



## 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

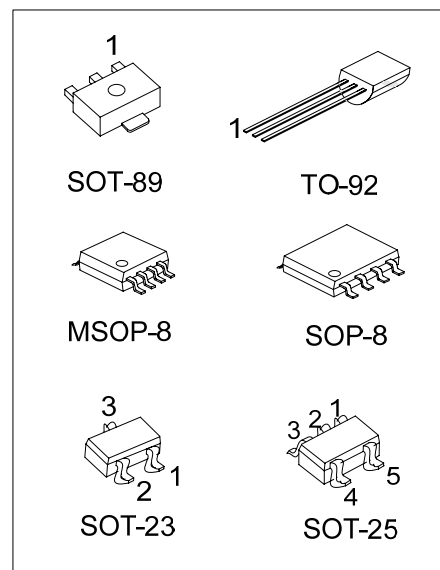
- \*Programmable output Voltage to 20V.
- \*Low dynamic output impedance  $0.2\Omega$ .
- \*Sink current capability of 1.0 ~ 100mA.
- \*Equivalent full-range temperature coefficient of 50ppm/ °C typical for operation over full rated operating temperature range.

#### ORDERING INFORMATION

| Order Number   |                   | Pin Assignment |   |   |   |   |   |   |   | Package | Packing   |
|----------------|-------------------|----------------|---|---|---|---|---|---|---|---------|-----------|
| Normal         | Lead Free Plating | 1              | 2 | 3 | 4 | 5 | 6 | 7 | 8 |         |           |
| TL431L-AB3-6-R | TL431LK-AB3-6-R   | R              | A | K | - | - | - | - | - | SOT-89  | Tape Reel |
| TL431L-AE3-3-R | TL431LK-AE3-3-R   | K              | R | A | - | - | - | - | - | SOT-23  | Tape Reel |
| TL431L-AF5-0-R | TL431LK-AF5-0-R   | X              | X | K | R | A | - | - | - | SOT-25  | Tape Reel |
| TL431L-S08-0-R | TL431LK-S08-0-R   | K              | A | A | X | X | A | A | R | SOP-8   | Tape Reel |
| TL431L-S08-0-T | TL431LK-S08-0-T   | K              | A | A | X | X | A | A | R | SOP-8   | Tube      |
| TL431L-SM1-0-R | TL431LK-SM1-0-R   | K              | X | X | X | X | A | X | R | MSOP-8  | Tape Reel |
| TL431L-SM1-0-T | TL431LK-SM1-0-T   | K              | X | X | X | X | A | X | R | MSOP-8  | Tube      |
| TL431L-T92-6-B | TL431LK-T92-6-B   | R              | A | K | - | - | - | - | - | TO-92   | Tape Box  |
| TL431L-T92-6-K | TL431LK-T92-6-K   | R              | A | K | - | - | - | - | - | TO-92   | Bulk      |
| TL431L-T92-6-R | TL431LK-T92-6-R   | R              | A | K | - | - | - | - | - | TO-92   | Tape Reel |

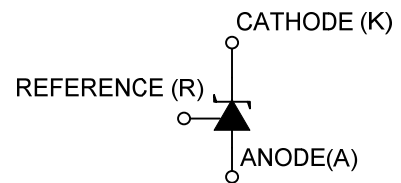
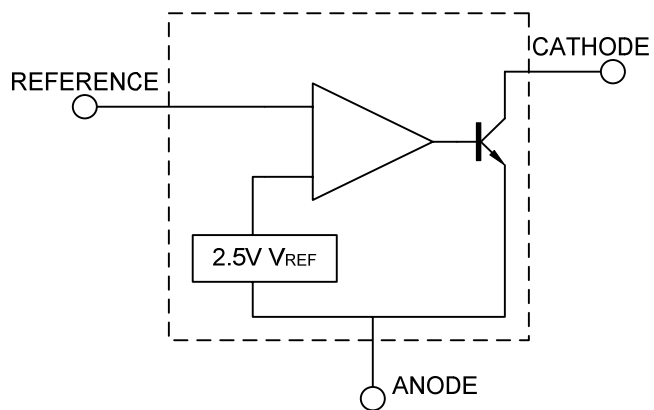
Note: Pin Code: K: Cathode A: Anode R: Reference X: No Connection

|                                                                                                             |                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>TL431LK-AB3-6-R</p> <p>(1)Packing Type<br/>(2)Pin Assignment<br/>(3)Package Type<br/>(4)Lead Plating</p> | <p>(1) B: Tape Box, K: Bulk, R: Tape Reel, T: Tube<br/>(2) refer to Pin Assignment<br/>(3) AB3: SOT-89, AE3: SOT-23, AF3: SOT-25, S08: SOP-8, SM1: MSOP-8, T92: TO-92<br/>(4) K: Lead Free Plating, Blank: Pb/Sn</p> |
|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



\*Pb-free plating product number: TL431LK

### ■ 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 Range      | $I_{REF}$ | -0.05 ~ +10 | mA   |
| Operating Junction Temperature     | $T_J$     | 150         | °C   |
| Operating Ambient Temperature      | $T_{OPR}$ | 0 ~ +70     | °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

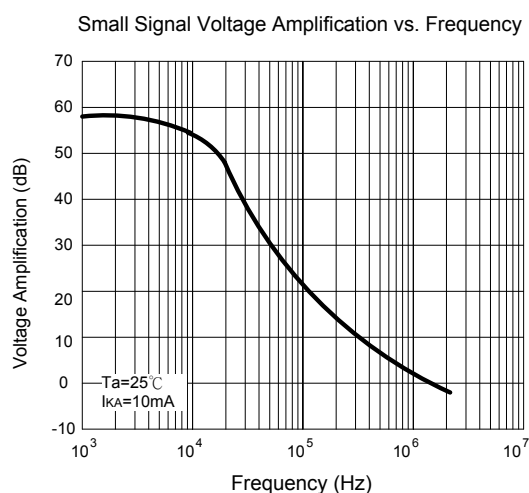
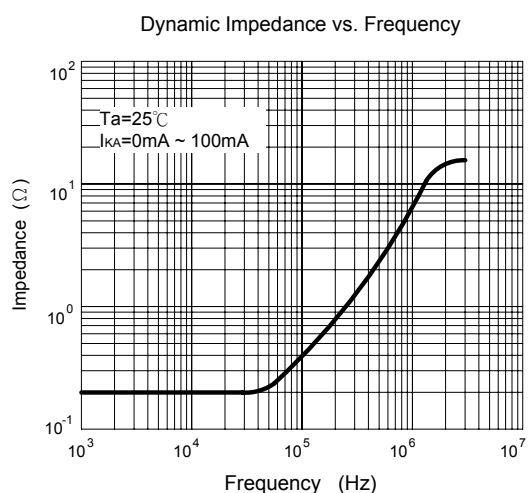
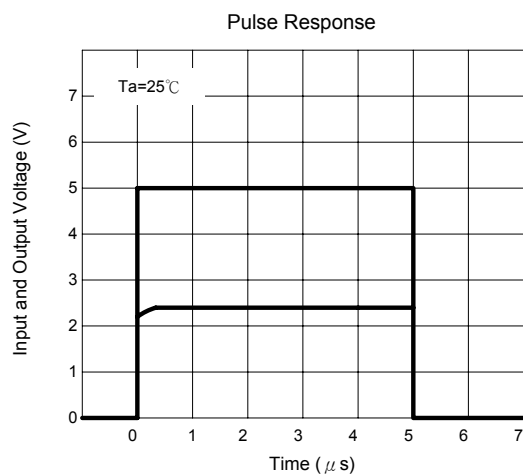
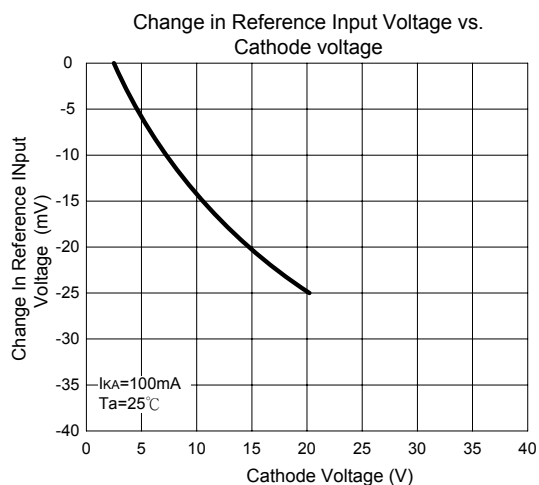
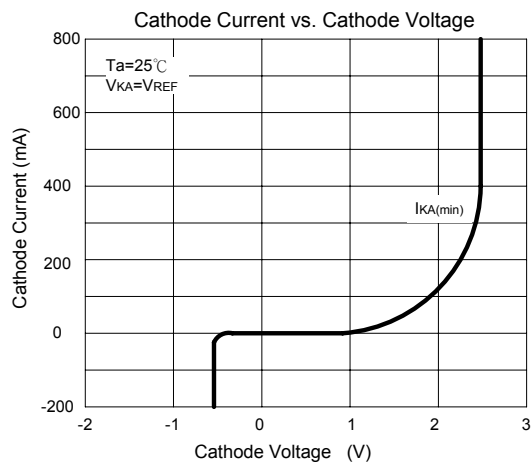
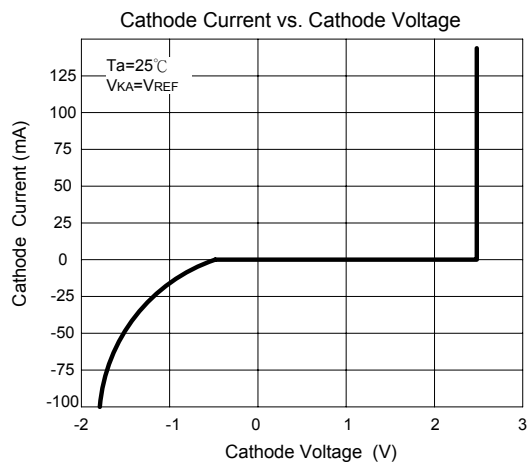
| PARAMETER       | SYMBOL   | MIN       | TYP | MAX | UNIT |
|-----------------|----------|-----------|-----|-----|------|
| Cathode Voltage | $V_{KA}$ | $V_{REF}$ |     | 20  | V    |
| Cathode Current | $I_{KA}$ | 1         |     | 100 | mA   |

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

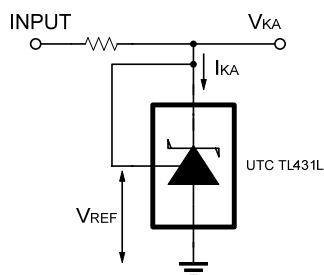
| PARAMETER                                                                   | SYMBOL                         | TEST CONDITIONS                                                                                               | MIN   | TYP          | MAX          | UNIT          |
|-----------------------------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------|-------|--------------|--------------|---------------|
| Reference Input Voltage                                                     | $V_{REF}$                      | $V_{KA}=V_{REF}$ , $I_{KA}=10\text{mA}$                                                                       | 2.450 | 2.50         | 2.550        | V             |
| Deviation of Reference Input Voltage Over temperature (note 1)              | $\Delta V_{REF}/\Delta T$      | $V_{KA}=V_{REF}$ , $I_{KA}=10\text{mA}$<br>$0 \leq T_A \leq 70$                                               |       | 4.5          | 17           | mV            |
| Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage | $\Delta V_{REF}/\Delta V_{KA}$ | $I_{KA}=10\text{mA}$<br>$\Delta V_{KA}=10\text{V} \sim V_{REF}$<br>$\Delta V_{KA}=20\text{V} \sim 10\text{V}$ |       | -1.0<br>-0.5 | -2.7<br>-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            | $\Delta I_{REF}/\Delta T$      | $I_{KA}=10\text{mA}$ , $R1=10\text{k}\Omega$ , $R2=\infty$<br>$T_A=\text{full Temperature}$                   |       | 0.4          | 1.2          | $\mu\text{A}$ |
| Minimum Cathode Current for Regulation                                      | $I_{KA(MIN)}$                  | $V_{KA}=V_{REF}$                                                                                              |       | 0.45         | 1.0          | mA            |
| Off-State Cathode Current                                                   | $I_{KA(OFF)}$                  | $V_{KA}=20\text{V}$ , $V_{REF}=0$                                                                             |       | 0.05         | 1.0          | $\mu\text{A}$ |
| Dynamic Impedance                                                           | $Z_{KA}$                       | $V_{KA}=V_{REF}$ , $I_{KA}=1 \sim 100\text{mA}$<br>$f \leq 1.0\text{kHz}$                                     |       | 0.15         | 0.5          | $\Omega$      |

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

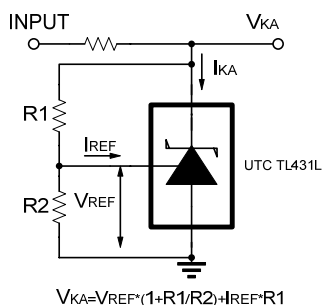
### TYPICAL CHARACTERISTICS



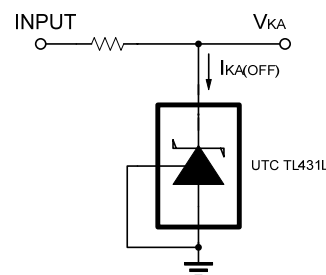
### ■ TEST CIRCUIT



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

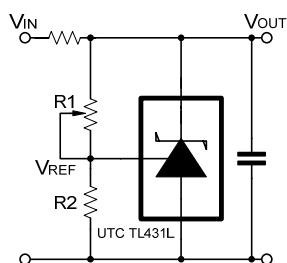


Test Circuit for  $V_{KA} \geq V_{REF}$

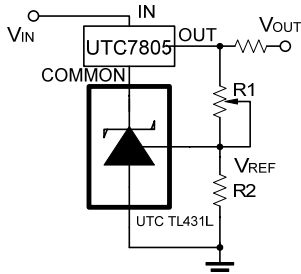


Test Circuit For  $I_{KA(OFF)}$

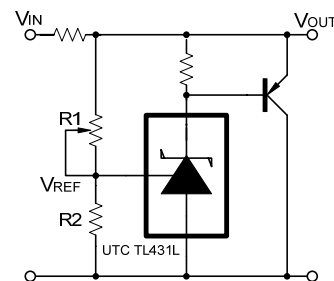
### ■ APPLICATION CIRCUIT



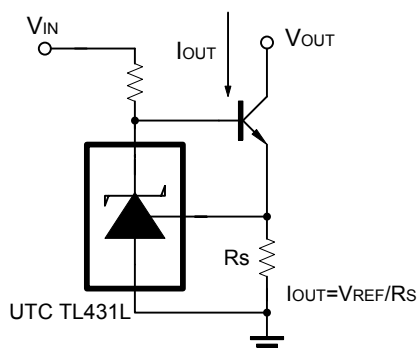
Shutdown Regulator



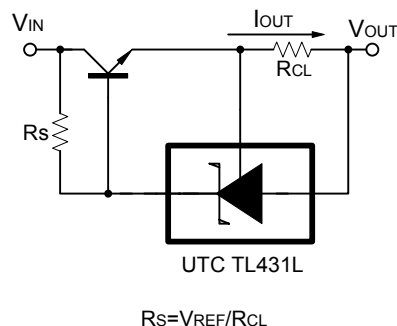
Output Control of a Three-Terminal Fixed Regulator



Higher-Current Shunt Regulator



Constant-Current Sink



Current Limiting or Current Source

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