

## LL431

## LINEAR INTEGRATED CIRCUIT

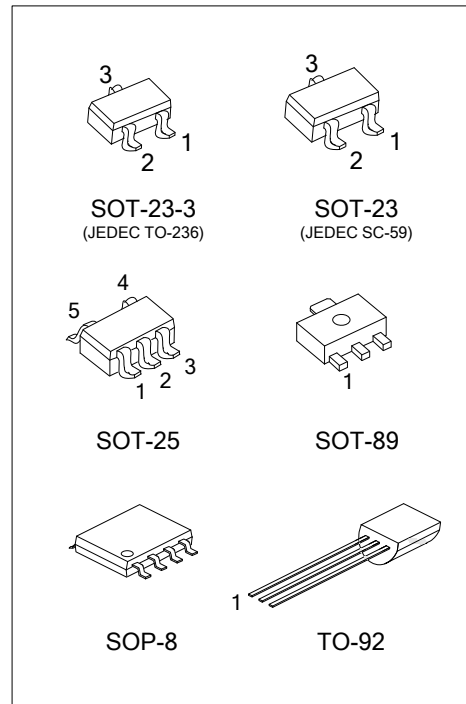
### PROGRAMMABLE PRECISION REFERENCE

#### DESCRIPTION

The UTC **LL431** 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 can be used in provides very wide applications including shunt regulator, series regulator, switching regulator, voltage reference and others.

#### FEATURES

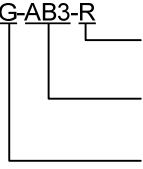
- \*Programmable output Voltage to 36V.
- \*Sink current capability of 1.0 to 100mA.
- \*Equivalent full-range temperature coefficient of 50ppm/ °C typical for operation over full rated operating temperature range.



#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
LL431K-AB3-R	LL431G-AB3-R	SOT-89	R	A	K	-	-	-	-	-	Tape Reel
LL431K-AE2-R	LL431G-AE2-R	SOT-23-3	K	R	A	-	-	-	-	-	Tape Reel
LL431NSL-AE2-R	LL431NSG-AE2-R	SOT-23-3	R	K	A	-	-	-	-	-	Tape Reel
LL431K-AE3-R	LL431G-AE3-R	SOT-23	K	R	A	-	-	-	-	-	Tape Reel
LL431NSK-AE3-R	LL431NSG-AE3-R	SOT-23	R	K	A	-	-	-	-	-	Tape Reel
LL431K-AF5-R	LL431G-AF5-R	SOT-25	X	X	K	R	A	-	-	-	Tape Reel
LL431K-S08-R	LL431G-S08-R	SOP-8	K	A	A	X	X	A	A	R	Tape Reel
LL431K-T92-B	LL431G-T92-B	TO-92	R	A	K	-	-	-	-	-	Tape Box
LL431K-T92-K	LL431G-T92-K	TO-92	R	A	K	-	-	-	-	-	Bulk
LL431K-T92-R	LL431G-T92-R	TO-92	R	A	K	-	-	-	-	-	Tape Reel

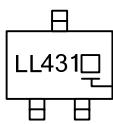
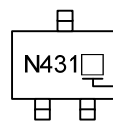
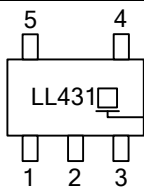
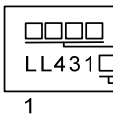
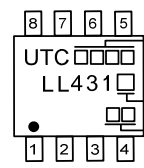
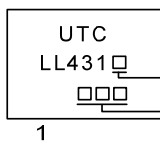
Note: Pin Code: K: Cathode A: Anode R: Reference X: No Connection

<p>LL431G-AB3-R</p>  <p>(1)Packing Type</p> <p>(2)Package Type</p> <p>(3)Green Package</p>	<p>(1) B: Tape Box, K: Bulk, R: Tape Reel</p> <p>(2) AB3: SOT-89, AE2: SOT-23-3, AE3: SOT-23, AF5: SOT-25, S08: SOP-8, T92: TO-92</p> <p>(3) G: Halogen Free, K: Lead Free</p> <p>G: Halogen Free, L: Lead Free Only for TL431NS Type</p>
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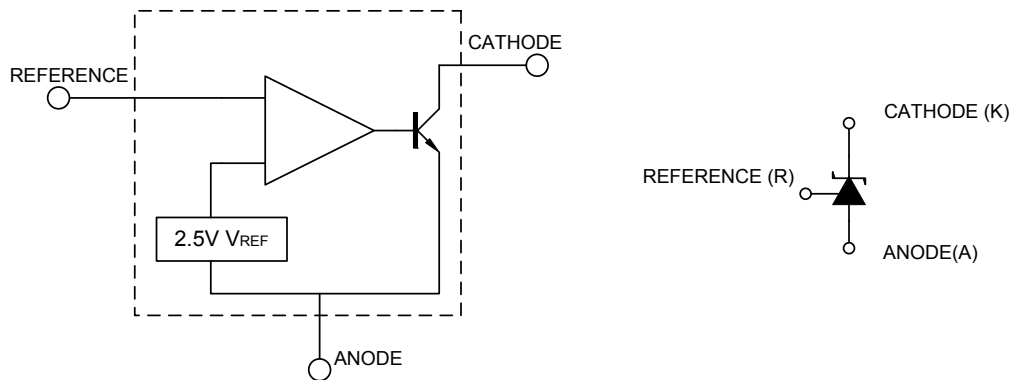
# LL431

## LINEAR INTEGRATED CIRCUIT

### MARKING

SOT-23-3 / SOT-23 (LL431)	SOT-23-3 / SOT-23 (LL431NS)	SOT-25
 <p>LL431 □ → G: Halogen Free K: Lead Free</p>	 <p>N431 □ → G: Halogen Free L: Lead Free</p>	 <p>LL431 □ → G: Halogen Free K: Lead Free</p>
SOT-89	SOP-8	TO-92
 <p>□□□□ → Date Code LL431 □ → G: Halogen Free K: Lead Free</p>	 <p>8 7 6 5 → Date Code UTC □□□□ → G: Halogen Free LL431 □ → K: Lead Free □□□□ → Lot Code</p>	 <p>UTC LL431 □ → L: Lead Free K: Halogen Free □□□□ → Date Code</p>

### 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		$I_{REF}$	-0.05 ~ +10	mA
Power Dissipation	SOT-89	$P_D$	500	mW
	SOT-23-3/SOT-23		300	mW
	SOT-25		600	mW
	SOP-8		770	mW
	TO-92			
Junction Temperature		$T_J$	+150	°C
Operating 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.

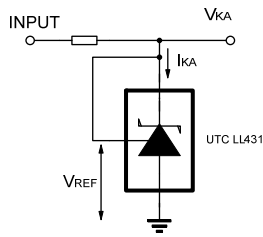
■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Cathode Voltage	$V_{KA}$	$V_{REF} \sim 36$	V
Cathode Current	$I_{KA}$	1 ~ 100	mA

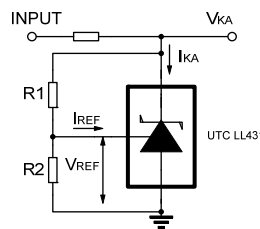
■ ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ , unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Reference Input Voltage	$V_{REF}$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	LL431-A	2.483	2.495	2.507	V
			LL431-1	2.470	2.495	2.520	V
			LL431-2	2.520	-	2.545	V
			LL431-3	2.445	-	2.470	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 -0.5	-2.7 -2.0	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	$I_{KA(MIN)}$	$V_{KA}=V_{REF}$			100	$\mu\text{A}$	
Off-State Cathode Current	$I_{KA(OFF)}$	$V_{KA}=36\text{V}, V_{REF}=0$		0.05	1.0	$\mu\text{A}$	
Dynamic Impedance	$Z_{KA}$	$V_{KA}=V_{REF}, I_{KA}=1 \text{ to } 100\text{mA}$ $f \leq 1.0\text{kHz}$		0.5		$\Omega$	

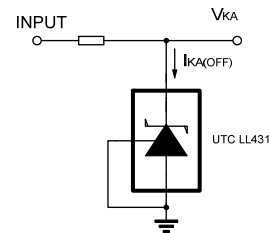
## ■ TEST CIRCUIT



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

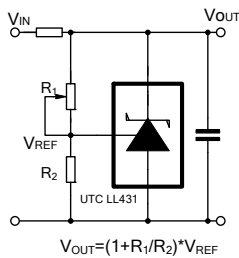


$V_{KA} = V_{REF}(1+R_1/R_2) + I_{REF}R_1$   
For  $V_{KA} \cong V_{REF}$



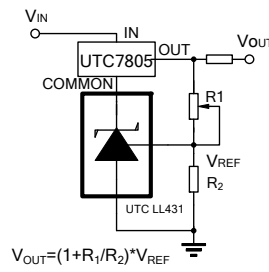
For  $I_{KA(OFF)}$

## ■ APPLICATION CIRCUIT



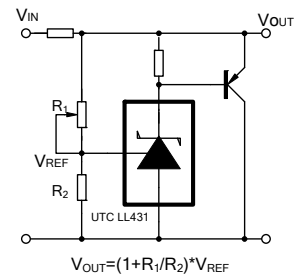
$$V_{OUT} = (1 + R_1/R_2) \cdot V_{REF}$$

Shutdown Regulator



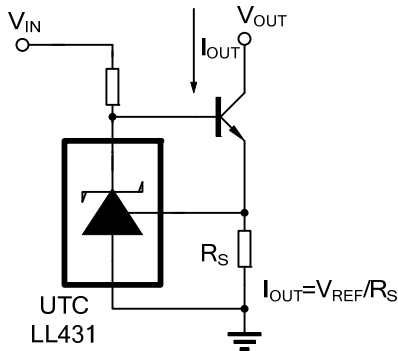
$$V_{OUT} = (1 + R_1/R_2) \cdot V_{REF}$$

Output Control of a Three-Terminal Fixed Regulator



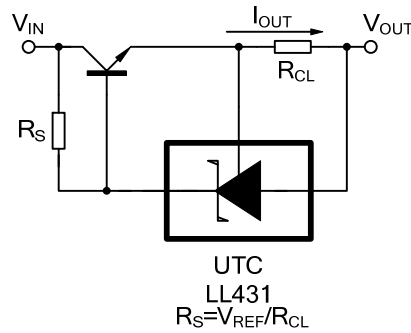
$$V_{OUT} = (1 + R_1/R_2) \cdot V_{REF}$$

Higher-current Shunt Regulator



$$I_{OUT} = V_{REF}/R_S$$

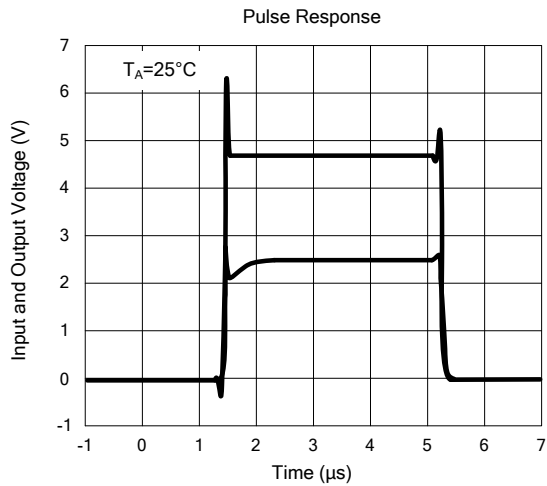
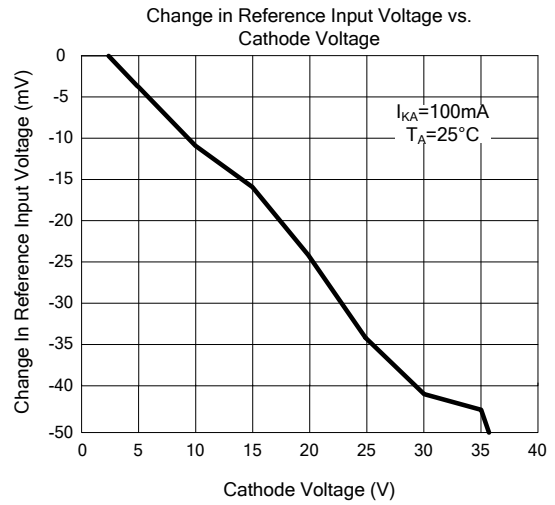
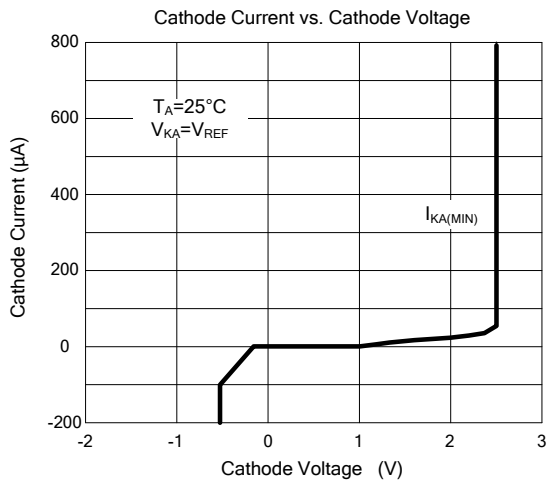
Constant-current Sink



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

Current Limiting or Current Source

## ■ TYPICAL CHARACTERISTICS



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