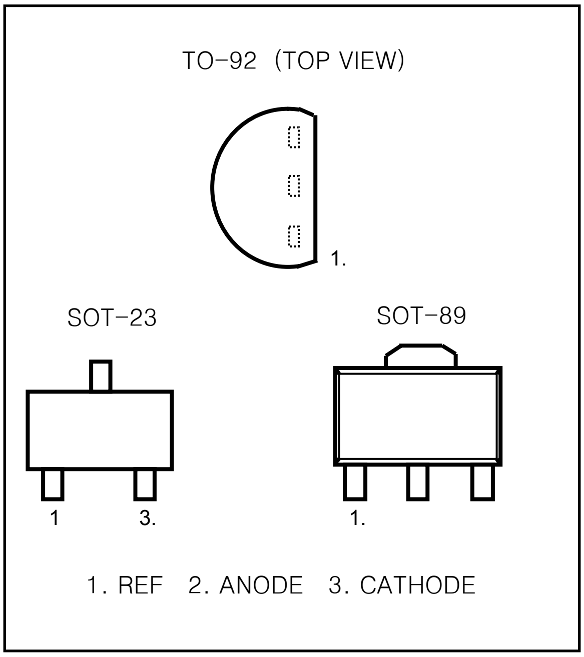
深圳市丽晶微电子科技有限公司



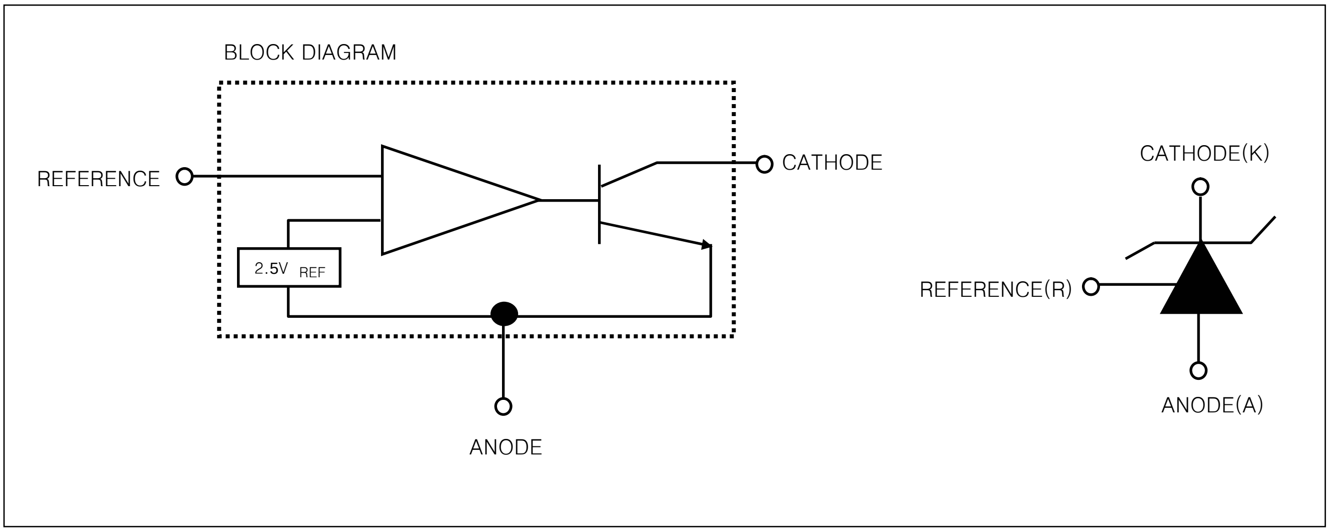
PROGRAMMABLE PRECISION REFERENCES

The TL431 is three-terminal adjustable shunt regulator with specified termal stability.
The output voltage may be set to any value between V_{REF} (Approx. 2.5V) and 36V with two external resistors. This device has a typical output inpedance of 0.2Ω. Active output circuitry provides a very sharp turn-on characteristic, making this device excellent replacement for zener diodes in many application.

FEATURES

- Equivalent Full Range Temperature Coefficient 50PPM/℃
- Temperature Compensated For Operation Over Full Rate Operating Temperature Range
- Adjustable Output Voltage
- Fast Turn-on Response
- Sink Current Capability 1㎃ to 100㎃
- Low (0.2Ω Typ.) Dynamic Output Impedance
- Low Output Noise

FUNCTION BLOCK DIAGRAM



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ABSOLUTE MAXIMUM RATINGS

(Full Operating Ambient Temperature Range Applies Unless Otherwise Noted)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Cathode Voltage	V_{KA}	37	V
Continuous Cathode Current Range	I_{KA}	−100~+150	㎃
Reference Input Current Range	I_{REF}	0.05~10	㎃
Junction Temperature	T_J	150	℃
Operating Temperature	T_{OPR}	−20 ~ 85	℃
Storage Temperature	T_{STG}	−65 ~ 150	℃
Total Power Dissipation	P_D	700	㎽

TL431A-0.3% ELECTRICAL CHARACTERISTIC

(T_A=25℃, unless otherwise specified)

CHARACTERISTIC	SYMBOL	CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Reference Input Voltage	V_{REF}	1	$V_{KA}=V_{REF}$, I_K=10㎃		2.487V	2.495V	2.502V	
Deviation of Reference Input Voltage Over Full Temperature Range	$\Delta V_{REF}/\Delta T$	1	$V_{KA}=V_{REF}$, I_K=10㎃ T_A=Full Range			3	17	㎷
Ratio of Change in Reference Input Voltage to the Change in Cathod Voltage	$\Delta V_{REF}/\Delta V_{KA}$	2	I_K=10㎃	$\Delta V_{KA}=10V-V_{REF}$		−1.4	−2.7	㎷/V
				ΔV_{KA}=36V−10V		−1	−2	
Reference Input Current	I_{REF}	2	I_{KA}=10㎃, R1=10㏀, R2=∞			1.8	4	㎂
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	2	I_K=10㎃, R1=10㏀, R2=∞ T_A=Full Range			0.4	1.2	㎂
Minimum Cathode Current for Regulation	$I_{KA}MIN$	1	$\Delta V_{KA}=V_{REF}$			0.5	1	㎃
Off-State Cathode Current	$I_{KA}OFF$	3	V_{KA}=36V, V_{REF}=0			0.2	1	㎂
Dynamic Impedance	Z_{KA}	1	$V_{KA}=V_{REF}$, I_K=1㎃~100㎃, f≤1㎑			0.2	0.5	Ω

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TL431A-0.5%ELECTRICAL CHARACTERISTIC

(T_A=25℃, unless otherwise specified)

CHARACTERISTIC	SYMBOL	CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Reference Input Voltage	V_{REF}	1	$V_{KA}=V_{REF}$, I_K=10㎃		2.482V	2.495V	2.507V	
Deviation of Reference Input Voltage Over Full Temperature Range	$\Delta V_{REF}/\Delta T$	1	$V_{KA}=V_{REF}$, I_K=10㎃ T_A=Full Range			3	17	㎷
Ratio of Change in Reference Input Voltage to the Change in Cathod Voltage	$\Delta V_{REF}/\Delta V_{KA}$	2	I_K=10㎃	ΔV_{KA}=10V−V_{REF}		−1.4	−2.7	㎷/V
				ΔV_{KA}=36V−10V		−1	−2	
Reference Input Current	I_{REF}	2	I_{KA}=10㎃, R1=10㏀, R2=∞			1.8	4	㎂
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	2	I_K=10㎃, R1=10㏀, R2=∞ T_A=Full Range			0.4	1.2	㎂
Minimum Cathode Current for Regulation	I_{KA}MIN	1	$\Delta V_{KA}=V_{REF}$			0.5	1	㎃
Off-State Cathode Current	I_{KA}OFF	3	V_{KA}=36V, V_{REF}=0			0.2	1	㎂
Dynamic Impedance	Z_{KA}	1	$V_{KA}=V_{REF,}$ I_K=1㎃~100㎃, f≤1㎑			0.2	0.5	Ω

TL431A-1%ELECTRICAL CHARACTERISTIC

(T_A=25℃, unless otherwise specified)

CHARACTERISTIC	SYMBOL	CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Reference Input Voltage	V_{REF}	1	$V_{KA}=V_{REF}$, I_K=10㎃		2.47V	2.495V	2.52V	
Deviation of Reference Input Voltage Over Full Temperature Range	$\Delta V_{REF}/\Delta T$	1	$V_{KA}=V_{REF}$, I_K=10㎃ T_A=Full Range			3	17	㎷
Ratio of Change in Reference Input Voltage to the Change in Cathod Voltage	$\Delta V_{REF}/\Delta V_{KA}$	2	I_K=10㎃	ΔV_{KA}=10V−V_{REF}		−1.4	−2.7	㎷/V
				ΔV_{KA}=36V−10V		−1	−2	
Reference Input Current	I_{REF}	2	I_{KA}=10㎃, R1=10㏀, R2=∞			1.8	4	㎂
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	2	I_K=10㎃, R1=10㏀, R2=∞ T_A=Full Range			0.4	1.2	㎂
Minimum Cathode Current for Regulation	I_{KA}MIN	1	$\Delta V_{KA}=V_{REF}$			0.5	1	㎃
Off-State Cathode Current	I_{KA}OFF	3	V_{KA}=36V, V_{REF}=0			0.2	1	㎂
Dynamic Impedance	Z_{KA}	1	$V_{KA}=V_{REF,}$ I_K=1㎃~100㎃, f≤1㎑			0.2	0.5	Ω

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Fig. 1 Test Circuit for $V_{KA}=V_{REF}$

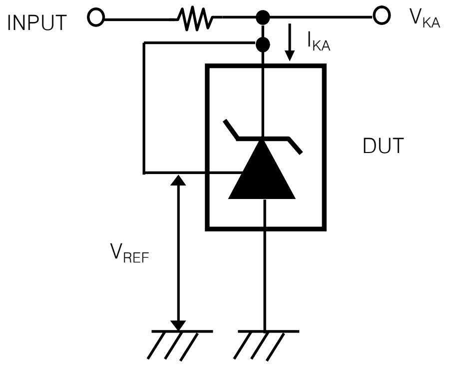


Fig. 2 Test Circuit for $V_{KA} \geq V_{REF}$

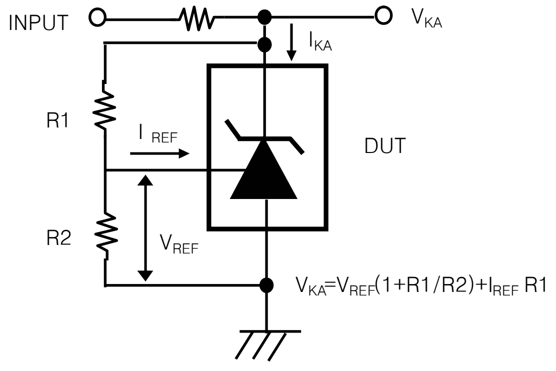
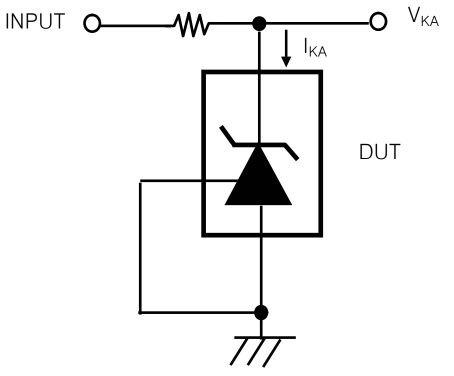


Fig. 3 Test Circuit for I_{KA} (off)



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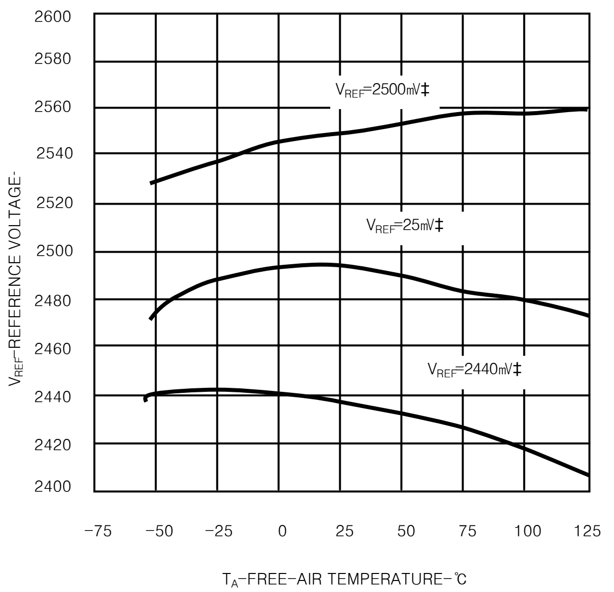
TYPICAL PERFORMANCE CHARACTERISTICS

REFERENCE VOLTAGE vs
FREE-AIR TEMPERATURE†

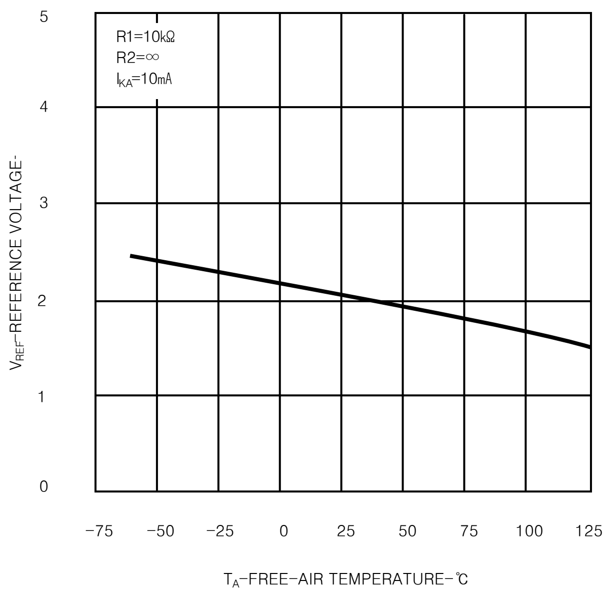


† Data is applicable only within the recommended operating free–air temperature ranges of the various devices.

‡ Data is for devices having the indicated value of V_{REF} at I_{KA}=10㎷, T_A=25℃

Figure 4.

REFERENCE CURRENT vs
FREE-AIR TEMPERATURE †



† Data is applicable only within the recommended operating free–air temperature ranges of the various devices.

Figure 5.

CATHODE CURRENT vs
CATHODE VOLTAGE

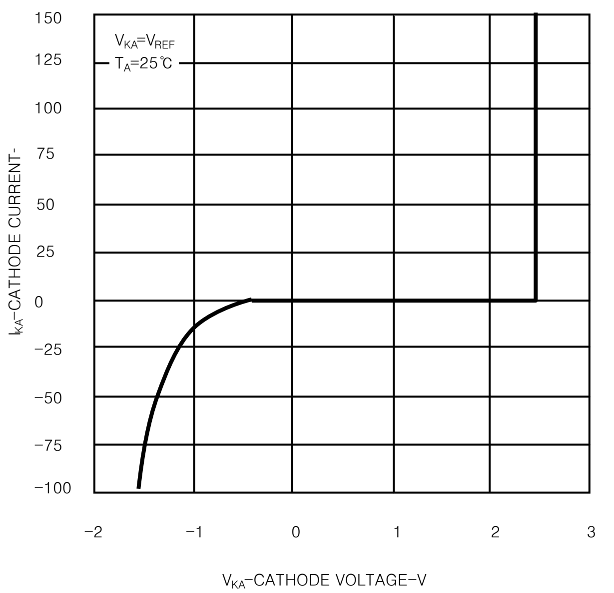


Figure 6.

CATHODE CURRENT vs
CATHODE VOLTAGE

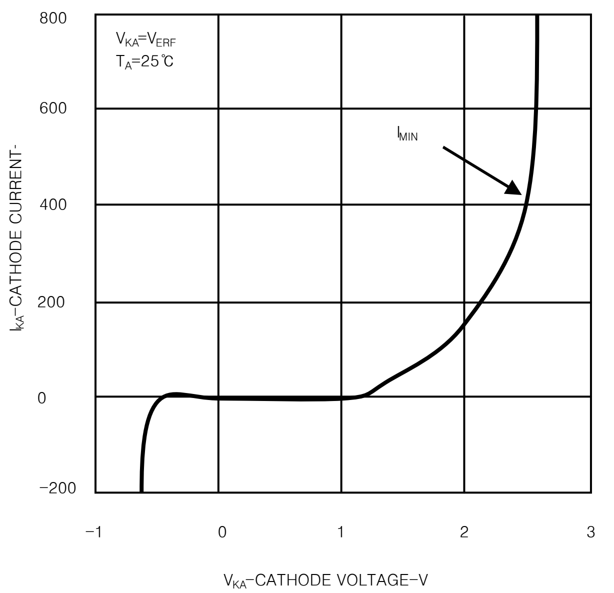


Figure 7.

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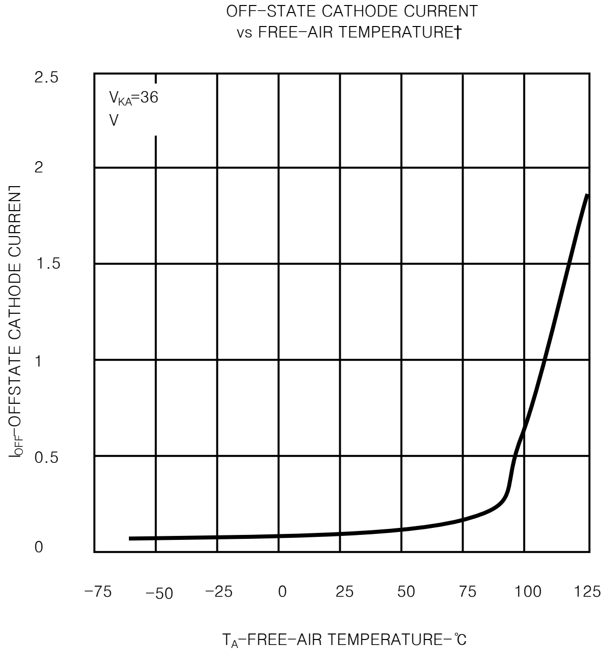
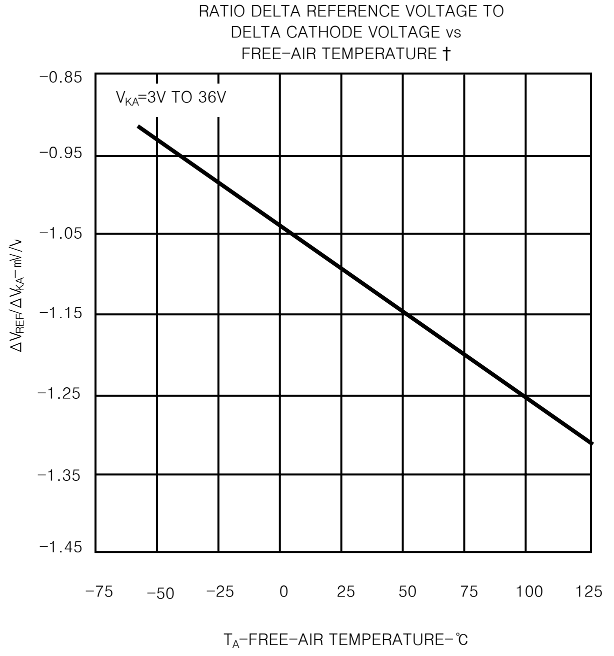
TYPICAL PERFORMANCE CHARACTERISTICS



† Data is applicable only within the recommended operating free-air temperature ranges of the various devices.

Figure 8.



† Data is applicable only within the recommended operating free-air temperature ranges of the various devices.

Figure 9.

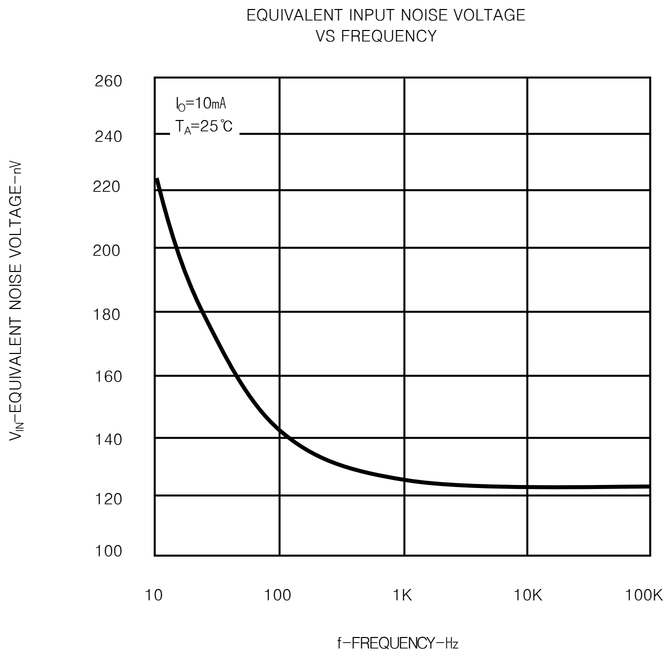


Figure 10.

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TYPICAL PERFORMANCE CHARACTERISTICS

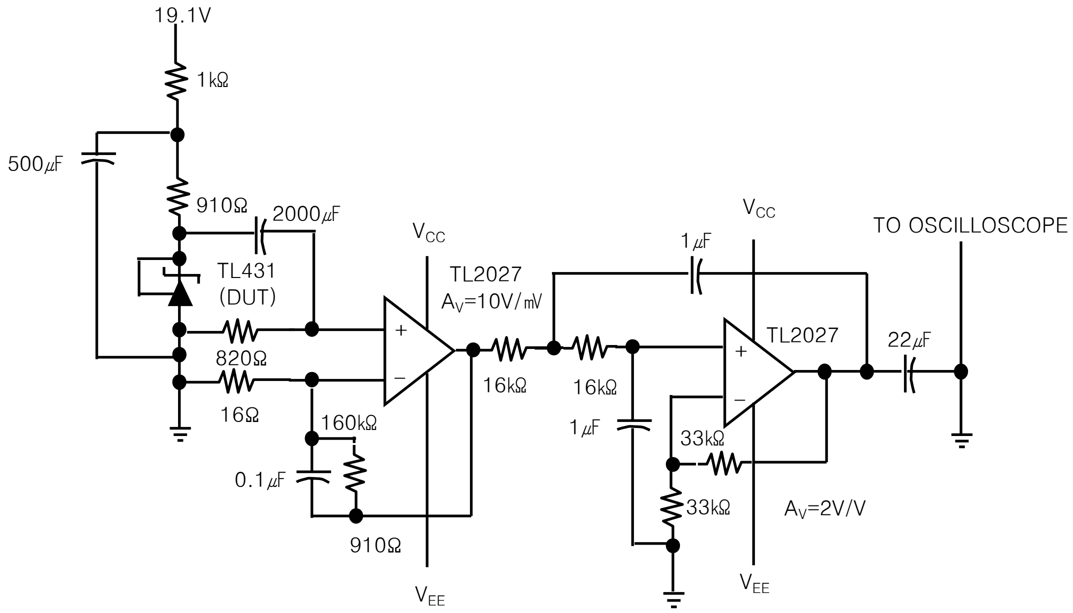
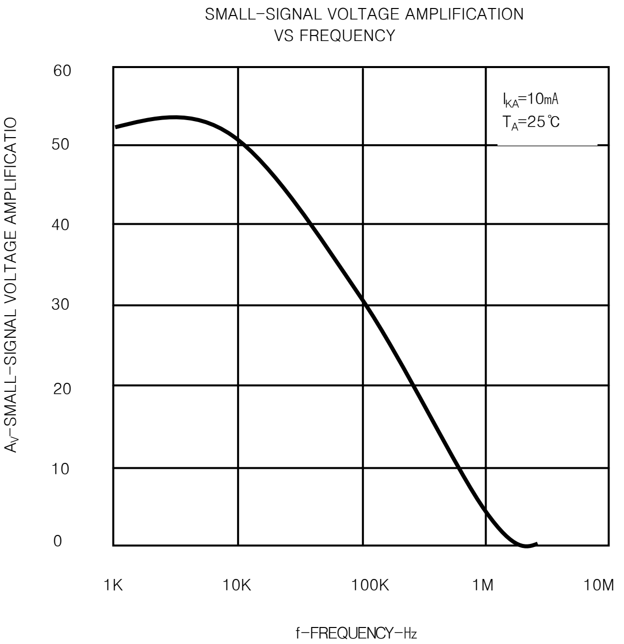
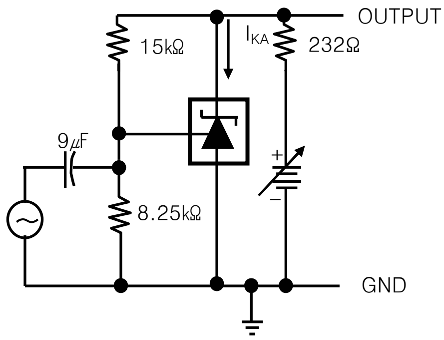


Figure 11. Test Circuit for Equivalent Input Noise Voltage





Test Circuit for Voltage Amplification

Figure 12.

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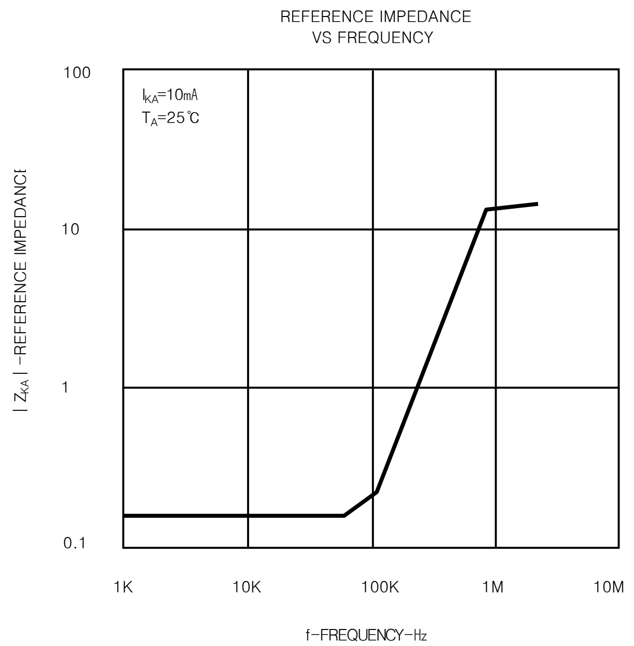
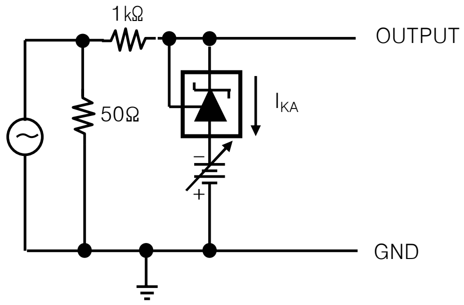
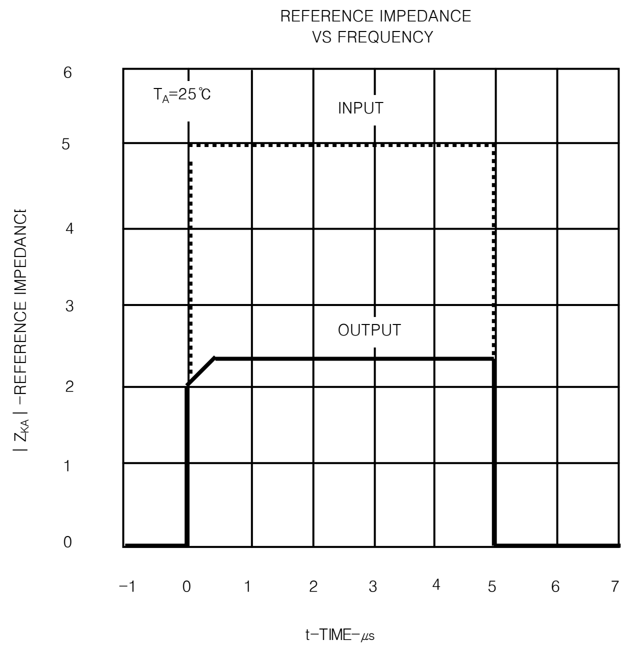
TYPICAL PERFORMANCE CHARACTERISTICS

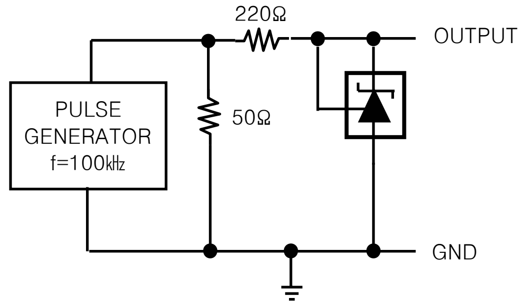




Test Circuit for Reference Impedance

Figure 13.





Test Circuit for Pulse Response

Figure 14.

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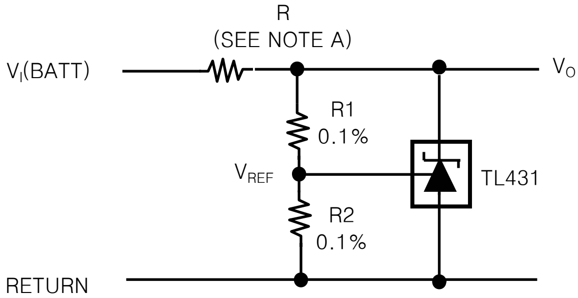
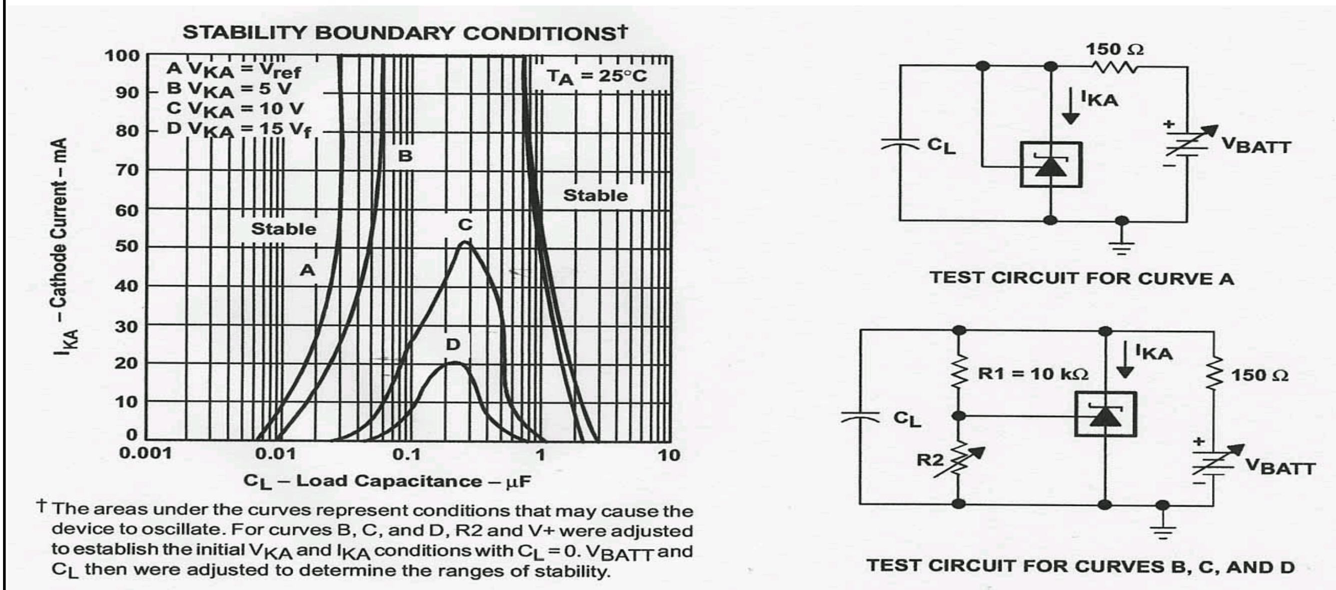


$V_O = (1+\frac{R1}{R2})\ V_{REF}$

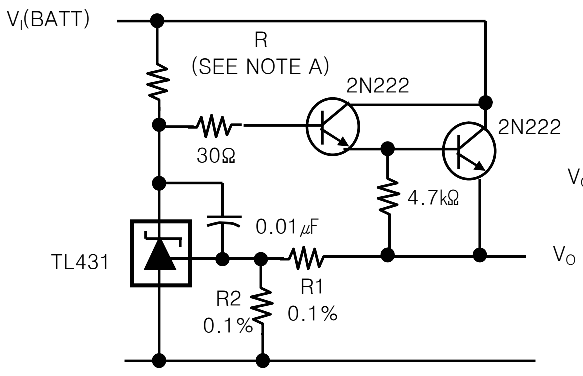
NOTE A：R Should provide cathode current≥1㎃ to the TL431 at minimum V_I(BATT)

Figure 15. Shunt Regulator



† The areas under the curves represent conditions that may cause the device to oscillate. For curves B, C, and D, R2 and V+ were adjusted to establish the initial V_{KA} and I_{KA} conditions with C_L = 0. V_{BATT} and C_L then were adjusted to determine the ranges of stability.

Figure 16



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

NOTE A：R Should provide cathode current≥1㎃ to the TL431 at minimum V_I(BATT)

Figure 17. Precision High-Current Series Regulator

APPLICATION INFORMATION

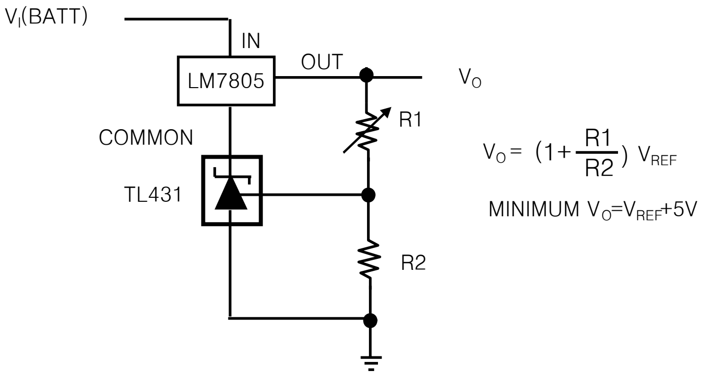


Figure 18. Output Control of a 3-Terminal Fixed Regulator

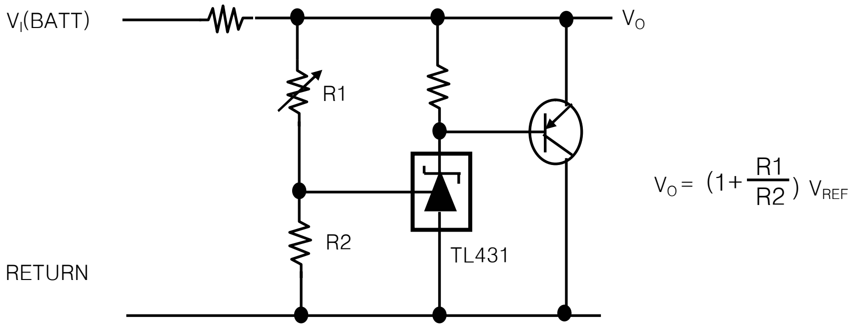
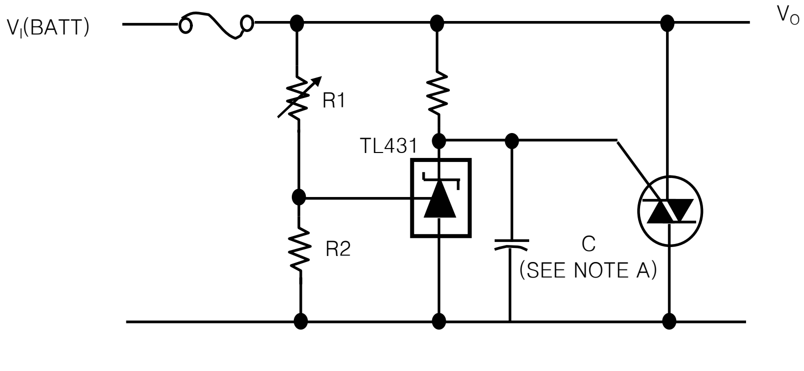


Figure 19. High-Current Shunt Regulator



NOTE A : Refer to the stability boundary conditions in Figure 16 to determine allowable values for C.

Figure 20. Crowbar Circuit

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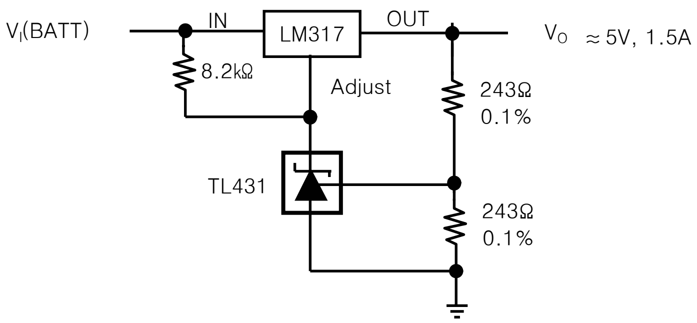
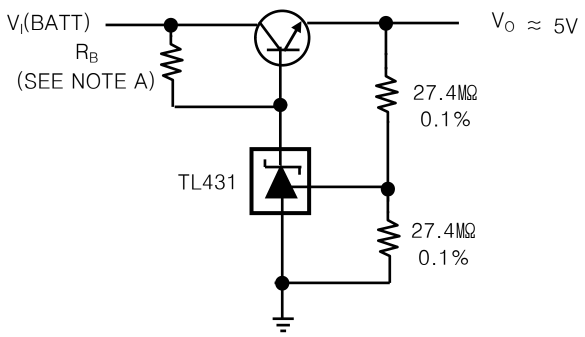


Figure 21. Precision 5−V 1.5A Regulator



NOTE A : R_B Should provide cathode current≥1㎃ to the TL431.

Figure 22. Efficient 5−V Precision Regulator

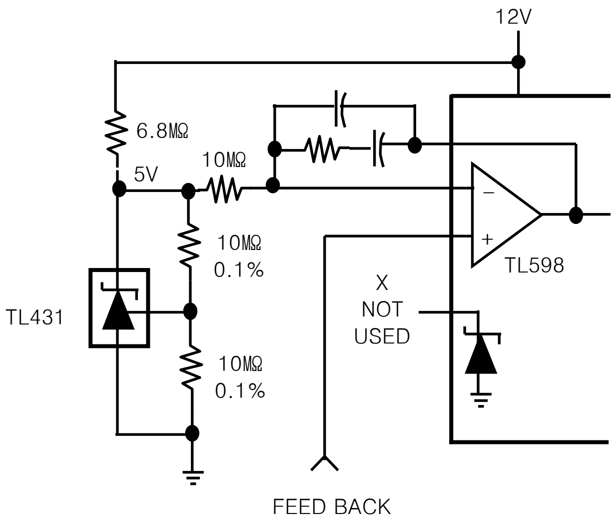


Figure 23. PWM Converter With Reference

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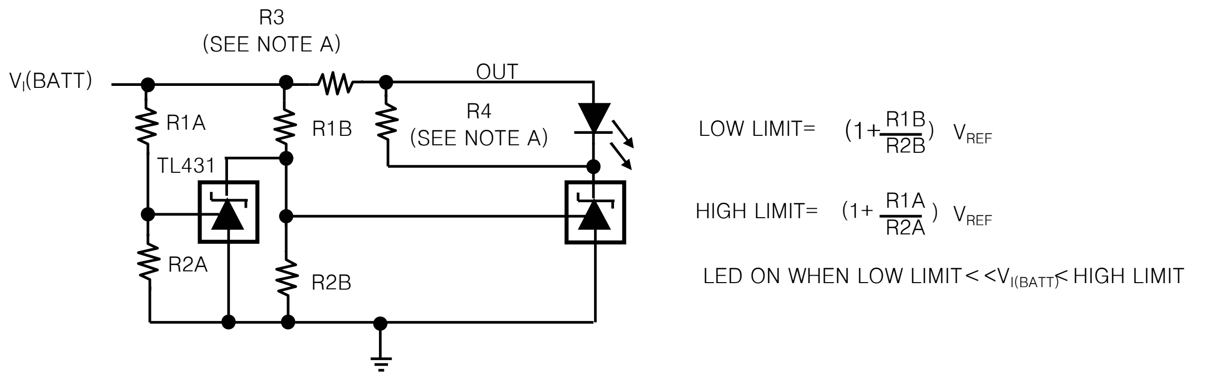

NOTE A : R3 and R4 are selected to provide the desired LED intensity and cathode current ≥1㎃ to the TL431 at the available $V_{I(BATT)}$.

Figure 24. Voltage Monitor

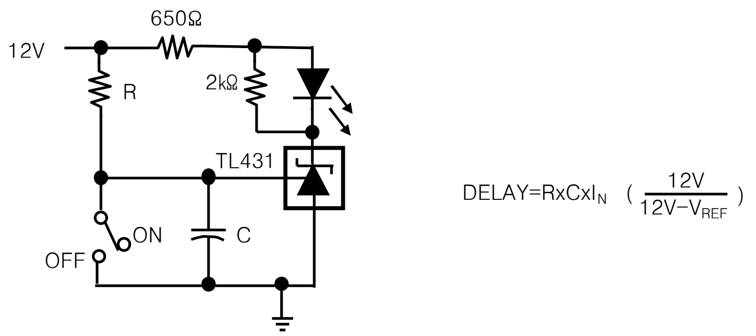

Figure 25. Delay Timer

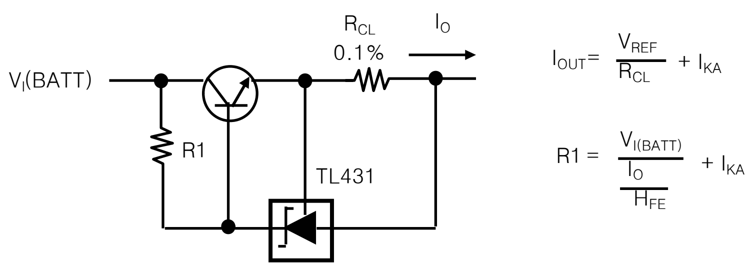

Figure 26. Precision Current Limiter

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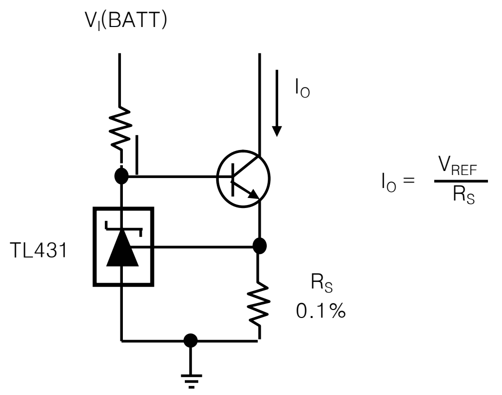

Figure 27. Precision Constant-Current Sink

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