



Micro Commercial Components



Micro Commercial Components  
20736 Marilla Street Chatsworth  
CA 91311  
Phone: (818) 701-4933  
Fax: (818) 701-4939

# TL431K

## Programmable Precision Regulator

### Features

- Lead Free Finish/RoHS Compliant ("P" Suffix designates RoHS Compliant. See ordering information)
- Epoxy meets UL 94 V-0 flammability rating
- Moisture Sensitivity Level 1
- Programmable Output Voltage 36V
- Sink Current Capability of 0.1mA to 100 mA
- The typical value of the equivalent temperature factor in the whole temperature scope is 50 ppm/°C
- Low output noise voltage and Fast turn on response
- The Reference Input Voltage tolerance is 0.5%
- Marking Code: 431K
- Halogen free available upon request by adding suffix "-HF"

### Maximum Ratings

| Parameter                     | Symbol    | Value      | Unit |
|-------------------------------|-----------|------------|------|
| Cathode Voltage               | $V_{KA}$  | 37         | V    |
| Cathode Current Range         | $I_K$     | -100~150   | mA   |
| Reference Input Current Range | $I_{REF}$ | 0.05~10    | mA   |
| Power Dissipation at 25°C     | $P_D$     | 0.3        | W    |
| Operating Temperature         | $T_{opr}$ | -40---85   | °C   |
| Storage Temperature Range     | $T_{STG}$ | -65---+150 | °C   |

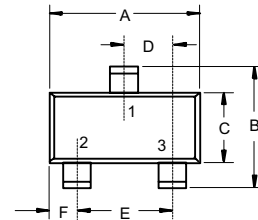
### Recommended Operating Conditions

| Parameter             | Sym      | Min       | Max | Unit |
|-----------------------|----------|-----------|-----|------|
| Cathode Voltage       | $V_{KA}$ | $V_{REF}$ | 36  | V    |
| Cathode Current Range | $I_K$    | 1.0       | 100 | mA   |

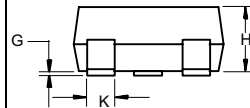
### Electrical Characteristics @ 25°C Unless Otherwise Specified

| Parameter   | Sym                                    | Min    | Typ    | Max    | Test conditions   |
|---|--|--------|--------|--------|---|
| Reference Input Voltage   | $V_{ref}$                              | 2.482V | 2.500V | 2.508V | $V_{KA}=V_{REF}, I_{KA}=10mA$                                       |
| Deviation of reference input voltage  | $\frac{\Delta V_{ref}}{\Delta T}$      |        | 4.5mV  | 17mV   | $V_{KA}=V_{REF}, I_{KA}=10mA$<br>$T_{min} \leq T_a \leq T_{max}$    |
| Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage | $\frac{\Delta V_{ref}}{\Delta V_{KA}}$ |        | -1.0   | -2.7   | $\Delta V_{KA}=10V \sim V_{ref}$                                    |
| Reference Input Current   | $I_{ref}$                              |        | 1.5µA  | 4.0µA  | $I_{KA}=10mA, R_1=10K\Omega, R_2=\infty$                            |
| Deviation of Reference Input Current Over Full Temperature Range            | $\frac{\Delta I_{ref}}{\Delta T}$      |        | 0.4µA  | 1.2µA  | $I_{KA}=10mA, R_1=10K\Omega, R_2=\infty$<br>$T_A=full\ Temperature$ |
| Minimum Cathode Current for Regulation                                      | $I_{KA(min)}$                          |        | 0.45mA | 1.0mA  |   |
| Off-State Cathode Current   | $I_{KA(off)}$                          |        | 0.05µA | 0.5µA  | $V_{KA}=40V, V_{REF}=0V$  |
| Dynamic Impedance   | $Z_{KA}$                               |        | 0.15Ω  | 0.5Ω   | $I_{KA}=1\ to\ 100mA, f \leq 1.0KHz$                                |

### SOT-23

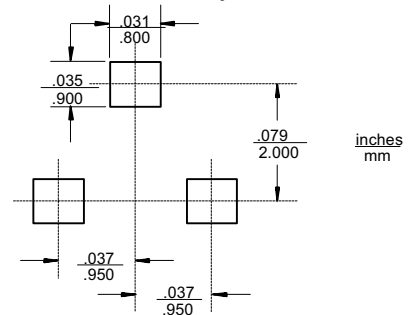


1. (A) ANODE
2. (R) REFERENCE
3. (K) CATHODE



| DIM | DIMENSIONS |       |      |      | NOTE |
|-----|------------|-------|------|------|------|
|     | INCHES     |       | MM   |      |      |
| A   | .110       | .120  | 2.80 | 3.04 |      |
| B   | .083       | .104  | 2.10 | 2.64 |      |
| C   | .047       | .055  | 1.20 | 1.40 |      |
| D   | .035       | .041  | .89  | 1.03 |      |
| E   | .070       | .081  | 1.78 | 2.05 |      |
| F   | .018       | .024  | .45  | .60  |      |
| G   | .0005      | .0039 | .013 | .100 |      |
| H   | .035       | .044  | .89  | 1.12 |      |
| J   | .003       | .007  | .085 | .180 |      |
| K   | .015       | .020  | .37  | .51  |      |

### Suggested Solder Pad Layout



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Figure 1. Test Circuit for  $V_{KA} = V_{ref}$

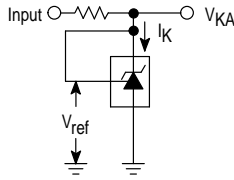


Figure 2. Test Circuit for  $V_{KA} > V_{ref}$

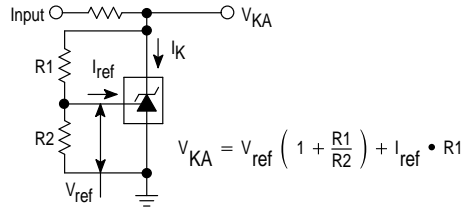
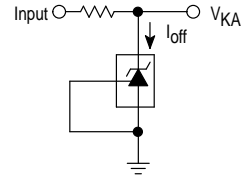
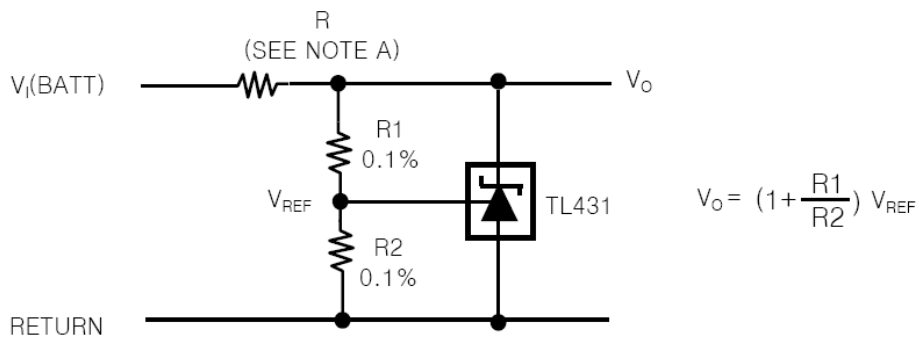


Figure 3. Test Circuit for  $I_{off}$



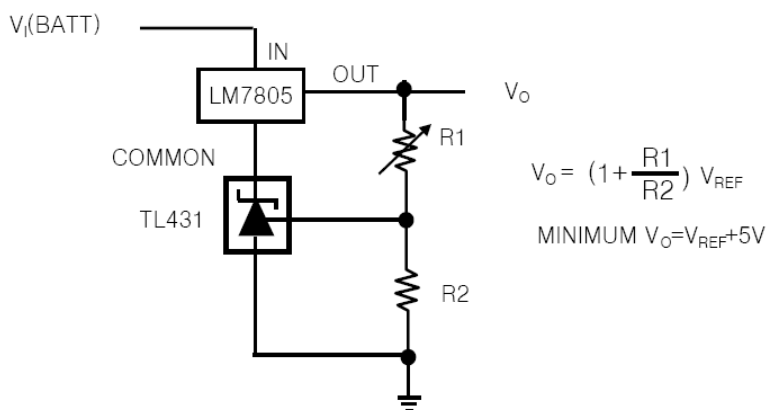
## APPLICATION INFORMATION

### 1. Shunt Regulator



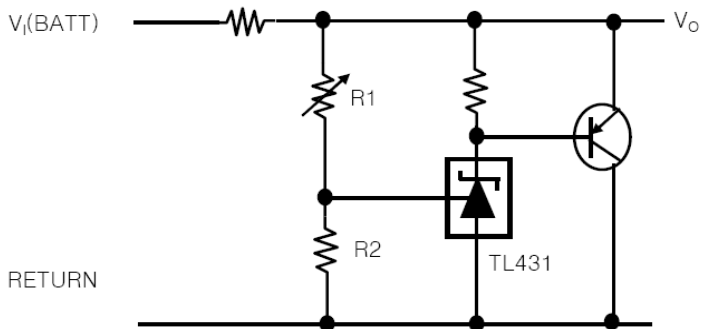
Note A : R Should provide cathode current 1mA to the TL431 at minimum  $V_{i(BATT)}$

### 2. Output Control of a Three-Terminal Fixed Regulator



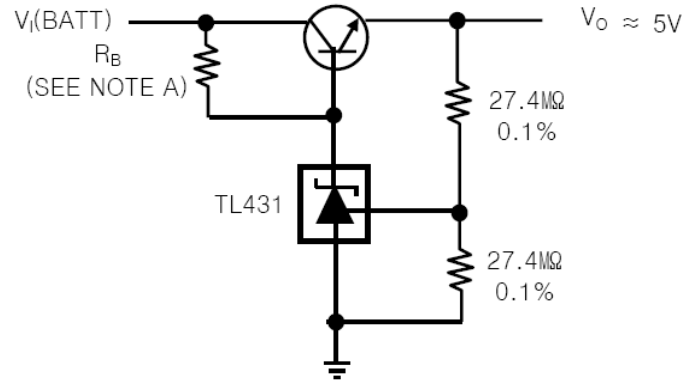
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### 3. High-Current Shunt Regulator



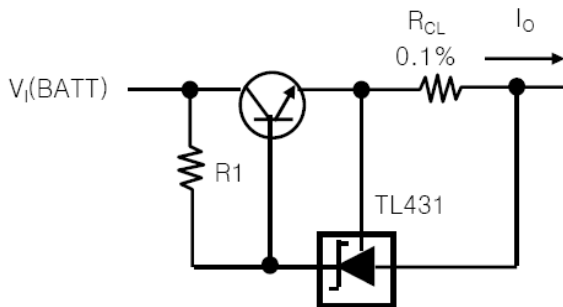
$$V_o = (1 + \dots)$$

### 4. Efficient 5-V Precision Regulator



NOTE A : R<sub>B</sub> Should provide cathode current ≥ 1mA to the TL431.

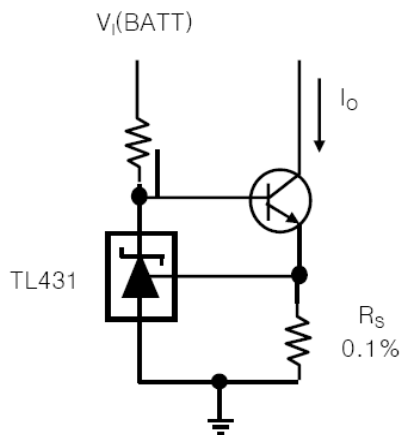
### 5. Precision Current Limiter



$$I_{OUT} = \frac{V_{REF}}{R_{CL}} + I_{KA}$$

$$R1 = \frac{V_{I(BATT)}}{I_o} + I_{KA} \cdot H_{FE}$$

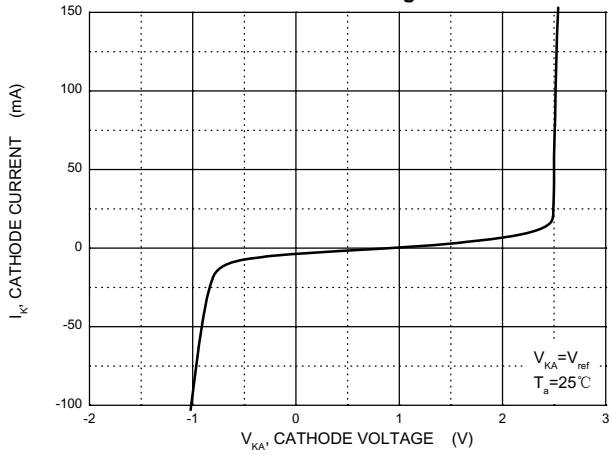
### 6. Precision Constant-Current Sink



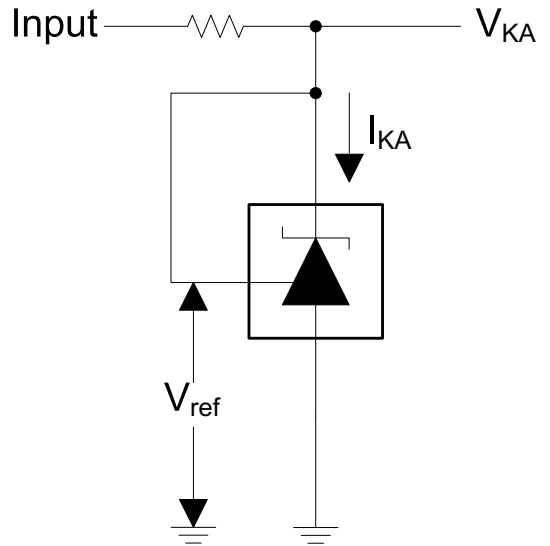
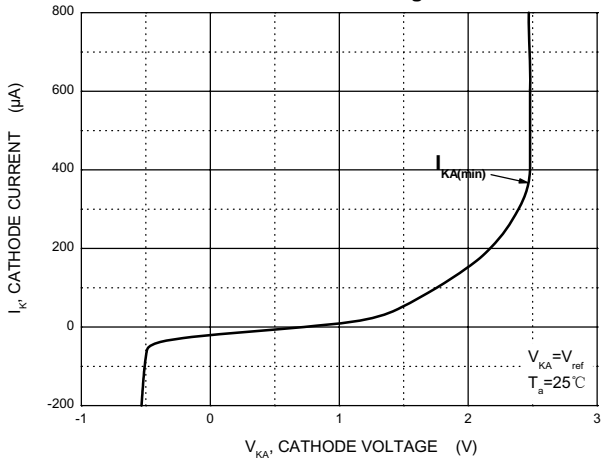
$$I_o = \frac{V_{REF}}{R_S}$$

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**Cathode Current versus Cathode Voltage**

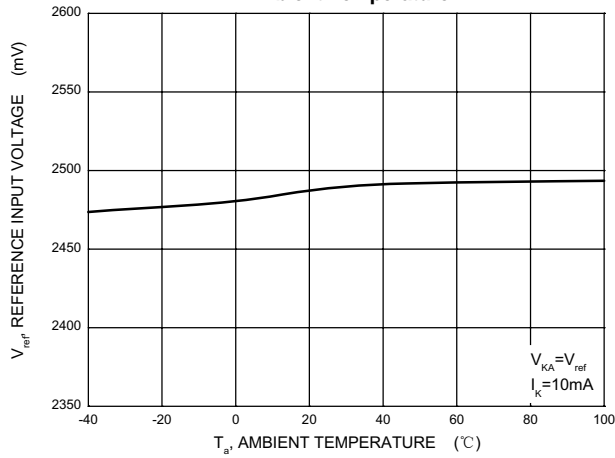


**Cathode Current versus Cathode Voltage**

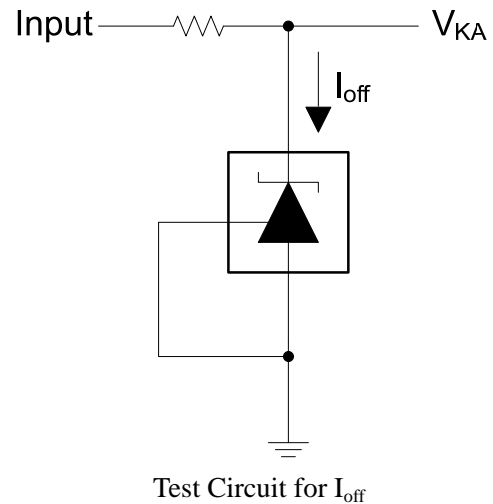
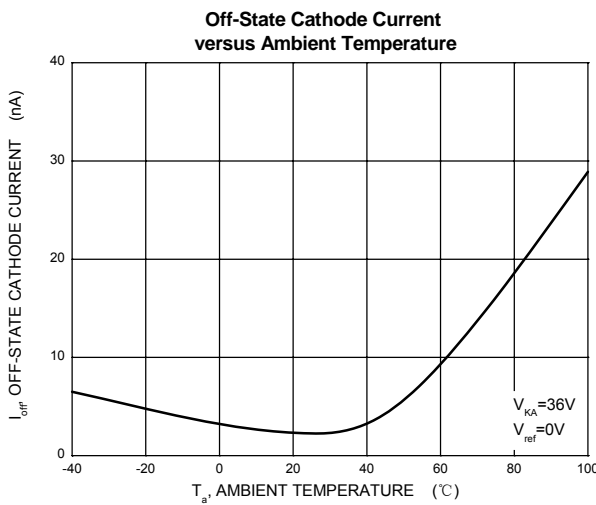
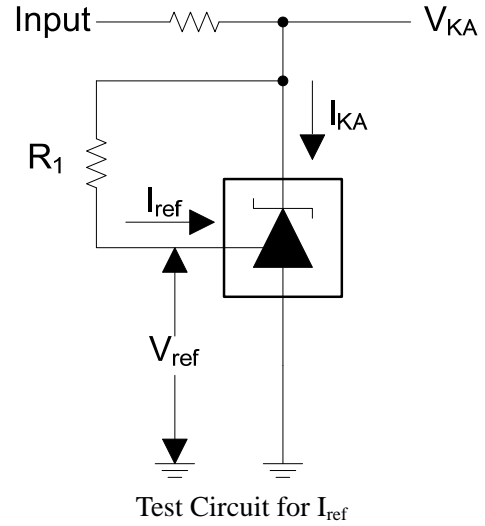
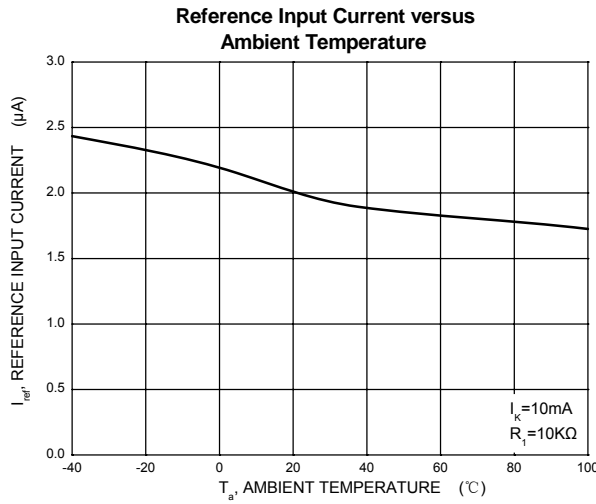
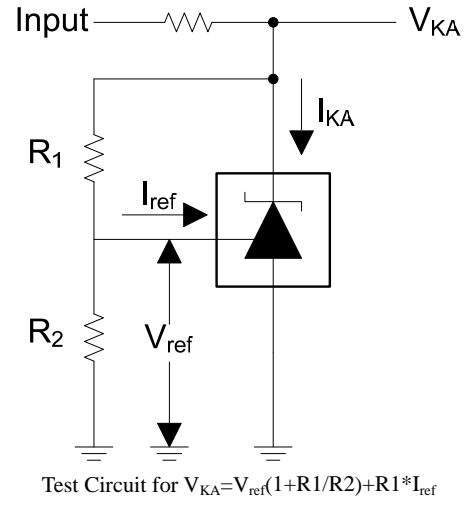
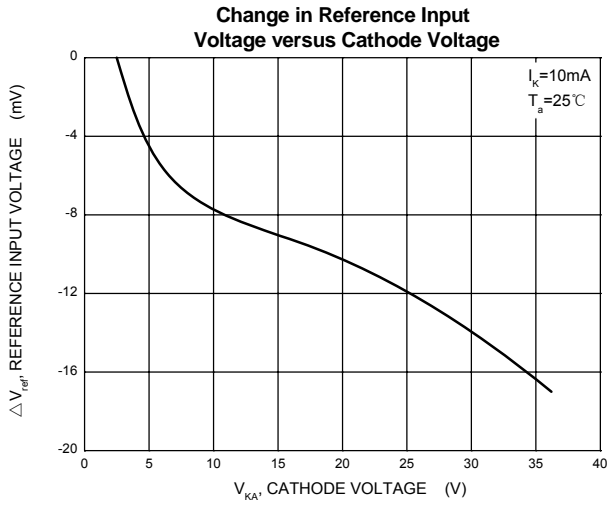


Test Circuit for  $V_{KA} = V_{ref}$

**Reference Input Voltage versus Ambient Temperature**



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### Ordering Information :

| Device         | Packing               |
|----------------|-----------------------|
| Part Number-TP | Tape&Reel; 3Kpcs/Reel |

Note : Adding "-HF" suffix for halogen free, eg. Part Number-TP-HF

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