



## TL431

## LINEAR INTEGRATED CIRCUIT

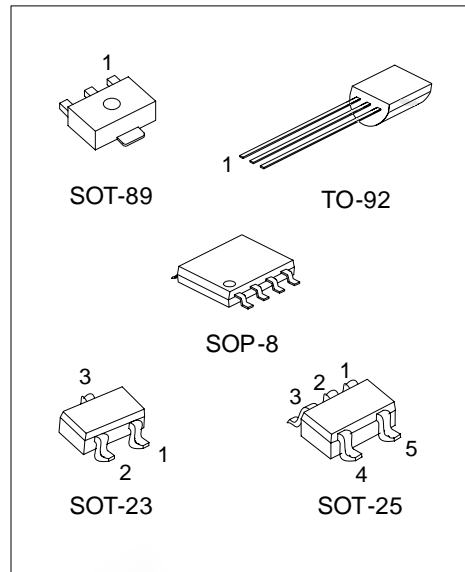
### PROGRAMMABLE PRECISION REFERENCE

#### DESCRIPTION

The UTC TL431 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 36 V 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 36V.
- \*Low dynamic output impedance 0.2Ω.
- \*Sink current capability of 1.0 to 100mA.
- \*Equivalent full-range temperature coefficient of 50ppm/ °C typical for operation over full rated operating temperature range.



\*Pb-free plating product number: TL431K  
 \*Pb-free plating product for SOT-23NS type number: TL431NSL

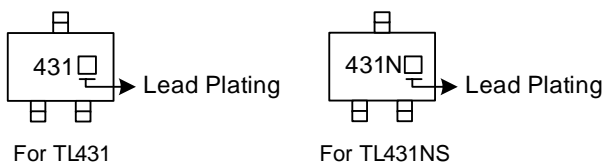
#### ORDERING INFORMATION

Order Number		Pin Assignment								Package	Packing
Normal	Lead Free Plating	1	2	3	4	5	6	7	8		
TL431-AB3-R	TL431K-AB3-R	R	A	K	-	-	-	-	-	SOT-89	Tape Reel
TL431-AE3-R	TL431K-AE3-R	K	R	A	-	-	-	-	-	SOT-23	Tape Reel
TL431NS-AE3-R	TL431NSL-AE3-R	R	K	A	-	-	-	-	-	SOT-23	Tape Reel
TL431-AF5-R	TL431K-AF5-R	X	X	K	R	A	-	-	-	SOT-25	Tape Reel
TL431-S08-R	TL431K-S08-R	K	A	A	X	X	A	A	R	SOP-8	Tape Reel
TL431-S08-T	TL431K-S08-T	K	A	A	X	X	A	A	R	SOP-8	Tube
TL431-T92-B	TL431K-T92-B	R	A	K	-	-	-	-	-	TO-92	Tape Box
TL431-T92-K	TL431K-T92-K	R	A	K	-	-	-	-	-	TO-92	Bulk
TL431-T92-R	TL431K-T92-R	R	A	K	-	-	-	-	-	TO-92	Tape Reel

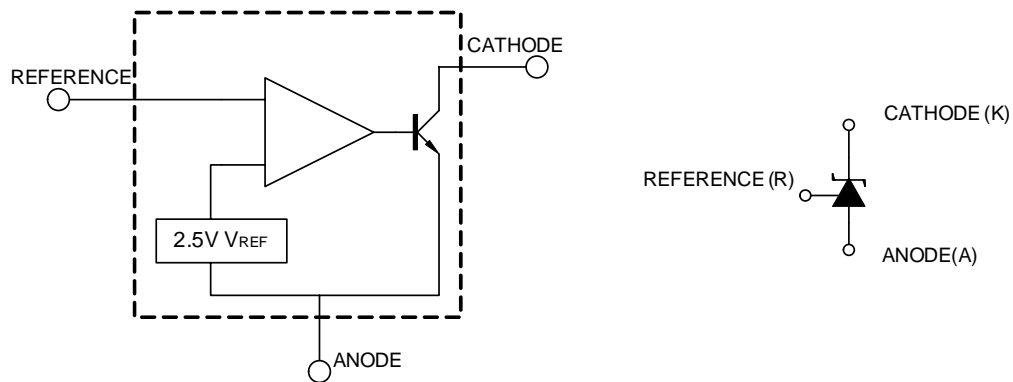
Note: Pin Code: K: Cathode A: Anode R: Reference X: No Connection

<p>TL431K-AB3-R</p> <p>(1)Packing Type (2)Package Type (3)Lead Plating</p>	<p>(1) B: Tape Box, K: Bulk, R: Tape Reel, T: Tube          (2) AB3: SOT-89, AE3: SOT-23, AF5: SOT-25, S08:SOP-8, T92: TO-92          (3) K: Lead Free Plating Blank Pb/Sn          L : Lead Free Plating Only for SOT-23NS Type</p>
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#### MARKING (SOT-23/SOT-25)



### ■ BLOCK DIAGRAM



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

PARAMETER		SYMBOL	RATINGS	UNIT
Cathode Voltage		$V_{KA}$	37	V
Cathode Current Range(Continuous)		$I_{KA}$	-100 ~ +150	mA
Reference Input Current Range		$I_{REF}$	-0.05 ~ +10	mA
Power Dissipation	TO-92	$P_D$	770	mW
	SOT-89		800	mW
	SOT-23/SOT-25		300	mW
Operating Junction Temperature		$T_J$	+150	°C
Operating Ambient Temperature		$T_{OPR}$	-40 ~ +85	°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.

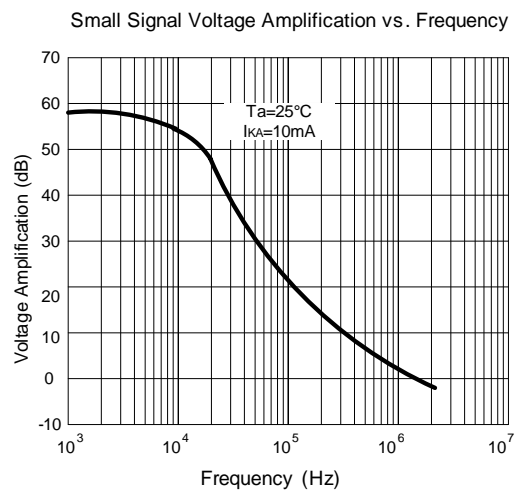
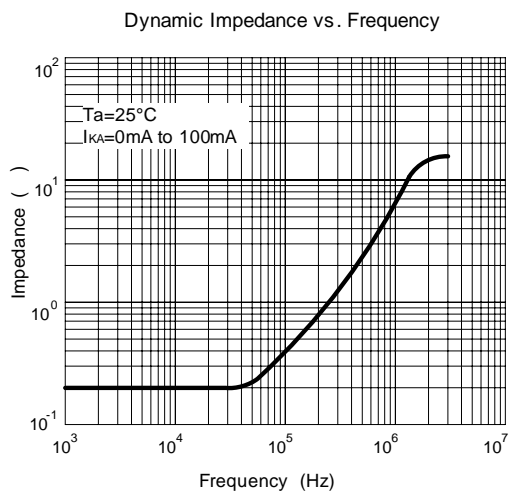
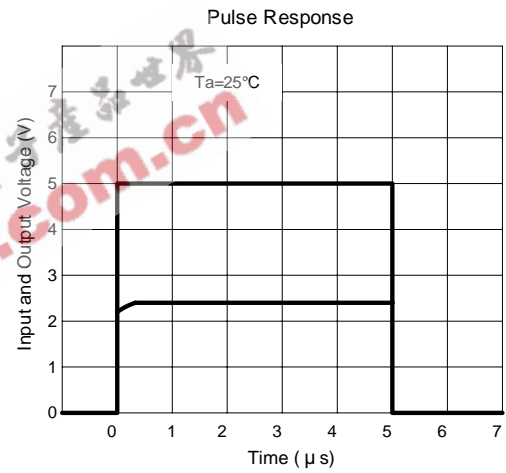
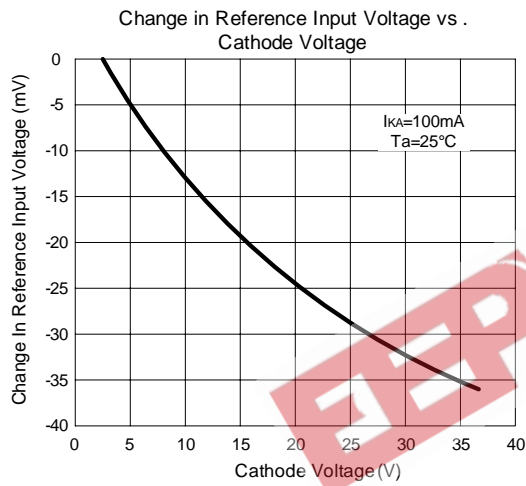
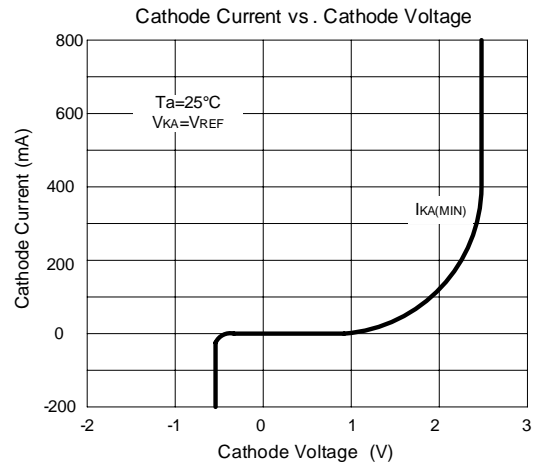
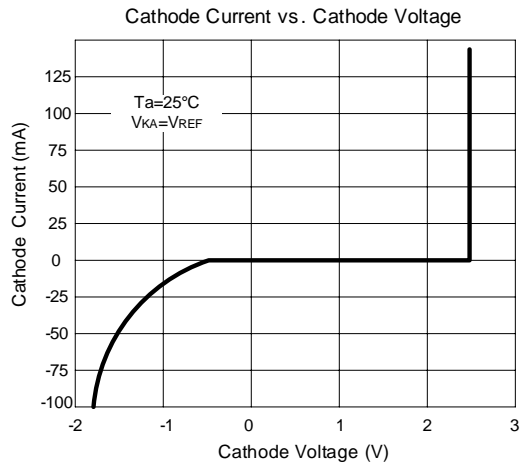
■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Cathode Voltage	$V_{KA}$	$V_{REF}$		36	V
Cathode Current	$I_{KA}$	1		100	mA

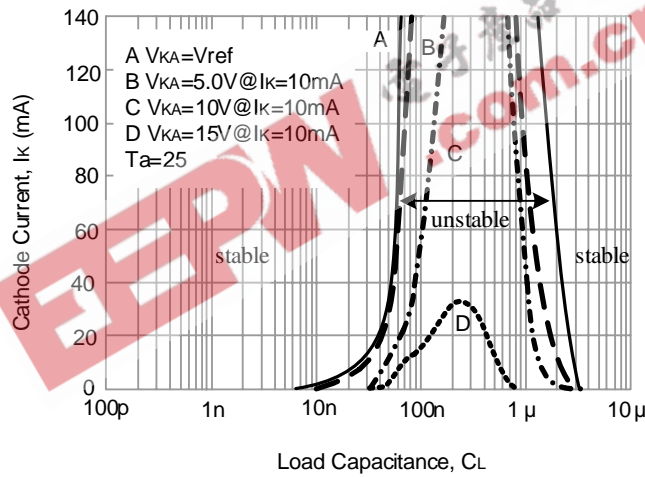
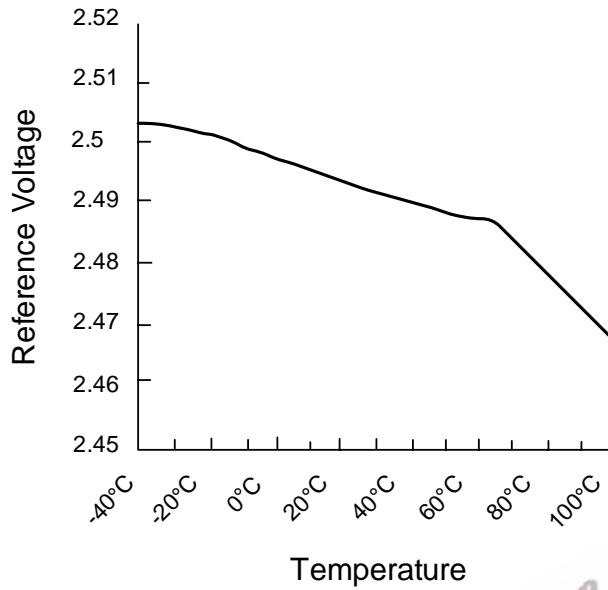
■ ELECTRICAL CHARACTERISTICS ( $T_C=25$  , unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference Input Voltage	$V_{REF}$	$V_{KA}=V_{REF}, I_{KA}=10mA$	2.470	2.495	2.520	V
Deviation of reference Input Voltage Over temperature	$\Delta V_{REF}/\Delta T$	$V_{KA}=V_{REF}, I_{KA}=10mA$ $0^\circ C \leq T_a \leq 70^\circ C$		4.5	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	$I_{KA}=10mA$ $\Delta V_{KA}=10V \sim V_{REF}$ $\Delta V_{KA}=36V \sim 10V$		-1.0	-2.7	mV/V
Reference Input Current	$I_{REF}$	$I_{KA}=10mA, R1=10k\Omega, R2=\infty$		1.5	4	$\mu A$
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	$I_{KA}=10mA, R1=10k\Omega, R2=\infty$ $T_a = \text{full Temperature}$		0.4	1.2	$\mu A$
Minimum Cathode Current for Regulation	$I_{KA(MIN)}$	$V_{KA}=V_{REF}$		0.45	1.0	mA
Off-State Cathode Current	$I_{KA(OFF)}$	$V_{KA}=36V, V_{REF}=0$		0.05	1.0	$\mu A$
Dynamic Impedance	$Z_{KA}$	$V_{KA}=V_{REF}, I_{KA}=1 \text{ to } 100mA$ $f \leq 1.0kHz$		0.15	0.5	$\Omega$

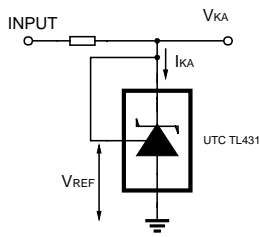
### TYPICAL CHARACTERISTICS



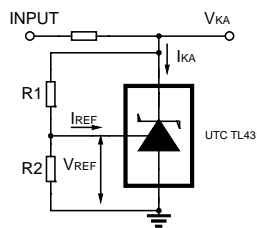
■ TYPICAL CHARACTERISTICS (Cont.)



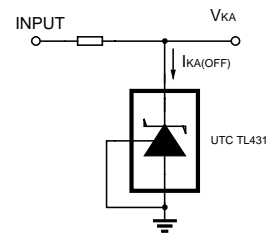
### TEST CIRCUIT



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

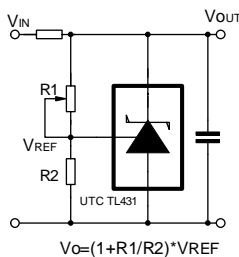


For  $V_{KA} = V_{REF} (1 + R1/R2) + I_{REF} \cdot R1$



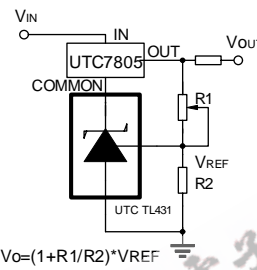
For  $I_{KA(OFF)}$

### APPLICATION CIRCUIT



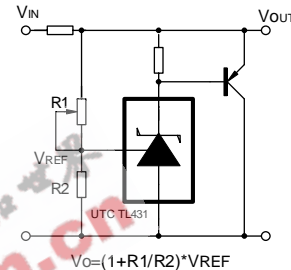
$$V_O = (1 + R1/R2) \cdot V_{REF}$$

Shutdown Regulator



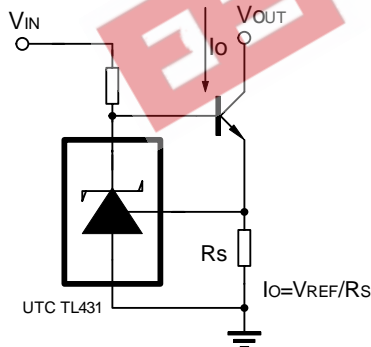
$$V_O = (1 + R1/R2) \cdot V_{REF}$$

Output Control of a Three-Terminal Fixed Regulator



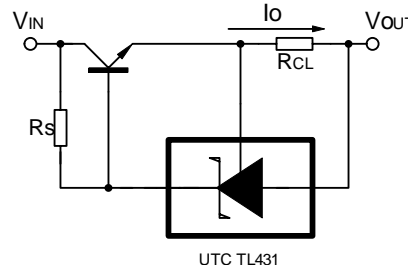
$$V_O = (1 + R1/R2) \cdot V_{REF}$$

Higher-current Shunt Regulator



$$I_O = V_{REF} / R_S$$

Constant-current Sink



$$R_S = V_{REF} / R_{CL}$$

Current Limiting or Current Source

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