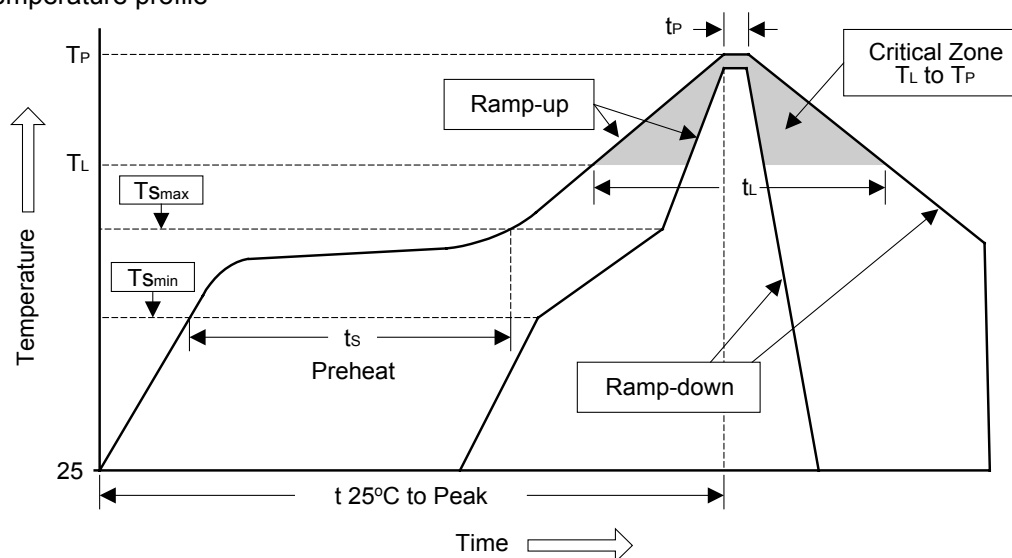
Ordering Information

Package	V _{REF} : 2.5±0.8%	V _{REF} : 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_L to T_P)	$<3^{\circ}\text{C}/\text{sec}$	$<3^{\circ}\text{C}/\text{sec}$
Preheat		
- Temperature Min (T_{smin})	100°C	150°C
- Temperature Max (T_{smax})	150°C	200°C
- Time (min to max) (t_s)	60~120 sec	60~180 sec
T_{smax} to T_L		
- Ramp-up Rate	$<3^{\circ}\text{C}/\text{sec}$	$<3^{\circ}\text{C}/\text{sec}$
Time maintained above:		
- Temperature (T_L)	183°C	217°C
- Time (t_L)	60~150 sec	60~150 sec
Peak Temperature (T_P)	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t_P)	10~30 sec	20~40 sec
Ramp-down Rate	$<6^{\circ}\text{C}/\text{sec}$	$<6^{\circ}\text{C}/\text{sec}$
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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