



## TL431L

## LINEAR INTEGRATED CIRCUIT

### PROGRAMMABLE PRECISION REFERENCE

#### DESCRIPTION

The UTC **TL431L** is a three-terminal adjustable regulator with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between  $V_{REF}$  (approximately 2.5V) and 20V with two external resistors. It provides very wide applications, including shunt regulator, series regulator, switching regulator, voltage reference and others.

#### FEATURES

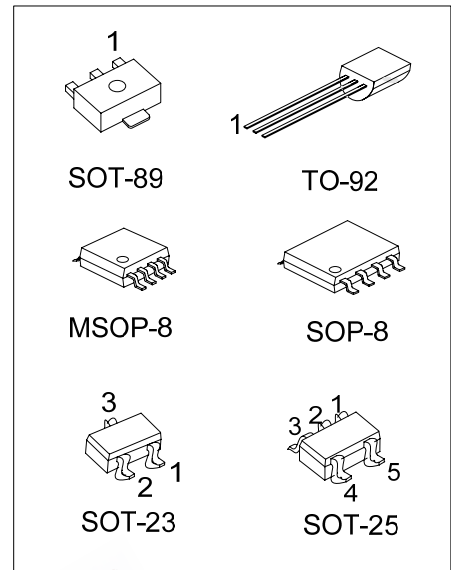
- \*Programmable output Voltage to 20V.
- \*Low dynamic output impedance 0.2Ω.
- \*Sink current capability of 1.0 ~ 100mA.
- \*Equivalent full-range temperature coefficient of 50ppm/ °C typical for operation over full rated operating temperature range.

#### ORDERING INFORMATION

Order Number		Pin Assignment								Package	Packing
Normal	Lead Free Plating	1	2	3	4	5	6	7	8		
TL431L-AB3-6-R	TL431LK-AB3-6-R	R	A	K	-	-	-	-	-	SOT-89	Tape Reel
TL431L-AE3-3-R	TL431LK-AE3-3-R	K	R	A	-	-	-	-	-	SOT-23	Tape Reel
TL431L-AF5-0-R	TL431LK-AF5-0-R	X	X	K	R	A	-	-	-	SOT-25	Tape Reel
TL431L-S08-0-R	TL431LK-S08-0-R	K	A	A	X	X	A	A	R	SOP-8	Tape Reel
TL431L-S08-0-T	TL431LK-S08-0-T	K	A	A	X	X	A	A	R	SOP-8	Tube
TL431L-SM1-0-R	TL431LK-SM1-0-R	K	X	X	X	X	A	X	R	MSOP-8	Tape Reel
TL431L-SM1-0-T	TL431LK-SM1-0-T	K	X	X	X	X	A	X	R	MSOP-8	Tube
TL431L-T92-6-B	TL431LK-T92-6-B	R	A	K	-	-	-	-	-	TO-92	Tape Box
TL431L-T92-6-K	TL431LK-T92-6-K	R	A	K	-	-	-	-	-	TO-92	Bulk
TL431L-T92-6-R	TL431LK-T92-6-R	R	A	K	-	-	-	-	-	TO-92	Tape Reel

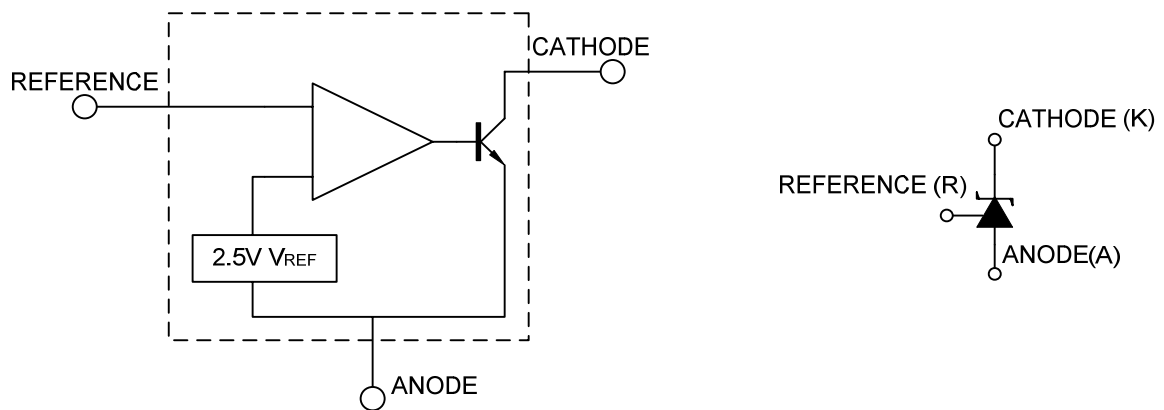
Note: Pin Code: K: Cathode A: Anode R: Reference X: No Connection

<p>TL431LK-AB3-6-R</p> <p>(1)Packing Type (2)Pin Assignment (3)Package Type (4)Lead Plating</p>	<p>(1) B: Tape Box, K: Bulk, R: Tape Reel, T: Tube (2) refer to Pin Assignment (3) AB3: SOT-89, AE3: SOT-23, AF3: SOT-25, S08: SOP-8, SM1: MSOP-8, T92: TO-92 (4) K: Lead Free Plating, Blank: Pb/Sn</p>
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\*Pb-free plating product number: TL431LK

### ■ BLOCK DIAGRAM



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■ ABSOLUTE MAXIMUM RATINGS (Operating temperature range applies unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Cathode Voltage	$V_{KA}$	20	V
Cathode Current Range (Continuous)	$I_{KA}$	-100 ~ +150	mA
Reference Input Current Range	$I_{REF}$	-0.05 ~ +10	mA
Operating Junction Temperature	$T_J$	150	°C
Operating Ambient Temperature	$T_{OPR}$	0 ~ +70	°C
Storage Temperature	$T_{STG}$	-65 ~ +150	°C

Note Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ RECOMMENDED OPERATING CONDITIONS

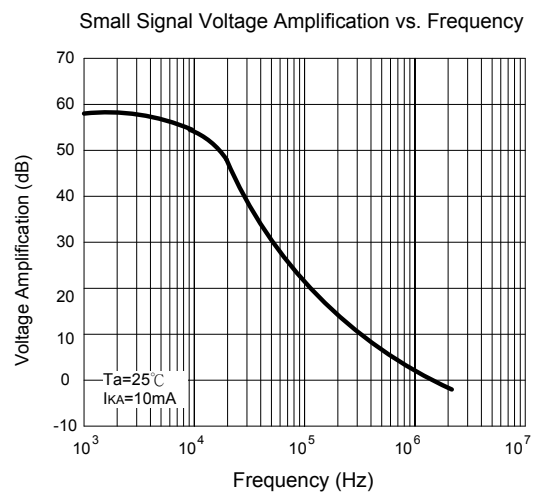
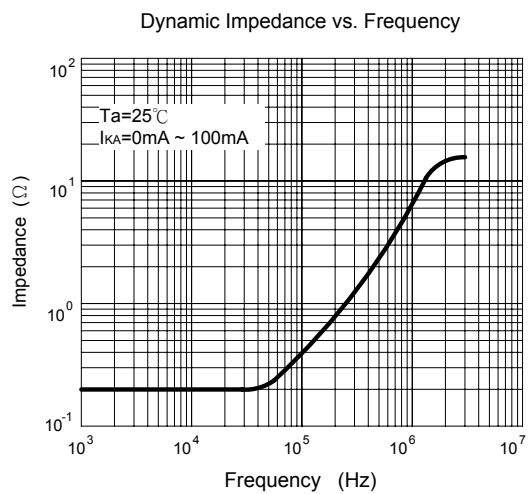
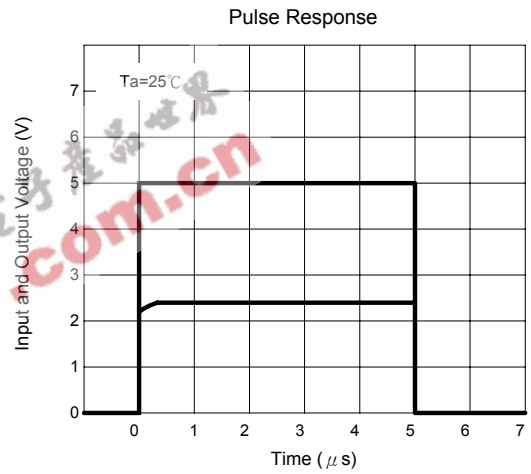
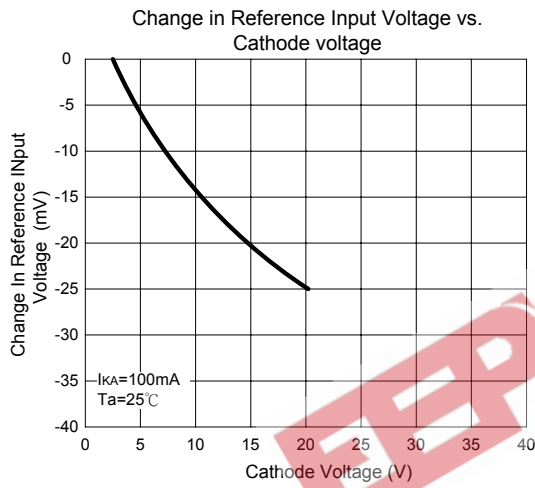
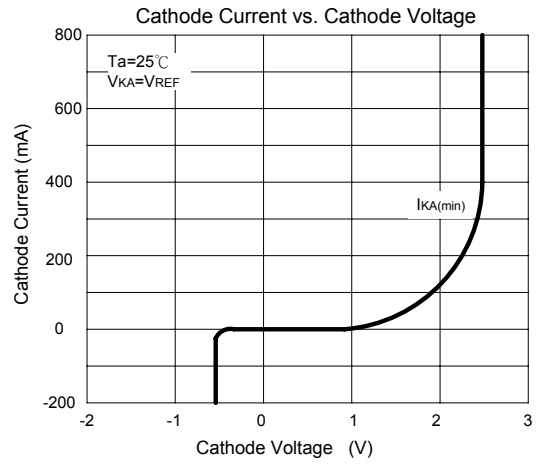
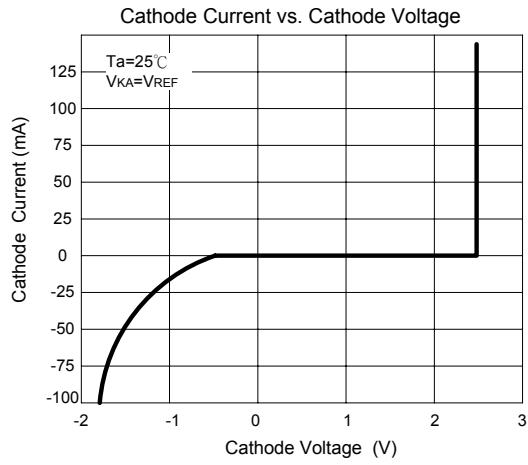
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Cathode Voltage	$V_{KA}$	$V_{REF}$		20	V
Cathode Current	$I_{KA}$	1		100	mA

■ ELECTRICAL CHARACTERISTICS ( $T_a=25^\circ\text{C}$ , unless otherwise specified)

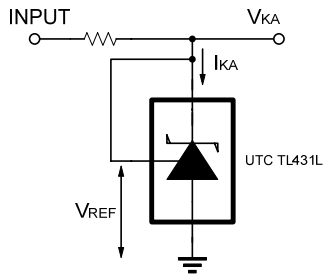
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference Input Voltage	$V_{REF}$	$V_{KA}=V_{REF}$ , $I_{KA}=10\text{mA}$	2.450	2.50	2.550	V
Deviation of Reference Input Voltage Over temperature (note 1)	$\Delta V_{REF}/\Delta T$	$V_{KA}=V_{REF}$ , $I_{KA}=10\text{mA}$ $0 \leq T_A \leq 70$		4.5	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	$I_{KA}=10\text{mA}$ $\Delta V_{KA}=10\text{V} \sim V_{REF}$ $\Delta V_{KA}=20\text{V} \sim 10\text{V}$		-1.0 -0.5	-2.7 -2.0	mV/V
Reference Input Current	$I_{REF}$	$I_{KA}=10\text{mA}$ , $R_1=10\text{k}\Omega$ , $R_2=\infty$		1.5	4	$\mu\text{A}$
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	$I_{KA}=10\text{mA}$ , $R_1=10\text{k}\Omega$ , $R_2=\infty$ $T_A=\text{full Temperature}$		0.4	1.2	$\mu\text{A}$
Minimum Cathode Current for Regulation	$I_{KA(MIN)}$	$V_{KA}=V_{REF}$		0.45	1.0	mA
Off-State Cathode Current	$I_{KA(OFF)}$	$V_{KA}=20\text{V}$ , $V_{REF}=0$		0.05	1.0	$\mu\text{A}$
Dynamic Impedance	$Z_{KA}$	$V_{KA}=V_{REF}$ , $I_{KA}=1 \sim 100\text{mA}$ $f \leq 1.0\text{kHz}$		0.15	0.5	$\Omega$

Remark: Reference voltage of  $\pm 1\%$  tolerance is also available per customer's request.

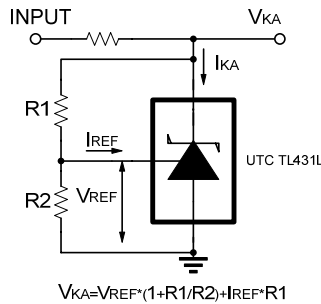
## TYPICAL CHARACTERISTICS



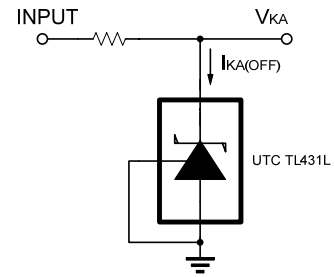
## TEST CIRCUIT



Test Circuit For  $V_{KA} = V_{REF}$

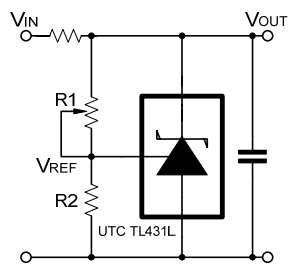


Test Circuit for  $V_{KA} \geq V_{REF}$



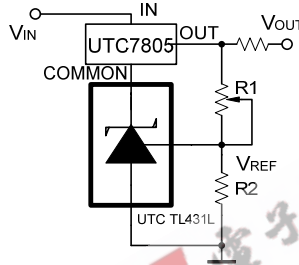
Test Circuit For  $I_{KA(OFF)}$

## APPLICATION CIRCUIT



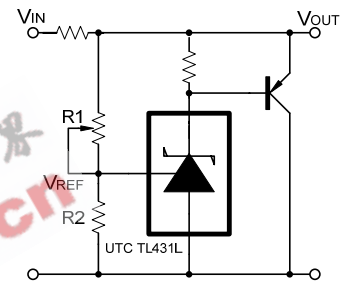
$$V_{OUT} = (1 + R1/R2) * V_{REF}$$

Shutdown Regulator



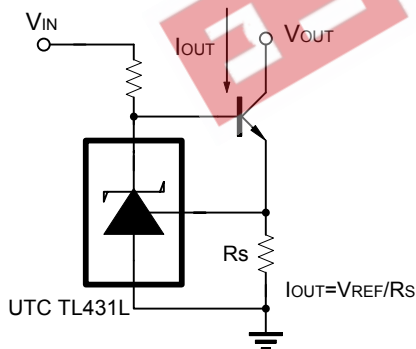
$$V_{OUT} = (1 + R1/R2) * V_{REF}$$

Output Control of a Three-Terminal Fixed Regulator

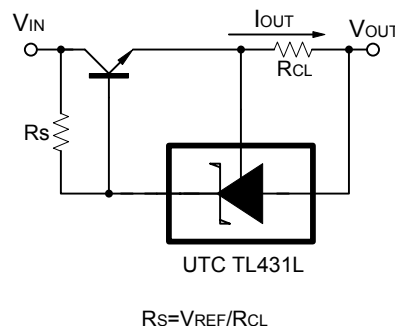


$$V_{OUT} = (1 + R1/R2) * V_{REF}$$

Higher-Current Shunt Regulator



Constant-Current Sink



Current Limiting or Current Source

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