



## TL431

## LINEAR INTEGRATED CIRCUIT

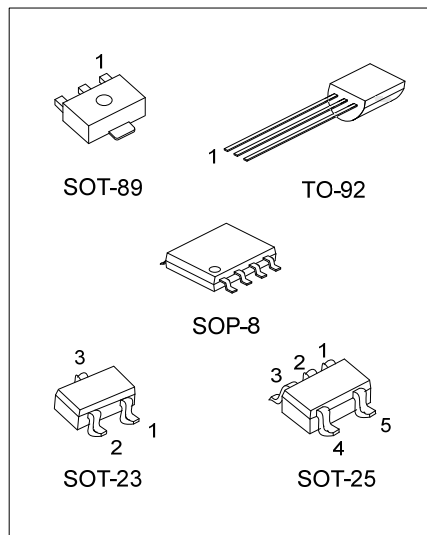
### PROGRAMMABLE PRECISION REFERENCE

#### 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.

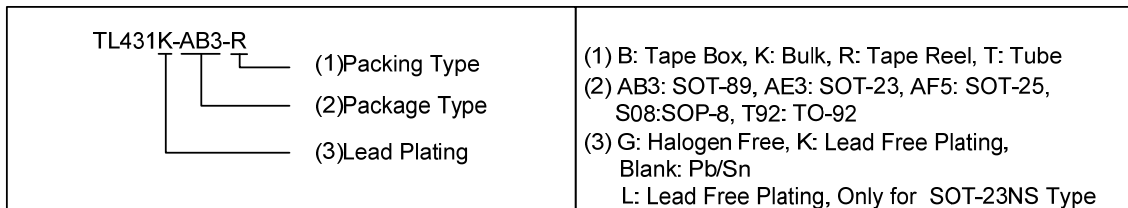


Lead-free: TL431K  
 Halogen-free: TL431G  
 \* For SOT-23NS:  
 Lead-free: TL431NSL  
 Halogen-free: TL431NSG

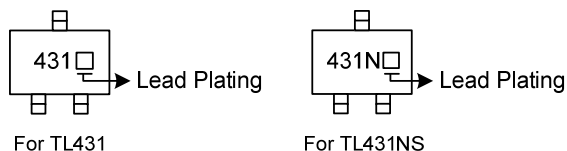
#### ORDERING INFORMATION

Ordering Number			Pin Assignment								Package	Packing
Normal	Lead Free Plating	Halogen-Free	1	2	3	4	5	6	7	8		
TL431-AB3-R	TL431K-AB3-R	TL431G-AB3-R	R	A	K	-	-	-	-	-	SOT-89	Tape Reel
TL431-AE3-R	TL431K-AE3-R	TL431G-AE3-R	K	R	A	-	-	-	-	-	SOT-23	Tape Reel
TL431NS-AE3-R	TL431NSL-AE3-R	TL431NSG-AE3-R	R	K	A	-	-	-	-	-	SOT-23	Tape Reel
TL431-AF5-R	TL431K-AF5-R	TL431G-AF5-R	X	X	K	R	A	-	-	-	SOT-25	Tape Reel
TL431-S08-R	TL431K-S08-R	TL431G-S08-R	K	A	A	X	X	A	A	R	SOP-8	Tape Reel
TL431-S08-T	TL431K-S08-T	TL431G-S08-T	K	A	A	X	X	A	A	R	SOP-8	Tube
TL431-T92-B	TL431K-T92-B	TL431G-T92-B	R	A	K	-	-	-	-	-	TO-92	Tape Box
TL431-T92-K	TL431K-T92-K	TL431G-T92-K	R	A	K	-	-	-	-	-	TO-92	Bulk
TL431-T92-R	TL431K-T92-R	TL431G-T92-R	R	A	K	-	-	-	-	-	TO-92	Tape Reel

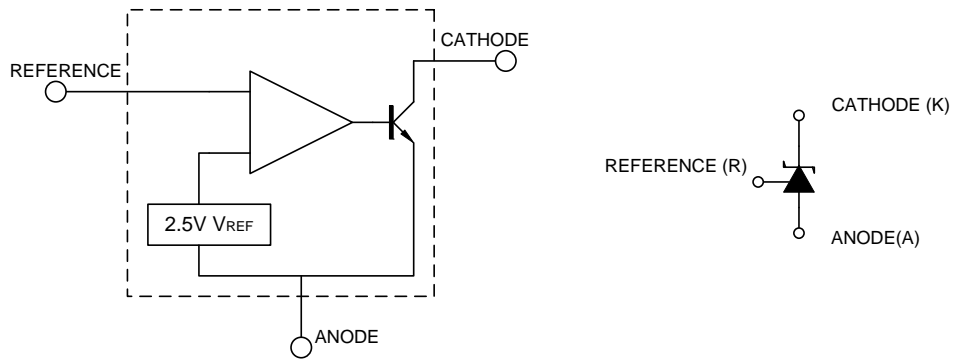
Note: Pin Code: K: Cathode A: Anode R: Reference X: No Connection



#### MARKING (SOT-23/SOT-25)



### ■ BLOCK DIAGRAM



■ 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.

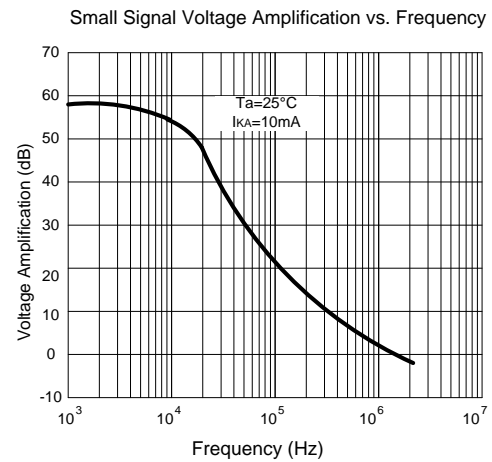
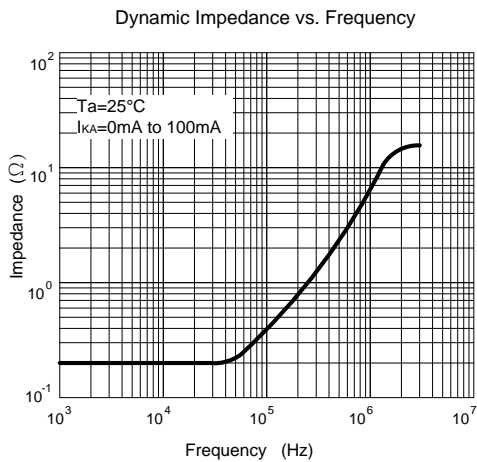
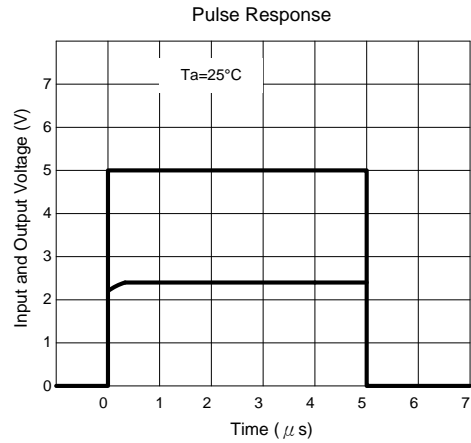
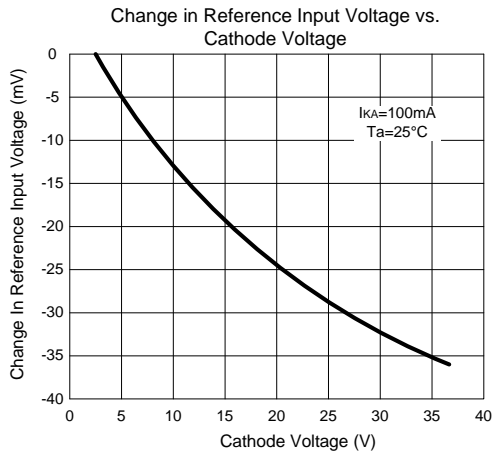
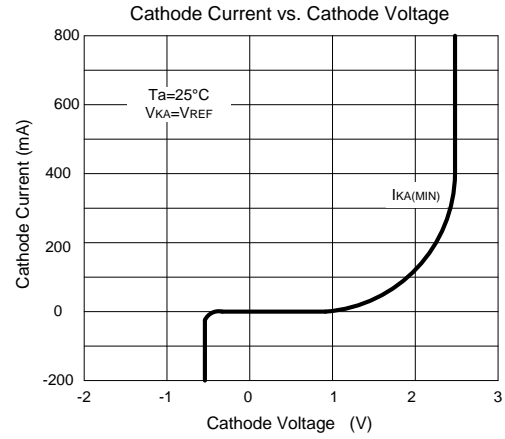
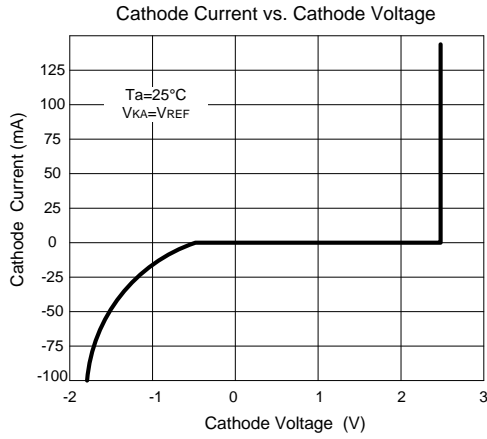
■ RECOMMENDED OPERATING CONDITIONS

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

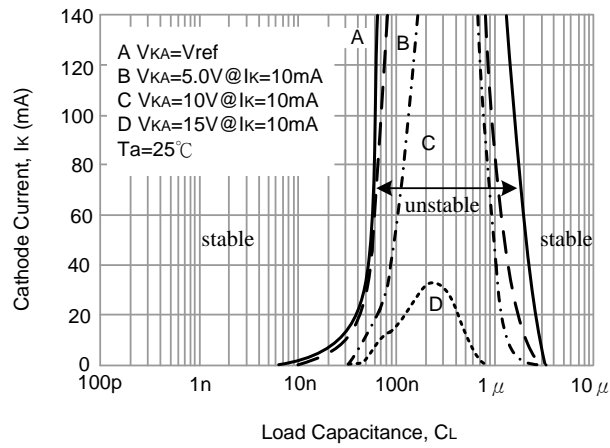
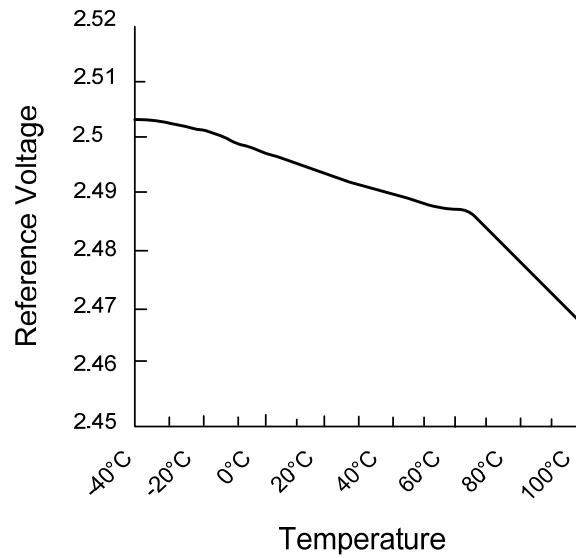
■ ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$ , unless otherwise specified.)

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

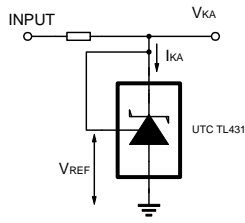
## TYPICAL CHARACTERISTICS



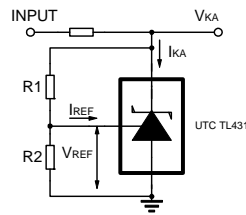
■ TYPICAL CHARACTERISTICS (Cont.)



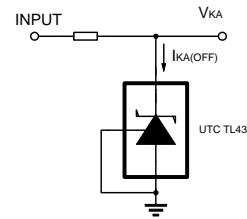
## ■ TEST CIRCUIT



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

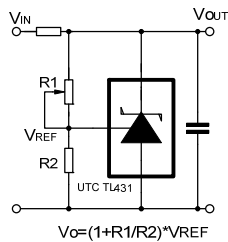


$V_{KA} = V_{REF}(1 + R1/R2) + I_{REF}R1$   
For  $V_{KA} \cong V_{REF}$



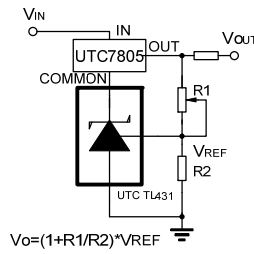
For  $I_{KA(OFF)}$

## ■ APPLICATION CIRCUIT



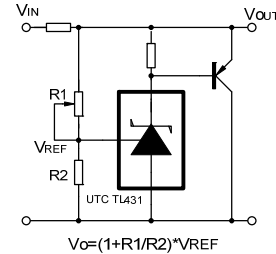
$V_o = (1 + R1/R2) * V_{REF}$

Shutdown Regulator



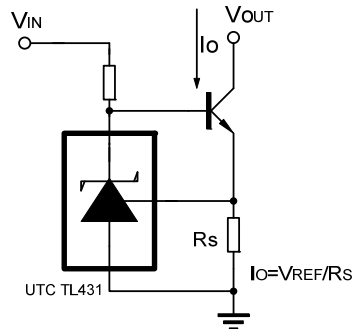
$V_o = (1 + R1/R2) * V_{REF}$

Output Control of a Three-Terminal Fixed Regulator



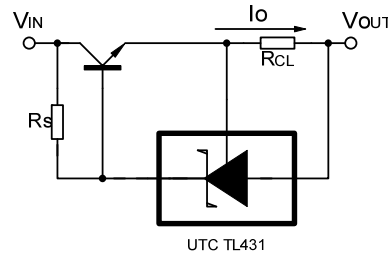
$V_o = (1 + R1/R2) * V_{REF}$

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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