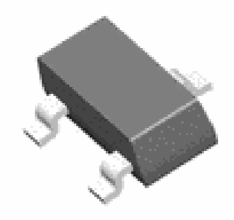
PROGRAMMABLE PRECISION SHUNT REGULATOR LM431/A/C

FEATURES

- Programmable Output Voltage to 40V
- Guaranteed 0.5% Reference Voltage Tolerance
- Low (0.2Ω Typ.) Dynamic Output Impedance
- Cathode Current Range(Continuous) – 100 ~ 150 mA
- Equivalent Full Range Temperature Coefficient of 50PPM/℃
- Temperature Compensated For Operation Over Full Rate Operating Temperature Range
- Low Output Noise Voltage
- Fast Turn-on Response
- SOT-23 3L Package

SOT-23 PKG



APPLICATION

- Shunt Regulator
- Precision High-Current Series Regulator
- High-Current Shunt Regulator
- Crowbar Circuit
- PWM Converter With Reference
- Voltage Monitor
- Precision Current Limiter

ORDERING INFORMATION

DEVICE	PACKAGE
LM431SF	SOT-23 3L

* Refer to the page 2 for detailed ordering Information,

DESCRIPSION

The LM431 is a three-terminal adjustable shunt regulator with specified thermal stability over applicable temperature V_{REF} (Approx. 2.5V) and 40V with two external resistors. This device has a typical dynamic output impedance of 0.2Ω. Active output circuitry provides a very sharp turn-on characteristic, making this device excellent replacement for zener diodes in many applications. The LM431 is characterized for operation from -40℃ to +125℃.

ABSOLUTE MAXIMUM RATINGS

(Operating temperature range applies unless otherwise specified)

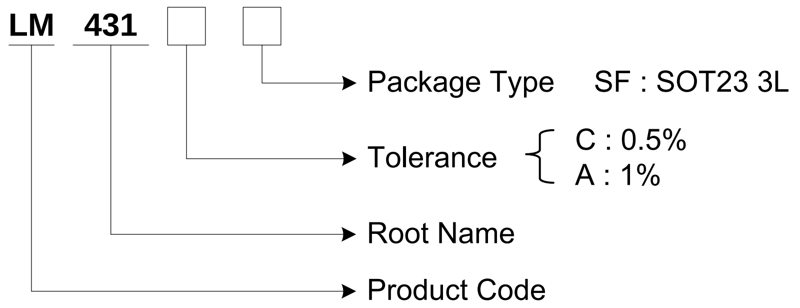
CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Cathode Voltage	V_{KA}	-	42	V
Cathode Current Range(Continuous)	I_K	-100	150	mA
Reference Input Current Range	I_{REF}	-0.05	10	mA
Junction Temperature Range	T_J	-40	150	℃
Operating Temperature Range	T_{OPR}	-40	125	℃
Storage Temperature Range	T_{STG}	-60	150	℃

RECOMMENDED OPERATING CONDITIONS

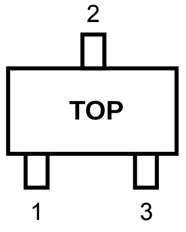
CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Cathode Voltage	V_{KA}	V_{REF}	40	V
Cathode Current	I_K	0.5	100	mA

ORDERING INFORMATION

Package	Tolerance	Order No.	Package Marking	Supplied As	Status
SOT-23	0.5%	LM431CSF	431O	Reel	Active
	1 %	LM431ASF	431O	Reel	Active



PIN CONFIGURATION



SOT-23 PKG

PIN DESCRIPTION

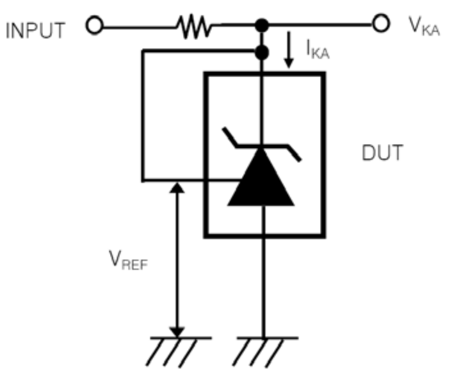
Pin No.	SOT-23	
	Name	Function
1	Cathode	Input Supply Voltage
2	Anode	Ground
3	Reference	Reference Voltage

LM431 ELECTRICAL CHARACTERISTICS

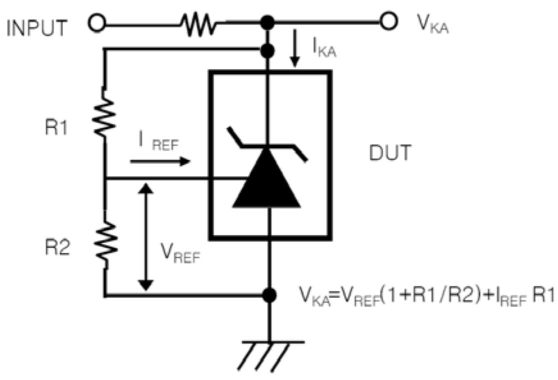
(T_A=25℃, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Reference Voltage	V_{REF}	V_{KA}=V_{REF}, I_K=10mA	0.5 %	2.487	2.500	2.512	V
			1 %	2.475	2.500	2.525	
Deviation of Reference Voltage	$\Delta V_{REF}/\Delta T$	V_{KA} = V_{REF}, I_K=10mA T_A =Full Range			8	20	mV
Ratio of Change in Reference Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	I_K=10mA	ΔV_{KA}=10V -V_{REF}		-1.4	-2.7	mV/V
			ΔV_{KA}=36V-10V		-1.0	-2.0	
Reference Current	I_{REF}	I_{KA}=10mA, R_1=10kΩ, R_2=∞			1.8	4.0	uA
Deviation of Reference Current	$\Delta I_{REF}/\Delta T$	I_K=10mA, R_1=10kΩ, R_2=∞ T_A =Full Range			0.4	1.2	uA
Minimum Cathode Current for Regulation	$I_{K(MIN)}$	V_{KA}= V_{REF}				0.5	mA
Off-State Cathode Current	$I_{K(OFF)}$	V_{KA}=36V, V_{REF}=0			0.17	0.90	uA
Dynamic Impedance	Z_{KA}	V_{KA}= V_{REF}, I_K=1mA~100mA f ≤ 1kHz			0.27	0.50	Ω

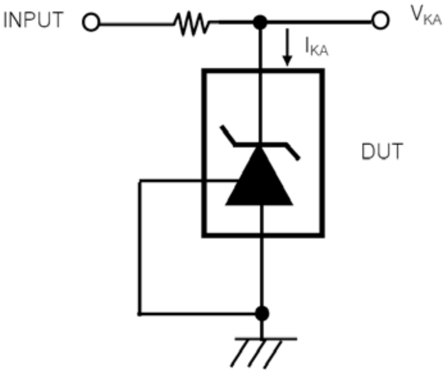
TEST CIRCUITS



[Fig 1. Test circuit for V_{KA} = V_{REF}]



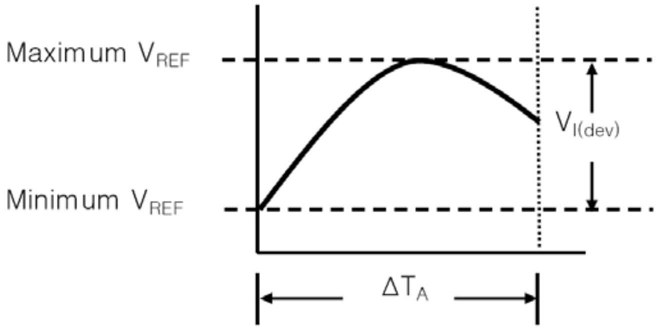
[Fig 2. Test circuit for V_{KA} ≥ V_{REF}]



[Fig 3. Test circuit for $I_{KA(OFF)}$]

The deviation parameters $\Delta V_{REF}/\Delta T$ and $\Delta I_{REF}/\Delta T$ are defined as the differences between the maximum and minimum values obtained over the recommended temperature range. The average full-range temperature coefficient of the reference voltage, αV_{REF}, is defined as :

$$\left| \alpha V_{REF} \right| \left(\frac{ppm}{℃} \right) = \frac{\left(\frac{V_{I(dev)}}{V_{REF} \text{ at } 25℃} \right) \times 10^{6}}{\Delta T_A}$$



Where :
ΔT_A is the recommended operating free-air temperature range of the device.

αV_{REF} can be positive or negative, depending on whether minimum V_{REF} or maximum V_{REF}, respectively, occurs at the lower temperature.

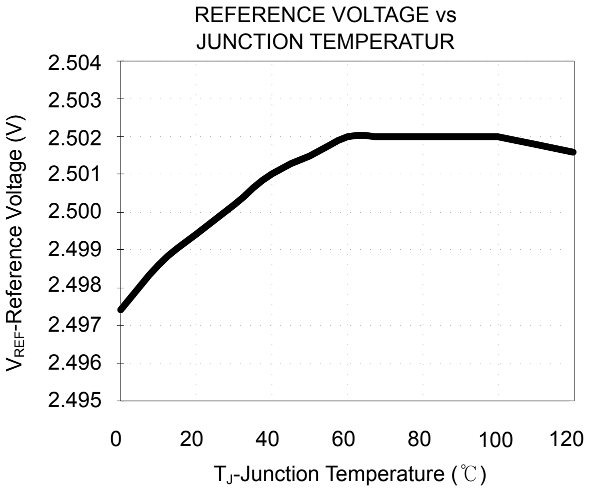
Calculating Dynamic Impedance

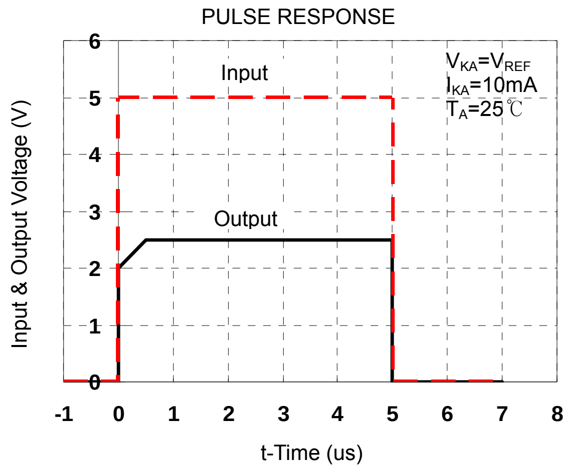
The dynamic impedance is defined as : $\left| Z_{KA} \right| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$

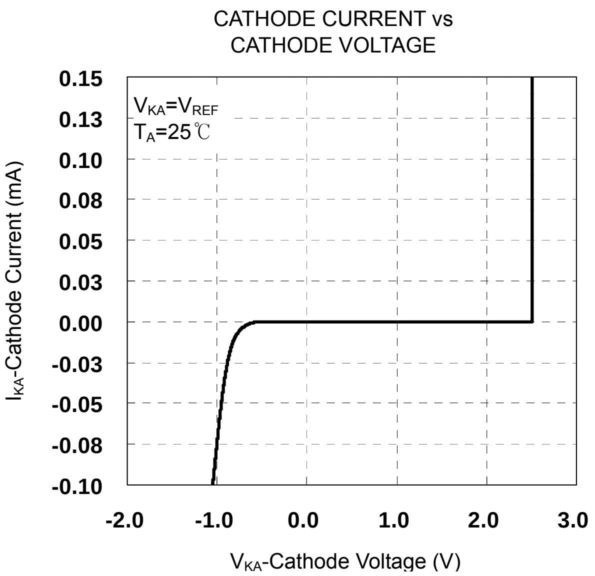
When the device is operating with two external resistors, the total dynamic impedance of the circuit is given by :

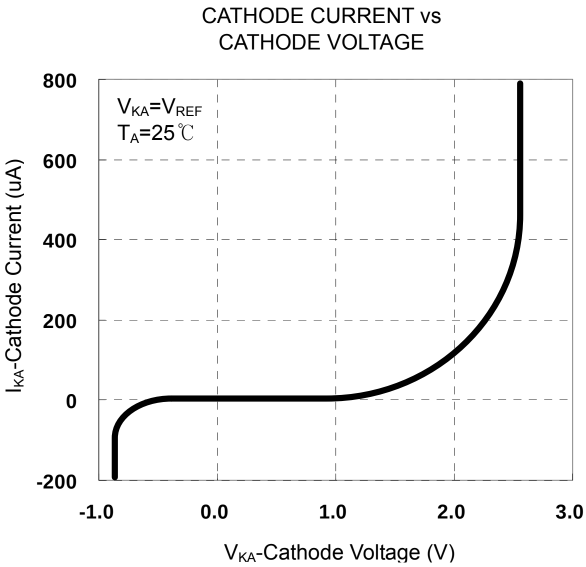
$$\left| Z' \right| = \frac{\Delta V}{\Delta I} \approx \left| Z_{KA} \right| \left(1 + \frac{R1}{R2} \right)$$

TYPICAL OPERATING CHARACTERISTICS





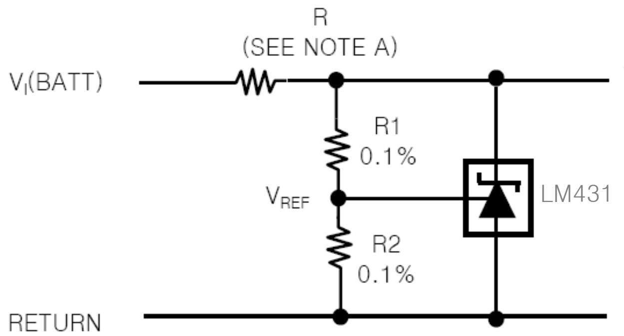




T.B.D

APPICATION INFORMATION

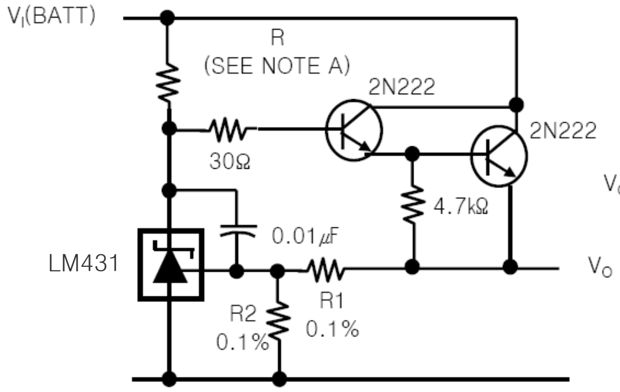
1. Shunt Regulator



$$V_O = \left(1+\frac{R1}{R2}\right) V_{REF}$$

Note A : R Should provide cathode current 1mA to the LM431 at minimum $V_{I(BATT)}$

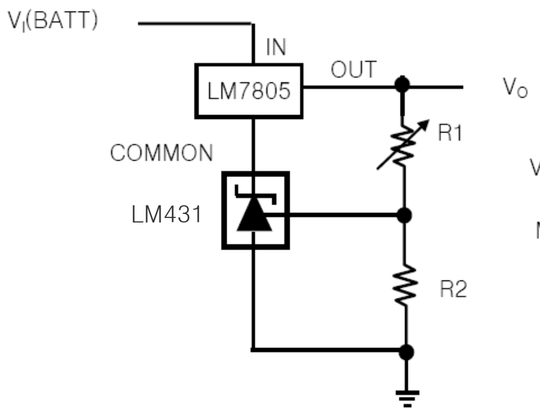
2. Precision High-Current Series Regulator



$$V_O = \left(1+\frac{R1}{R2}\right) V_{REF}$$

Note A : R Should provide cathode current≥1mA to the LM431 at minimum $V_{I(BATT)}$

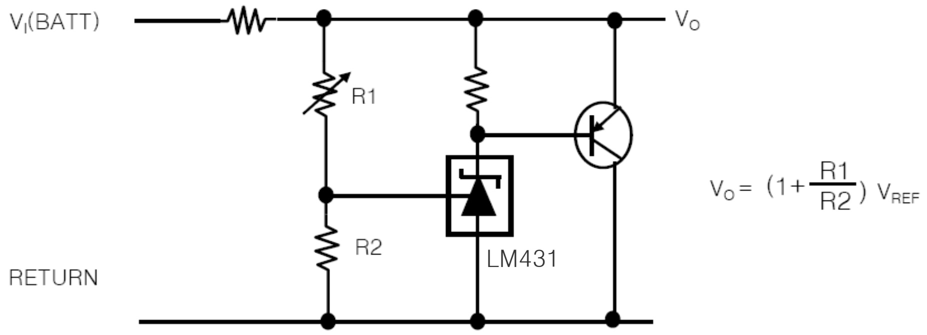
3. Output Control of a Three-Terminal Fixed Regulator



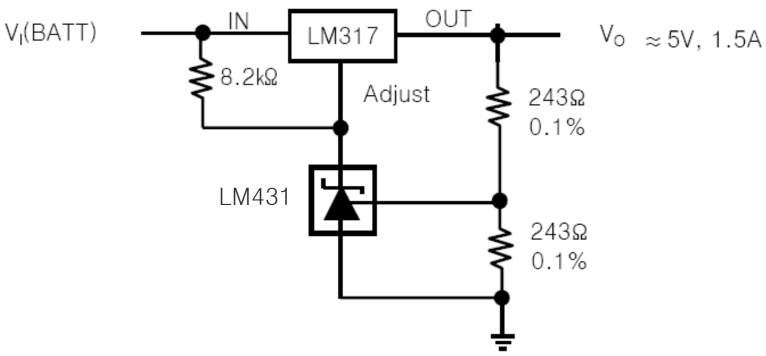
$$V_O = \left(1+\frac{R1}{R2}\right) V_{REF}$$

MINIMUM $V_O = V_{REF} + 5V$

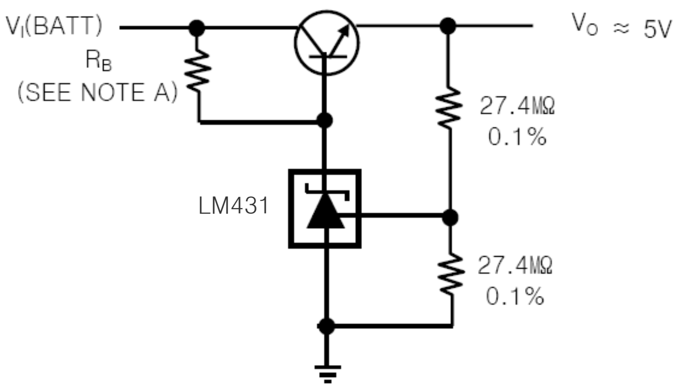
4. High-Current Shunt Regulator



5. Precision 5V 1.5A Regulator

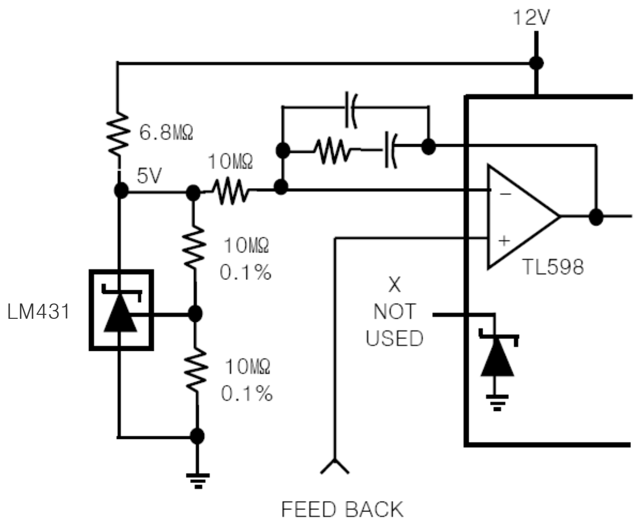


6. Efficient 5-V Precision Regulator

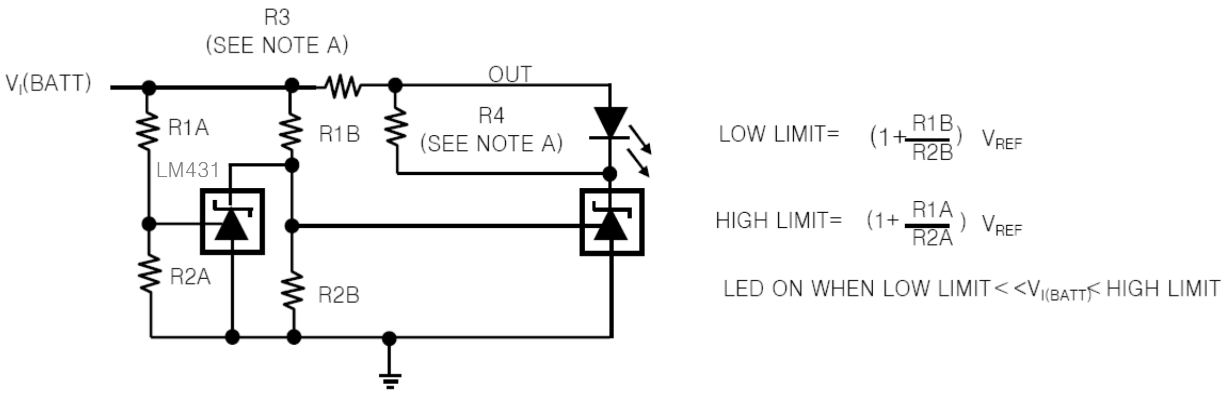


NOTE A : R_B Should provide cathode current≥1mA to the LM431.

7. PWM Converter With Reference

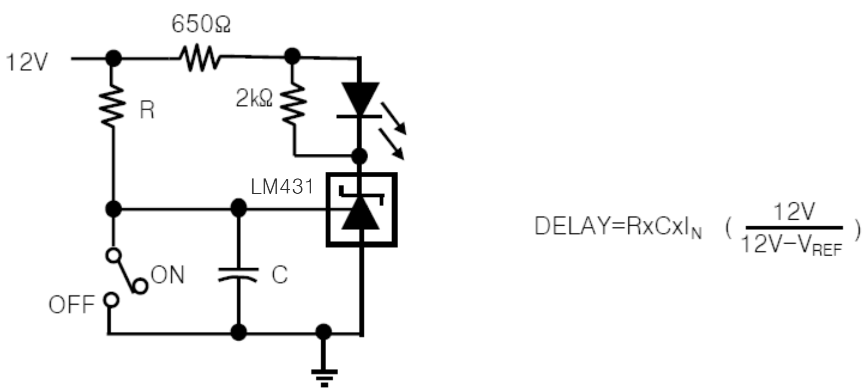


8. Voltage Monitor

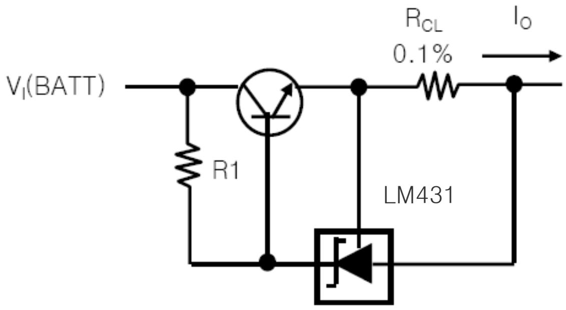


NOTE A : R3 and R4 are selected to provide the desired LED intensity and cathode current ≥1mA to the LM431 at the available $V_{I(BATT)}$.

9. Delay Timer



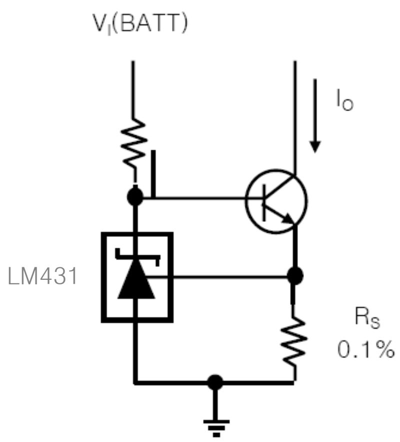
10. Precision Current Limiter



$$I_{OUT} = \frac{V_{REF}}{R_{CL}} + I_{KA}$$

$$R1 = \frac{V_{I(BATT)}}{\frac{I_O}{H_{FE}}} + I_{KA}$$

11. Precision Constant-Current Sink



$$I_O = \frac{V_{REF}}{R_S}$$