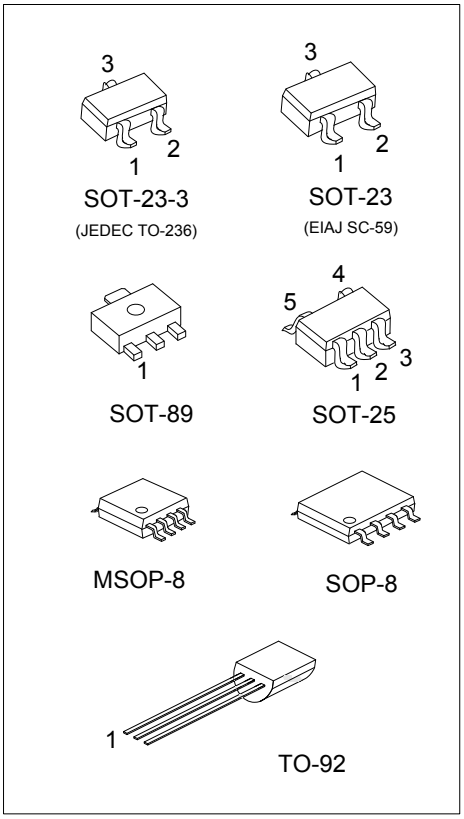
TL431L

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

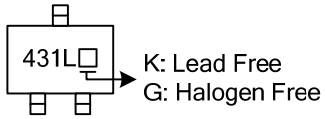
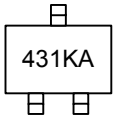
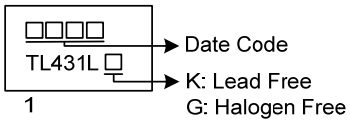
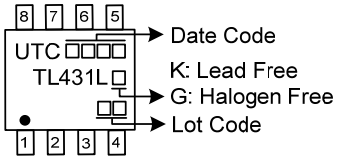
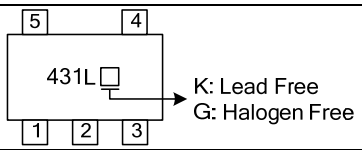
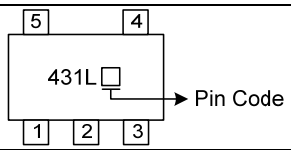
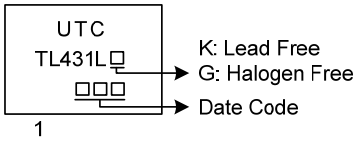
Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
TL431LK-AB3-R	TL431LG-AB3-R	SOT-89	R	A	K	-	-	-	-	-	Tape Reel
TL431LK-AE2-R	TL431LG-AE2-R	SOT-23-3	R	K	A	-	-	-	-	-	Tape Reel
-	TL431KRA-AE2-R	SOT-23-3	K	R	A	-	-	-	-	-	Tape Reel
TL431LK-AE3-R	TL431LG-AE3-R	SOT-23	R	K	A	-	-	-	-	-	Tape Reel
-	TL431KRA-AE3-R	SOT-23	K	R	A	-	-	-	-	-	Tape Reel
TL431LK-AF5-R	TL431LG-AF5-R	SOT-25	X	X	K	R	A	-	-	-	Tape Reel
TL431LK-AF5-C-R	TL431LG-AF5-C-R	SOT-25	R	A	K	X	X	-	-	-	Tape Reel
TL431LK-S08-R	TL431LG-S08-R	SOP-8	K	A	A	X	X	A	A	R	Tape Reel
TL431LK-S08-T	TL431LG-S08-T	SOP-8	K	A	A	X	X	A	A	R	Tube
TL431LK-SM1-R	TL431LG-SM1-R	MSOP-8	K	X	X	X	X	A	X	R	Tape Reel
TL431LK-SM1-T	TL431LG-SM1-T	MSOP-8	K	X	X	X	X	A	X	R	Tube
TL431LK-T92-B	TL431LG-T92-B	TO-92	R	A	K	-	-	-	-	-	Tape Box
TL431LK-T92-K	TL431LG-T92-K	TO-92	R	A	K	-	-	-	-	-	Bulk
TL431LK-T92-R	TL431LG-T92-R	TO-92	R	A	K	-	-	-	-	-	Tape Reel

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

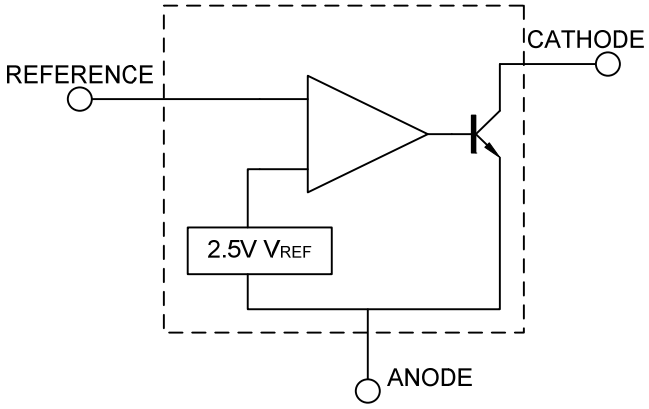
TL431LG-AF5-C-R
(1)Packing Type
(2)Pin Assignment
(3)Package Type
(4)Green Package

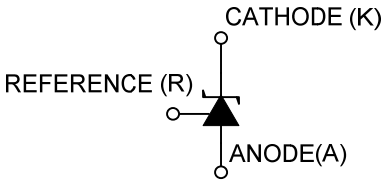
(1) B: Tape Box, K: Bulk, R: Tape Reel, T: Tube
(2) refer to Pin Assignment
(3) AB3: SOT-89, AE2: SOT-23-3, AE3: SOT-23, AF5: SOT-25, S08: SOP-8, SM1: MSOP-8, T92: TO-92
(4) G: Halogen Free and Lead Free, K: Lead Free

■ MARKING

PACKAGE	MARKING	PACKAGE	MARKING
SOT-23-3 SOT-23 (TL431L)		SOT-23-3 SOT-23 (TL431KRA)	
SOT-89		SOP-8 MSOP-8	
SOT-25		SOT-25 (Pin C)	
TO-92			

■ BLOCK DIAGRAM





■ 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	I_{REF}	-0.05 ~ +10	mA
Junction Temperature	T_J	+150	°C
Operating Temperature	T_{OPR}	-40 ~ +125	°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

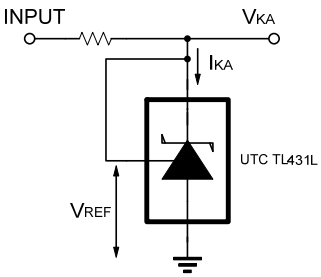
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Cathode Voltage	V_{KA}	V_{REF}		20	V
Cathode Current	I_{KA}	1		100	mA

■ ELECTRICAL CHARACTERISTICS (T_A=25°C, unless otherwise specified)

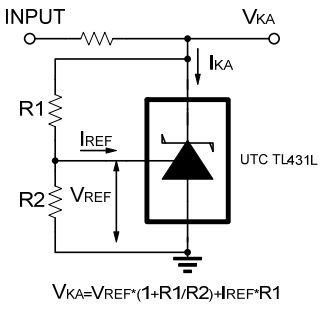
PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Reference Input Voltage	V_{REF}	$V_{KA}=V_{REF}$, I_{KA}=10mA	TL431L-A(±0.5%)	2.487	2.50	2.512	V
			TL431L-1(±1%)	2.475	2.50	2.525	V
			TL431L-2(+2%)	2.525		2.550	V
			TL431L-3(-2%)	2.450		2.475	V
Deviation of Reference Input Voltage Over temperature (note 1)	$\Delta V_{REF}/\Delta T$	$V_{KA}=V_{REF}$, I_{KA}=10mA $0 \le T_A \le 70$			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}=10mA	ΔV_{KA}=10V~V_{REF}		-1.0	-2.7	mV/V
			ΔV_{KA}=20V~10V		-0.5	-2.0	
Reference Input Current	I_{REF}	I_{KA}=10mA, R1=10kΩ, R2=∞			1.5	4	μA
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	I_{KA}=10mA, R1=10kΩ, R2=∞ T_A=full Temperature			0.4	1.2	μA
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}=20V, V_{REF}=0			0.05	1.0	μA
Dynamic Impedance	Z_{KA}	$V_{KA}=V_{REF}$, I_{KA}=1 ~ 100mA f≤1.0kHz			0.15	0.5	Ω

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

■ TEST CIRCUIT

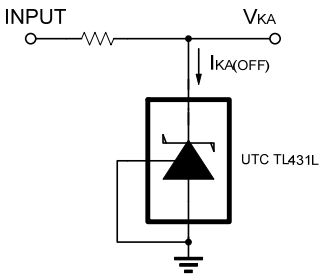


Test Circuit For $V_{KA}=V_{REF}$



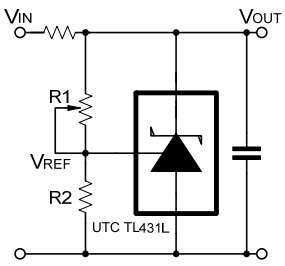
$V_{KA}=V_{REF}*(1+R1/R2)+I_{REF}*R1$

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



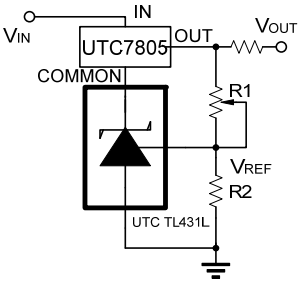
Test Circuit For $I_{KA(OFF)}$

■ APPLICATION CIRCUIT



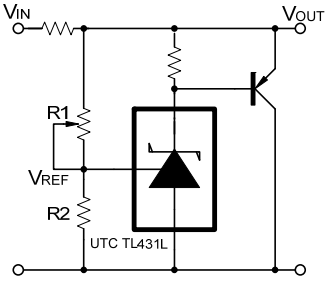
$V_{OUT}=(1+R1/R2)*V_{REF}$

Shutdown Regulator



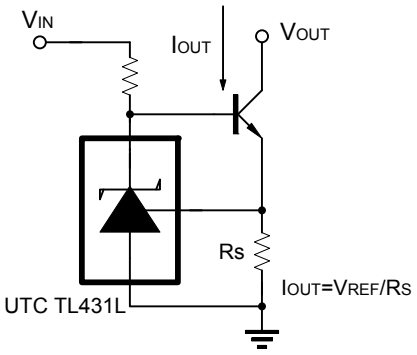
$V_{OUT}=(1+R1/R2)*V_{REF}$

Output Control of a Three-Terminal Fixed Regulator

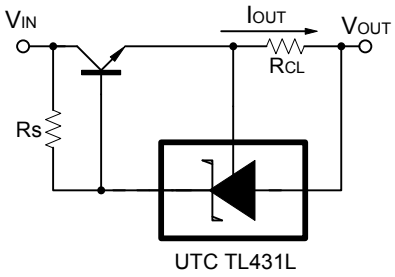


$V_{OUT}=(1+R1/R2)*V_{REF}$

Higher-Current Shunt Regulator



Constant-Current Sink

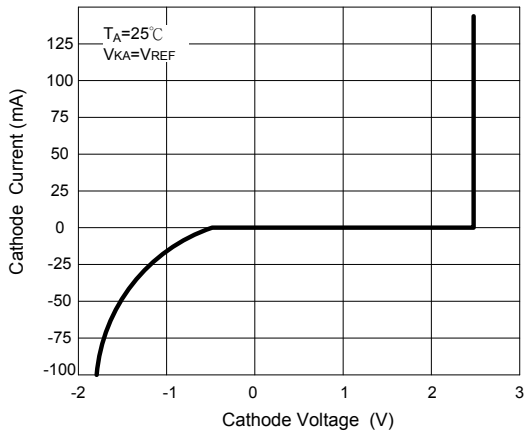


$R_S=V_{REF}/R_{CL}$

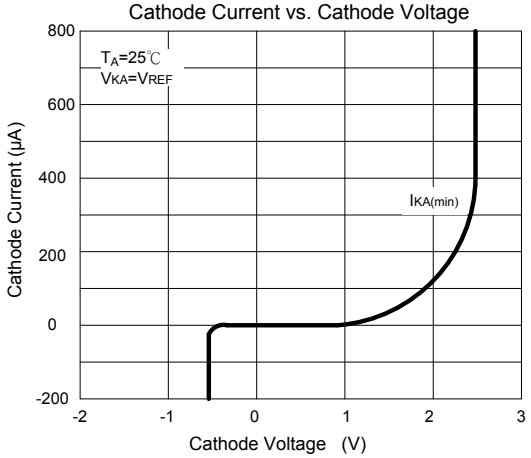
Current Limiting or Current Source

■ TYPICAL CHARACTERISTICS

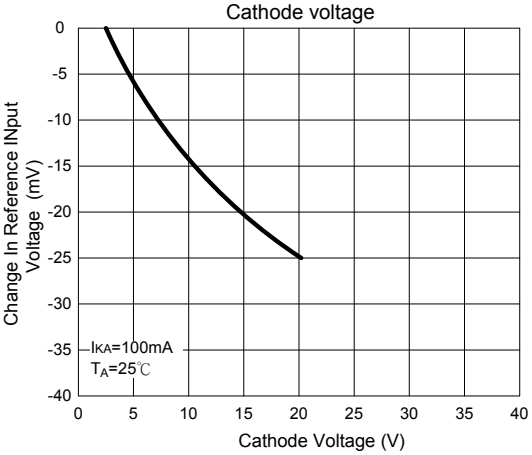
Cathode Current vs. Cathode Voltage



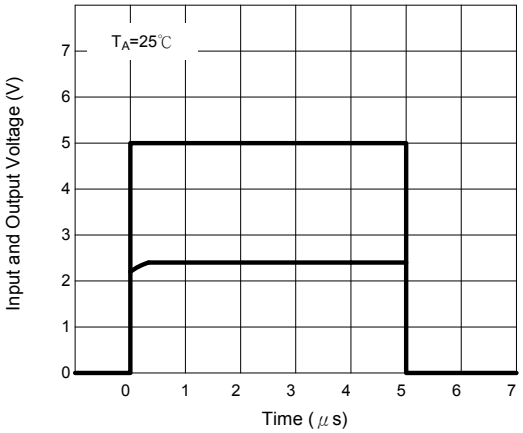
Cathode Current vs. Cathode Voltage



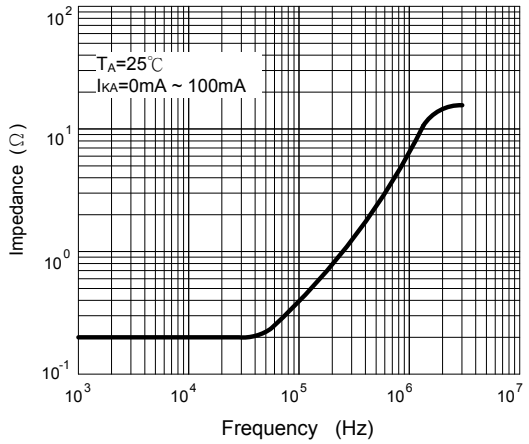
Change in Reference Input Voltage vs. Cathode voltage



Pulse Response



Dynamic Impedance vs. Frequency



Small Signal Voltage Amplification vs. Frequency