

TL431

LINEAR INTEGRATED CIRCUIT

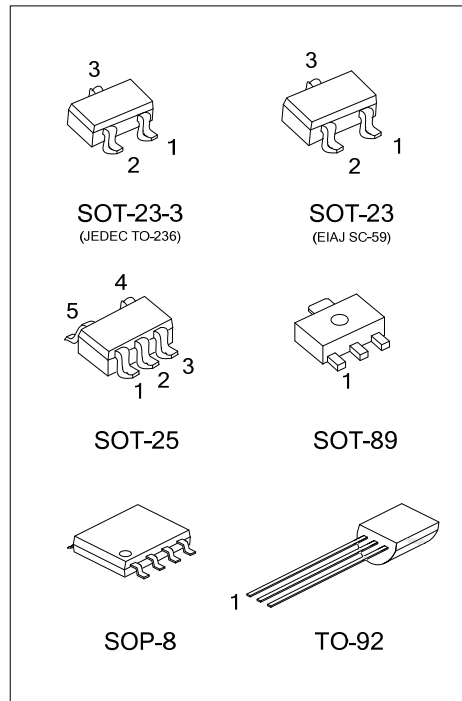
4 PROGRAMMABLE PRECISION REFERENCE

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 36V with two external resistors. It provides very wide applications, including shunt regulator, series regulator, switching regulator, voltage reference and others.

FEATURES

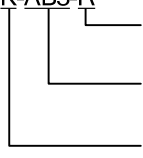
- * Programmable output Voltage to 36V.
- * Low dynamic output impedance 0.2Ω.
- * Sink current capability of 1.0 to 100mA.
- * Equivalent full-range temperature coefficient of 50ppm/ °C typical for operation over full rated operating temperature range.



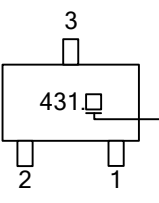
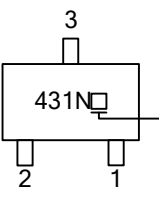
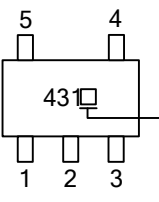
ORDERING INFORMATION

Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
TL431K-AB3-R	TL431G-AB3-R	SOT-89	R	A	K	-	-	-	-	-	Tape Reel
TL431K-AE2-R	TL431G-AE2-R	SOT-23-3	K	R	A	-	-	-	-	-	Tape Reel
TL431K-AE3-R	TL431G-AE3-R	SOT-23	K	R	A	-	-	-	-	-	Tape Reel
TL431NSL-AE3-R	TL431NSG-AE3-R	SOT-23	R	K	A	-	-	-	-	-	Tape Reel
TL431NSL-AE2-R	TL431NSG-AE2-R	SOT-23-3	R	K	A	-	-	-	-	-	Tape Reel
TL431K-AF5-R	TL431G-AF5-R	SOT-25	X	X	K	R	A	-	-	-	Tape Reel
TL431K-S08-R	TL431G-S08-R	SOP-8	K	A	A	X	X	A	A	R	Tape Reel
TL431K-S08-T	TL431G-S08-T	SOP-8	K	A	A	X	X	A	A	R	Tube
TL431K-T92-B	TL431G-T92-B	TO-92	R	A	K	-	-	-	-	-	Tape Box
TL431K-T92-K	TL431G-T92-K	TO-92	R	A	K	-	-	-	-	-	Bulk
TL431K-T92-R	TL431G-T92-R	TO-92	R	A	K	-	-	-	-	-	Tape Reel

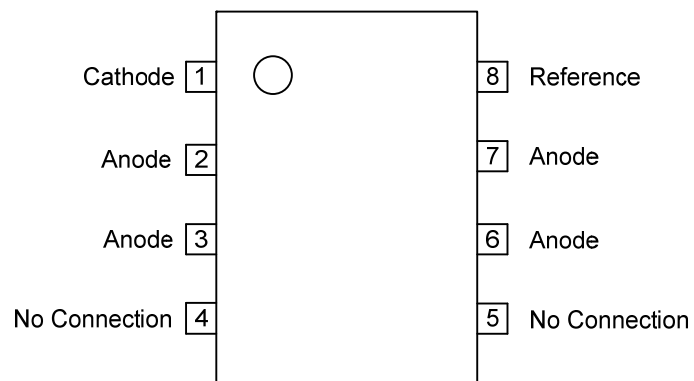
Note: Pin Code: K: Cathode A: Anode R: Reference X: No Connection

<p>TL431K-AB3-R</p>  <p>(1)Packing Type</p> <p>(2)Package Type</p> <p>(3)Lead Free</p>	<p>(1) B: Tape Box, K: Bulk, R: Tape Reel, T: Tube</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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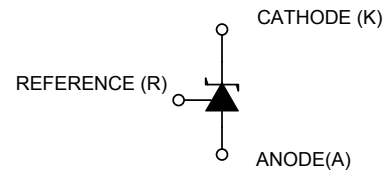
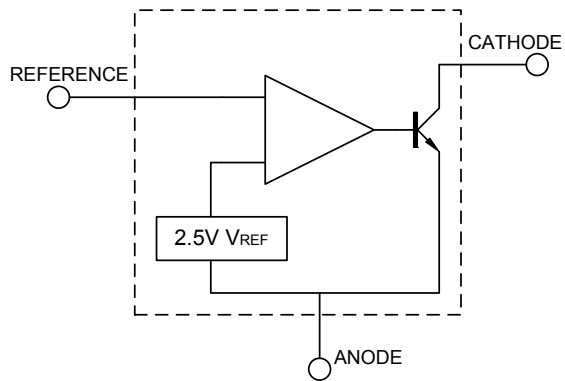
MARKING

PACKAGE	MARKING
SOT-23-3 SOT-23	 <p>3 431 □ 2 1</p> <p>→ K: Lead Free G: Halogen Free</p>
SOT-23-3 SOT-23 (TL431NS)	 <p>3 431N □ 2 1</p> <p>→ L: Lead Free G: Halogen Free</p>
SOT-25	 <p>5 4 431 □ 1 2 3</p> <p>→ K: Lead Free G: Halogen Free</p>

PIN CONFIGURATION(For SOP-8)



■ 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-23-3/SOT-25		300	mW
	SOP-8		600	mW
Operating Junction	T_J	+150	°C	
Operating Ambient	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.

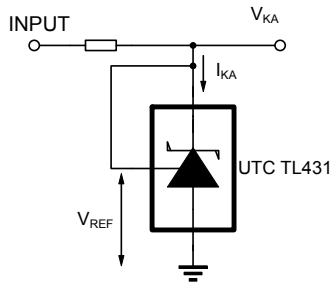
■ **RECOMMENDED OPERATING CONDITIONS**

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

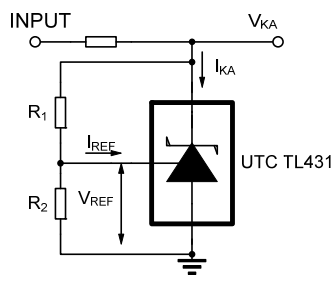
■ **ELECTRICAL CHARACTERISTICS** ($T_C = 25^\circ\text{C}$, unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Reference Input Voltage	V_{REF}	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	TL431-A	2.483	2.495	2.507	V
			TL431-1	2.470	2.495	2.520	V
			TL431-2	2.520	-	2.545	V
			TL431-3	2.445	-	2.470	V
Deviation of reference Input Voltage Over temperature	$\frac{\Delta V_{REF}}{\Delta T}$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}, 0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$		4.5	17	mV	
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	$I_{KA}=10\text{mA}$	$\Delta V_{KA}=10\text{V} \sim V_{REF}$		-1.0	-2.7	mV/V
			$\Delta V_{KA}=36\text{V} \sim 10\text{V}$		-0.5	-2.0	mV/V
Reference Input Current	I_{REF}	$I_{KA}=10\text{mA}, R1=10\text{k}\Omega, R2=\infty$		1.5	4	μA	
Deviation of Reference Input Current Over Full Temperature Range	$\frac{\Delta I_{REF}}{\Delta T}$	$I_{KA}=10\text{mA}, R1=10\text{k}\Omega, R2=\infty, T_A = \text{full Temperature}$		0.4	1.2	μA	
Minimum Cathode Current for Regulation	$I_{KA(MIN)}$	$V_{KA}=V_{REF}$		0.3	0.5	mA	
Off-State Cathode Current	$I_{KA(OFF)}$	$V_{KA}=36\text{V}, V_{REF}=0$		0.05	1.0	μA	
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	Ω	

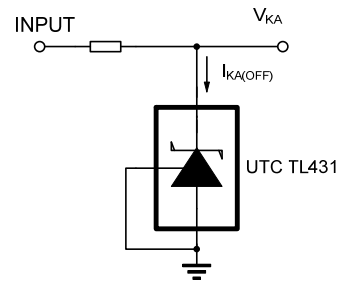
■ TEST CIRCUIT



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

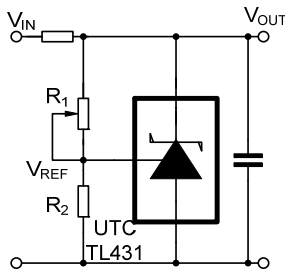


$V_{KA} = V_{REF} \times (1 + R_1/R_2) + I_{REF} \times R_1$
For $V_{KA} \geq V_{REF}$



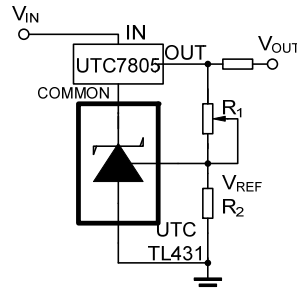
For $I_{KA(OFF)}$

■ APPLICATION CIRCUIT



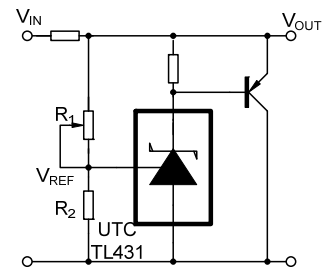
$$V_{OUT} = (1 + R_1/R_2) \times V_{REF}$$

Shutdown Regulator



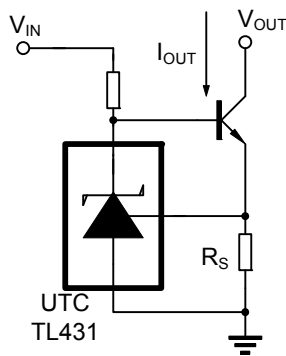
$$V_{OUT} = (1 + R_1/R_2) \times V_{REF}$$

Minimum $V_{OUT} = V_{REF} + 5V$
Output Control of a Three-Terminal Fixed Regulator



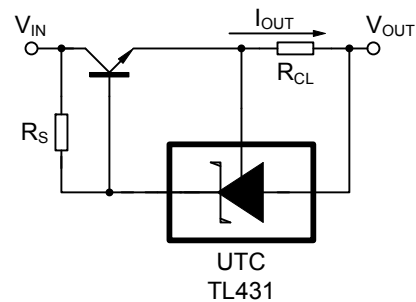
$$V_{OUT} = (1 + R_1/R_2) \times V_{REF}$$

Higher-current Shunt Regulator



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

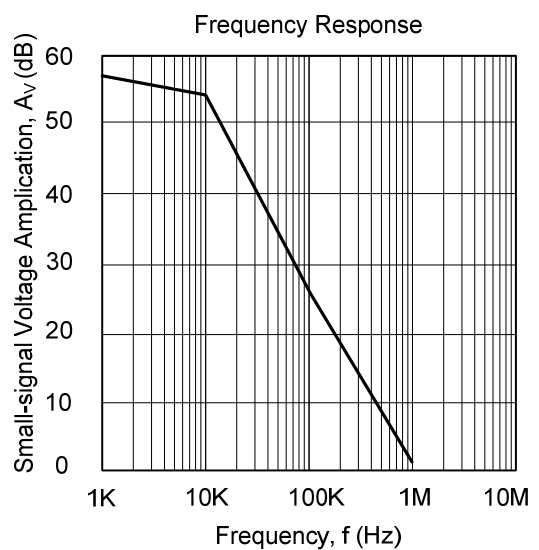
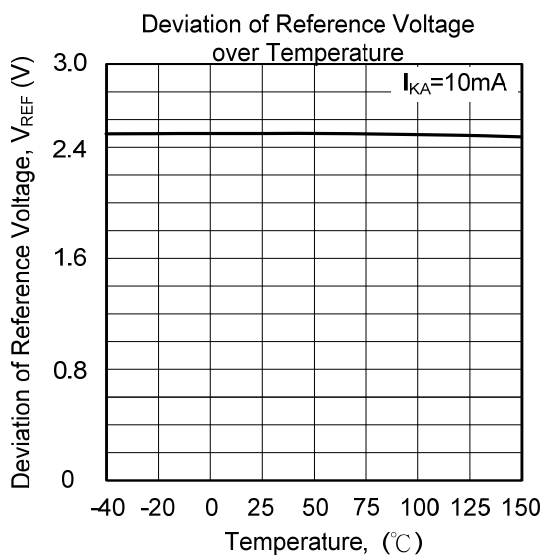
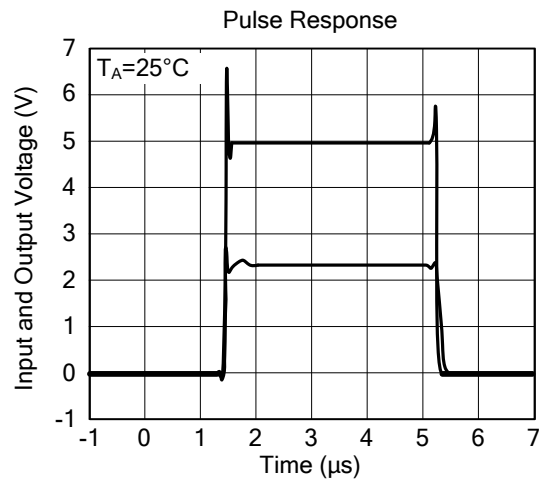
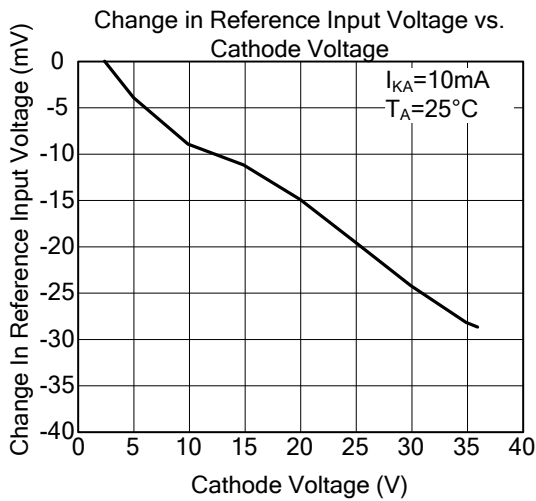
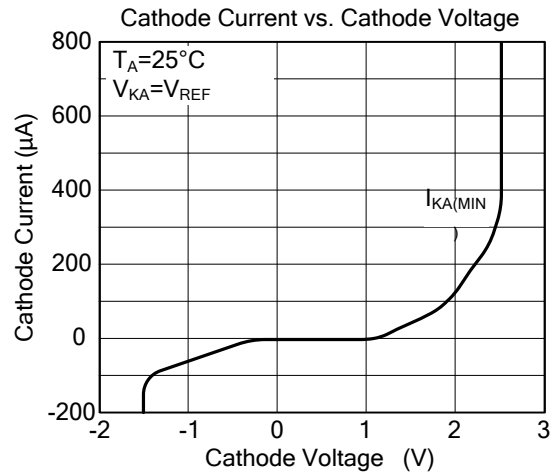
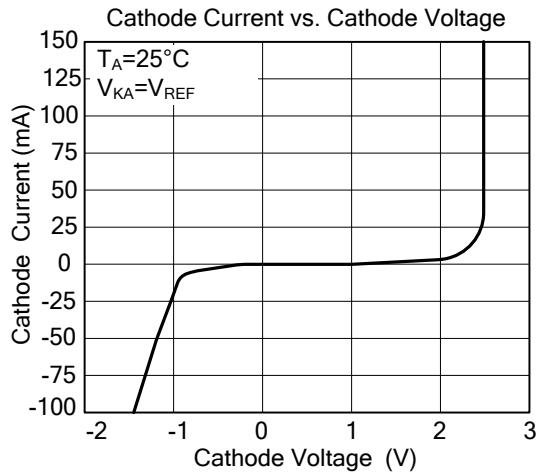
Constant-current Sink



$$I_{OUT} = V_{REF}/R_{CL}$$

Current Limiting or Current Source

TYPICAL CHARACTERISTICS



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