

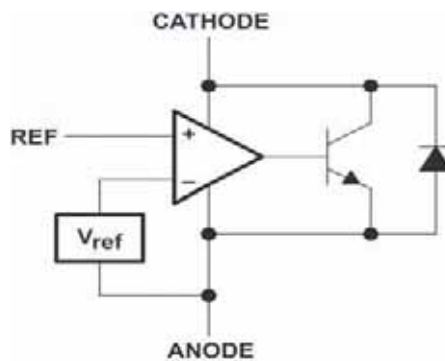
Description

The R431AS2 is a 3-terminal adjustable shunt regulator with guaranteed temperature stability over the entire temperature range of operation. The output voltage may be set at any level greater than 2.5V (VREF) up to 36V merely by selecting two external resistors that act as a voltage divided network. Due to the sharp turn-on characteristics this device is an excellent replacement for many zener diode applications.

Features

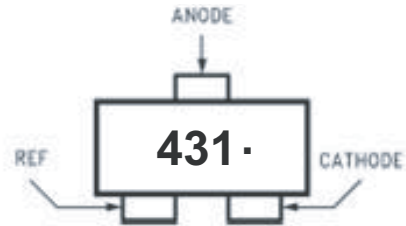
- Average temperature coefficient 50 ppm/°C
- Temperature compensated for operation over the full temperature range
- Programmable output voltage
- Fast turn-on response
- Low output noise

Representative Block Diagram

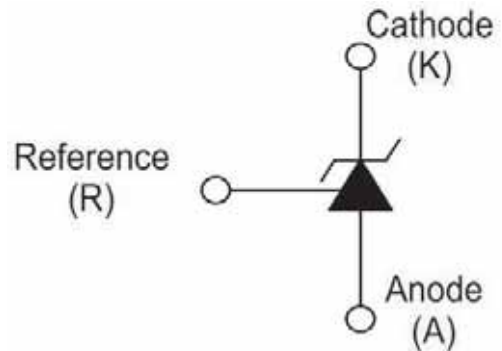


PACKAGE

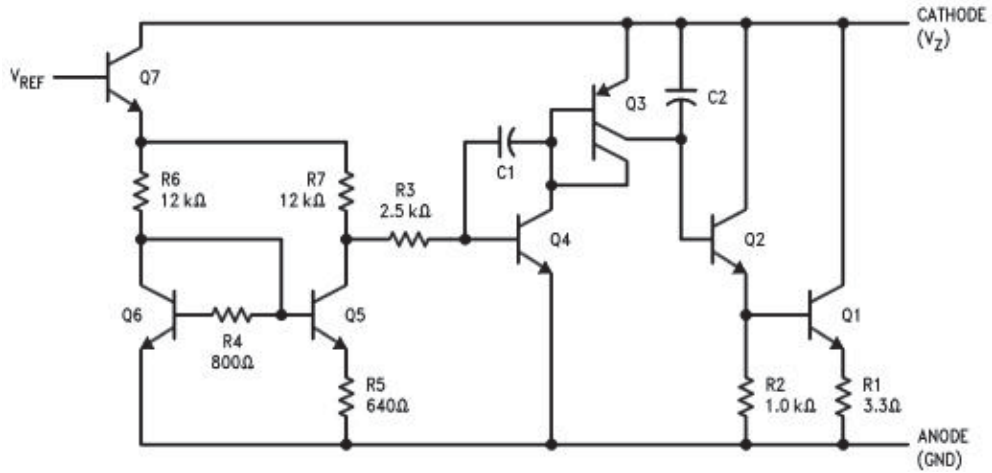
SOT-23:



Symbol



Representative Schematic Diagram



Absolute Maximum Ratings (Note 2)

Parameter		Value	Unit
Storage Temperature Range		-65~150	°C
Operating Temperature Range		-40~85	°C
Infrared or Convection (10 sec.)		235	°C
Cathode Voltage		37	V
Continuous Cathode Current		-100~150	mA
Reference Voltage		0.7	V
Reference Input Current		10	mA
Internal Power Dissipation (Notes 3, 4)	SOT-23 Package	0.28	W
	Cathode Voltage	36	V
Operating Conditions	Cathode Current	1~100	mA

Electrical Characteristics

$T_A = 25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{REF}	Reference Voltage	$V_Z = V_{REF}$, $I_I = 10\text{ mA}$ ($\pm 0.4\%$) (Figure 1)	2.483	2.495	2.508	V
V_{DEV}	Deviation of Reference Input Voltage Over Temperature (Note 5)	$V_Z = V_{REF}$, $I_I = 10\text{ mA}$, $T_A = \text{Full Range}$ (Figure 1)		8.0	17	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	$I_Z = 10\text{ mA}$, V_Z from V_{REF} to 10V Figure 2) V_Z from 10V to 36V		-1.4	-2.7	mV/V
I_{REF}	Reference Input Current	$R_1 = 10\text{ k}$, $R_2 = \infty$, $I_I = 10\text{ mA}$ (Figure 2)		2.0	4.0	
I_{REF}	Deviation of Reference Input Current over	$R_1 = 10\text{ k}$, $R_2 = \infty$, $I_I = 10\text{ mA}$,		0.4	1.2	μA

	Temperature	TA = Full Range				
IZ(MIN)	Minimum Cathode Current for Regulation	VZ = VREF		0.4	1.0	mA
IZ(OFF)	Off-State Current	VZ = 36V, VREF = 0V (Figure 3)		0.3	1.0	uA
rZ	Dynamic Output Impedance	VZ = VREF, TL431AA, Frequency = 0 Hz (Figure 1)			0.75	
		VZ = VREF, TL431AB, TL431AC Frequency = 0 Hz (Figure 1)			0.50	

Note 2: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device beyond its rated operating conditions.

Note 3: TJ Max = 150°C.

Note 4: Ratings apply to ambient temperature at 25°C. Above this temperature, derate the SOT-23 at 2.2 mW/°C.

Note 5: Deviation of reference input voltage, VDEV, is defined as the maximum variation of the reference input voltage over the full temperature range.

DC Test Circuits

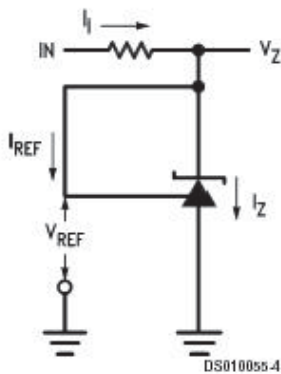
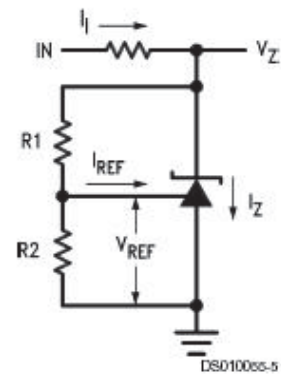


FIGURE 1. Test Circuit for $V_Z = V_{REF}$



Note: $V_Z = V_{REF} (1 + R1/R2) + I_{REF} \cdot R1$

FIGURE 2. Test Circuit for $V_Z > V_{REF}$

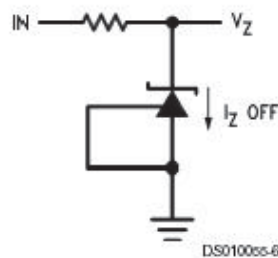
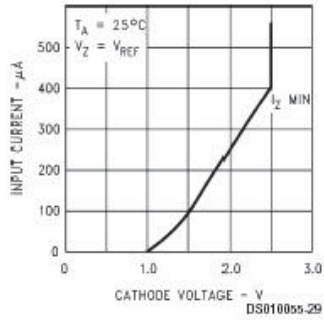


FIGURE 3. Test Circuit for Off-State Current

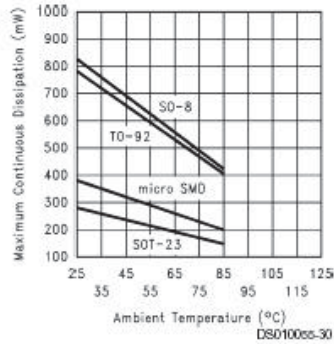
RATING AND CHARACTERISTICS CURVES (R431AS2)

Typical Performance Characteristics

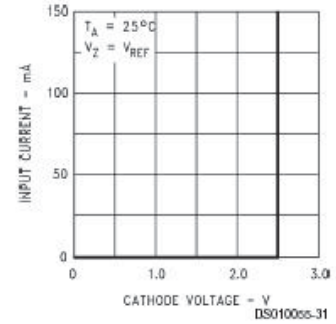
Input Current vs V_Z



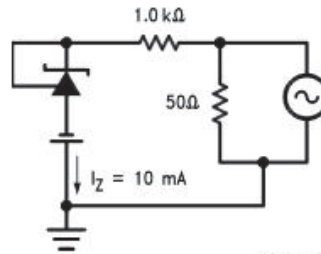
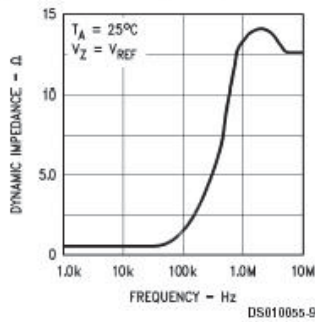
Thermal Information



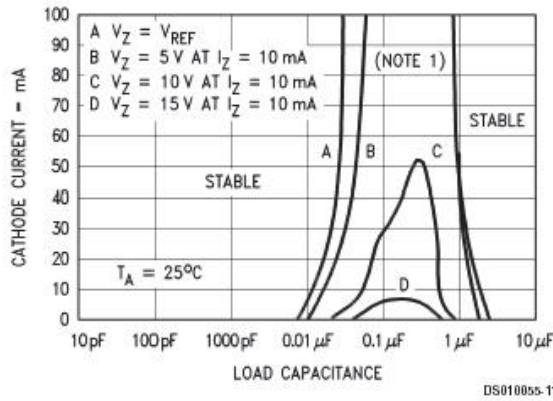
Input Current vs V_Z



Dynamic Impedance vs Frequency

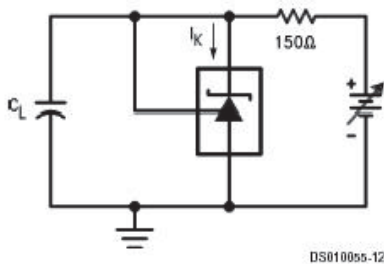


Stability Boundary Conditions

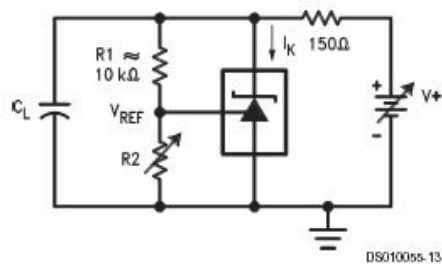


Note: The areas under the curves represent conditions that may cause the device to oscillate. For curves B, C, and D, R_2 and V^+ were adjusted to establish the initial V_Z and I_Z conditions with $C_L = 0$. V^+ and C_L were then adjusted to determine the ranges of stability.

Test Circuit for Curve A Above

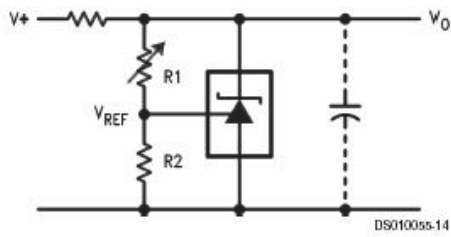


Test Circuit for Curves B, C and D Above



Typical Applications

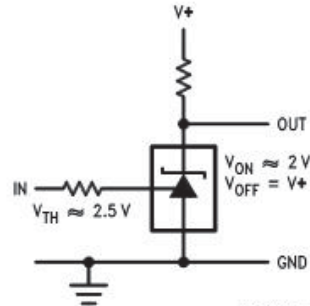
Shunt Regulator



DS010055-14

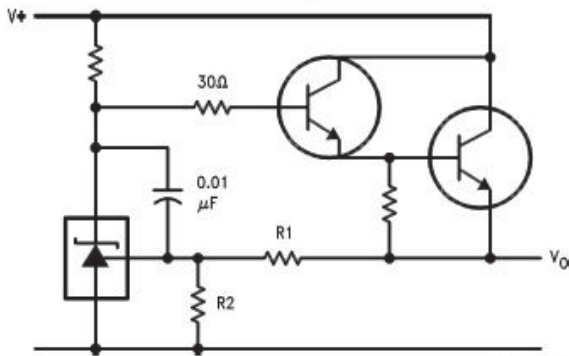
$$V_O \approx \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

Single Supply Comparator with Temperature Compensated Threshold



DS010055-15

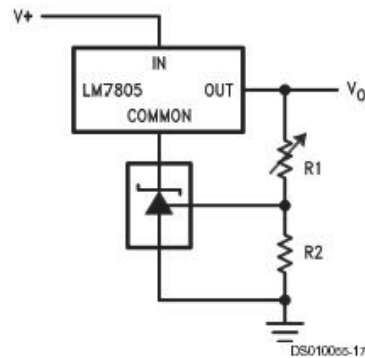
Series Regulator



DS010055-16

$$V_O \approx \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

Output Control of a Three Terminal Fixed Regulator

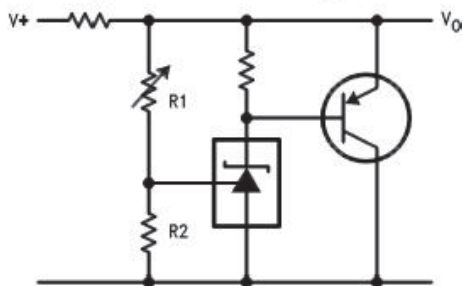


DS010055-17

$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

$$V_{O \text{ MIN}} = V_{REF} + 5V$$

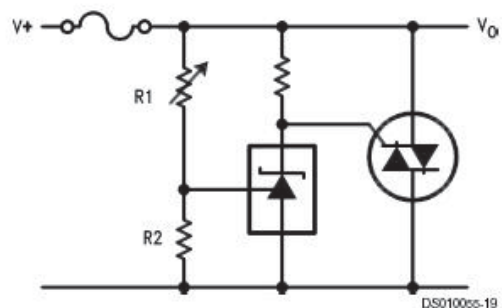
Higher Current Shunt Regulator



DS010055-18

$$V_O \approx \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

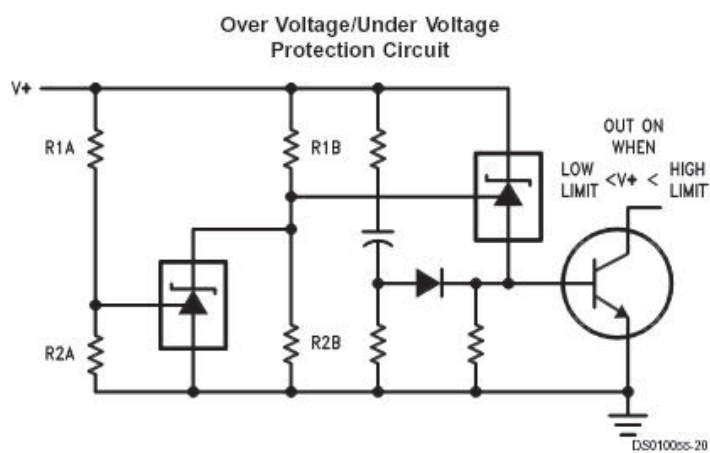
Crow Bar



DS010055-19

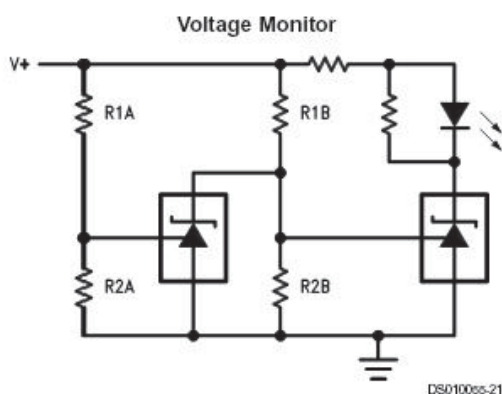
$$V_{LIMIT} \approx \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

Typical Applications (Continued)



$$\text{LOW LIMIT} \approx V_{\text{REF}} \left(1 + \frac{R1B}{R2B} \right) + V_{\text{BE}}$$

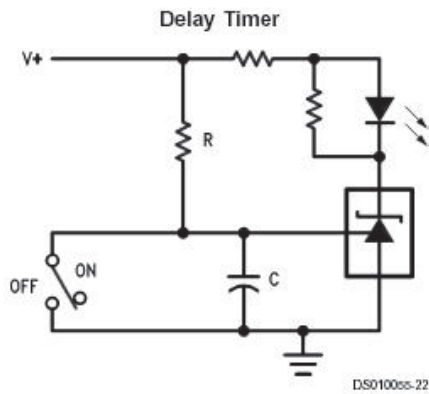
$$\text{HIGH LIMIT} \approx V_{\text{REF}} \left(1 + \frac{R1A}{R2A} \right)$$



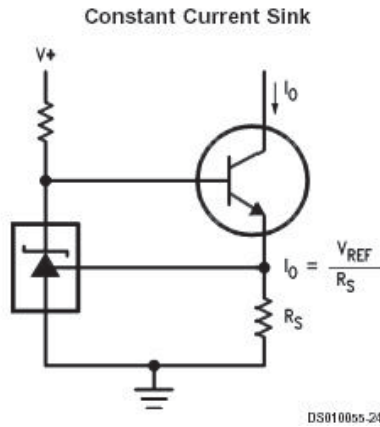
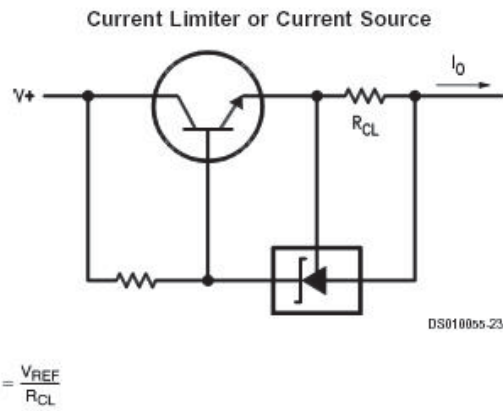
$$\text{LOW LIMIT} \approx V_{\text{REF}} \left(1 + \frac{R1B}{R2B} \right) \quad \text{LED ON WHEN LOW LIMIT} < V^+ < \text{HIGH LIMIT}$$

$$\text{HIGH LIMIT} \approx V_{\text{REF}} \left(1 + \frac{R1A}{R2A} \right)$$

Typical Applications (Continued)



$$\text{DELAY} = R \cdot C \cdot \ln \frac{V^+}{(V^+) - V_{REF}}$$



Package	Tube (pcs/tube)	Tube (pcs/inner box)	Tube (pcs/cartoon)	Tape&Reel (pcs/reel)	Tape&Reel (pcs/inner box)	Tape&Reel (pcs/cartoon)
DFN5x6/DFN3x3	100	10,000	100,000	2,500	5,000	40,000
DFN1006	—	—	—	10,000	10,000	400,000
SOP-8	100	10,000	100,000	4,000	4,000	20,000
TSSOP-8	100	32,000	128,000	3,000	6,000	48,000
SOT-23-3L	—	—	—	3,000	30,000	120,000
SOT-23-6L	—	—	—	3,000	30,000	120,000
SOT-23(6R)	—	—	—	3,000	30,000	120,000
SOT-363	—	—	—	3,000	30,000	120,000
SOT-523	—	—	—	3,000	30,000	120,000
SOT223	—	—	—	2,500	2,500	20,000
TO-220	50	1,000	5,000	—	—	—
TO-220F	50	1,000	10,000	—	—	—
TO-247	30	300	1,200	—	—	—
TO-251	80	4,000	40,000	—	—	—
TO-251S(4R)	80	4,000	40,000	—	—	—
TO-252-2L(4R)	80	4,000	40,000	2,500	2,500	25,000
TO-263-2L	50	1,000	10,000	800	800	8,000
TO-3P	30	300	3,000	—	—	—
TO-92	—	—	—	1,000(袋装)	10,000	100,000

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