

## ADJUSTABLE PRECISION SHUNT REGULATOR

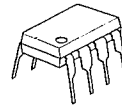
### GENERAL DESCRIPTION

The NJM431 is a 3 terminal adjustable shunt regulator. The output voltage may be set to any value between  $V_{REF}$  (about 2.5V) and 36V by two resistors. Output circuitry shows a sharp turn-on characteristics. Applications include shunt regulators, series regulators for small power and isolation regulators with photo couplers.

### FEATURES

- Operating Voltage ( $V_{KA} = V_{REF} \sim 36V$ )
- Fast Turn-On Respability
- Cathode Current (1mA ~ 100mA)
- Low Dynamic Output Impedance (0.2Ω typ.)
- Package Outline DIP8, DMP8, TO-92, SOT-89
- Bipolar Technology

### PACKAGE OUTLINE



NJM431D

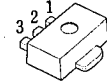


NJM431M



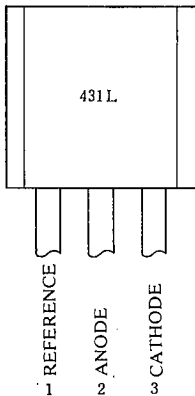
NJM431L (TO-92)

1. REF
2. ANODE
3. CATHODE

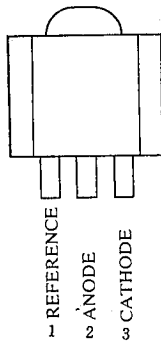


NJM431U (SOT-89)

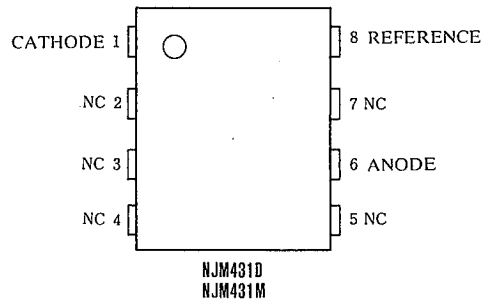
### PIN CONFIGURATION



NJM431L



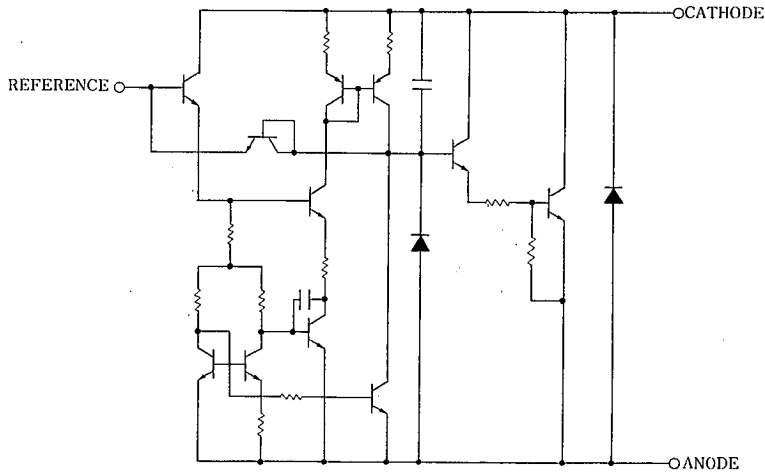
NJM431U



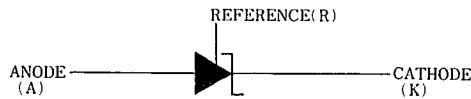
NJM431D  
NJM431M

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### EQUIVALENT CIRCUIT



## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

| PARAMETER                  | SYMBOL           | RATINGS     | UNIT |
|----------------------------|------------------|-------------|------|
| Cathode Voltage (note)     | V <sub>KA</sub>  | 37          | V    |
| Continuous Cathode Current | I <sub>KA</sub>  | -100 ~ 150  | mA   |
| Reference Input Current    | I <sub>REF</sub> | -0.05 ~ 10  | mA   |
| Power Dissipation          | P <sub>D</sub>   | (DIP8) 700  | mW   |
|                            |                  | (DMP8) 300  | mW   |
|                            |                  | (TO92) 500  | mW   |
|                            |                  | (SOT89) 350 | mW   |
| Operating Temperature      | T <sub>opr</sub> | -40 ~ +85   | °C   |
| Storage Temperature        | T <sub>stg</sub> | -40 ~ +125  | °C   |

(note) Unless specified, all voltage values are with respect to the anode terminal.

## ■ RECOMMENDED OPERATING CONDITIONS

| PARAMETER       | SYMBOL          | MIN.             | TYP. | MAX. | UNIT |
|-----------------|-----------------|------------------|------|------|------|
| Cathode Voltage | V <sub>KA</sub> | V <sub>REF</sub> | —    | 36   | V    |
| Cathode Current | I <sub>K</sub>  | I                | —    | 100  | mA   |

## ■ ELECTRICAL CHARACTERISTICS (Ta=25°C)

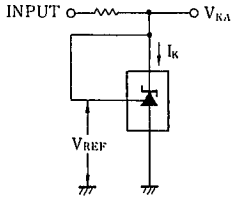
| PARAMETER  | SYMBOL                                 | TEST CONDITION  | MIN. | TYP. | MAX. | UNIT |
|--|--|---|------|------|------|------|
| Reference Voltage  | V <sub>REF</sub>                       | V <sub>KA</sub> =V <sub>REF</sub> , I <sub>K</sub> =10mA (note 1)                         | 2440 | 2495 | 2550 | mV   |
| Reference Voltage Change<br>(Full Oper. Temp. Range)       | V <sub>REF</sub><br>(dev)              | V <sub>KA</sub> =V <sub>REF</sub> , I <sub>K</sub> =10mA (note 1),<br>Ta=-20°C~+85°C      | —    | 8    | 17   | mV   |
| Reference Voltage Change<br>vs. Cathode Voltage Change     | $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | I <sub>K</sub> =10mA (note 2)   | —    | -1.4 | -2.7 | mV/V |
|  |  | $\frac{\Delta V_{KA}=10V-V_{REF}}{\Delta V_{KA}=36V-10V}$                                 | —    | -1   | -2   | mV/V |
| Reference Input Current                                    | I <sub>REF</sub>                       | I <sub>K</sub> =10mA, R <sub>1</sub> =10kΩ, R <sub>2</sub> =∞ (note 2)                    | —    | 2    | 4    | μA   |
| Reference Input Current Change<br>(Full Oper. Temp. Range) | I <sub>REF</sub><br>(dev)              | I <sub>K</sub> =10mA, R <sub>1</sub> =10kΩ, R <sub>2</sub> =∞ (note 2),<br>Ta=-20°C~+85°C | —    | 0.4  | 1.2  | μA   |
| Minimum Input Current                                      | I <sub>MIN</sub>                       | V <sub>KA</sub> =V <sub>REF</sub> (note 1)  | —    | 0.4  | 1.0  | mA   |
| Cathode Current (Off Cond.)                                | I <sub>OFF</sub>                       | V <sub>KA</sub> =36V, V <sub>REF</sub> =0 (note 3)  | —    | 0.1  | 1.0  | μA   |
| Dynamic Impedance  | Z <sub>KA</sub>                        | V <sub>KA</sub> =V <sub>REF</sub> , I <sub>K</sub> =1mA~100mA,<br>f≤1kHz (note 1)         | —    | 0.2  | 0.5  | Ω    |

(note 1) TEST CIRCUIT (Fig. 1)

(note 2) TEST CIRCUIT (Fig. 2)

(note 3) TEST CIRCUIT (Fig. 3)

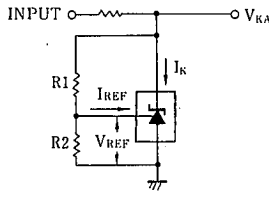
## TEST CIRCUITS



1.  $V_{KA} = V_{REF}$

$$V_O = V_{KA} = V_{REF}$$

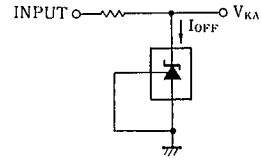
(Fig. 1)



2.  $V_{KA} > V_{REF}$

$$V_O = V_{KA} = V_{REF} \cdot \left(1 + \frac{R1}{R2}\right) + I_{REF} \cdot R1$$

(Fig. 2)

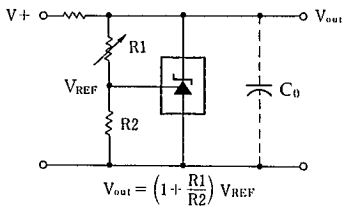


3.  $I_{OFF}$

(Fig. 3)

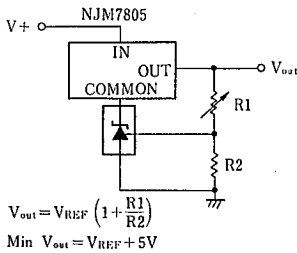
## TYPICAL APPLICATION

### (1) Shunt Regulator



$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

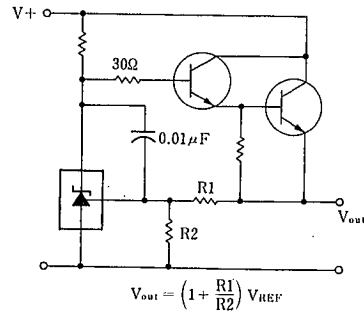
### (3) Output Control of a Three-Terminal fixed Regulator



$$V_{out} = V_{REF} \left(1 + \frac{R1}{R2}\right)$$

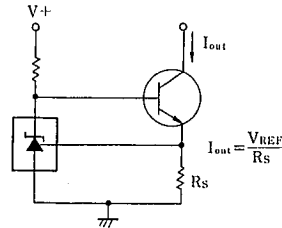
Min  $V_{out} = V_{REF} + 5V$

### (2) Series Regulator



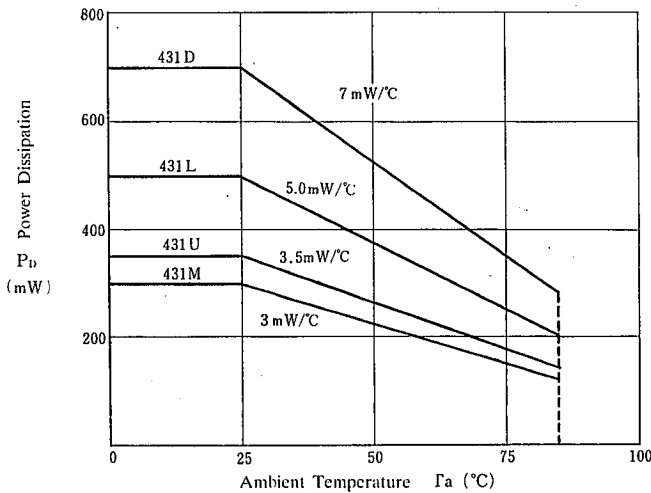
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

### (4) Constant Current Source

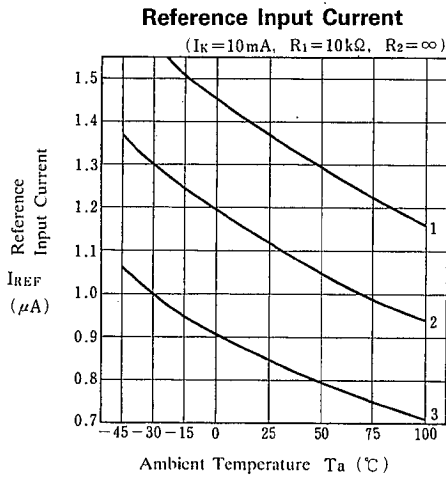
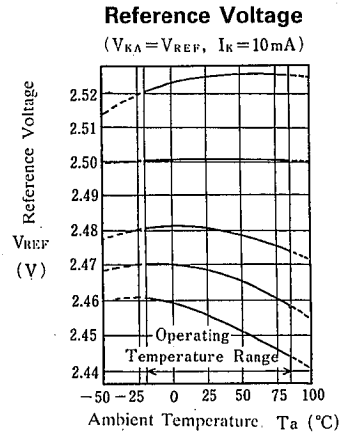
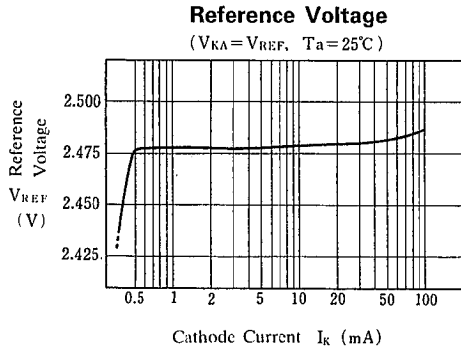


$$I_{out} = \frac{V_{REF}}{R_s}$$

## POWER DISSIPATION VS. AMBIENT TEMPERATURE

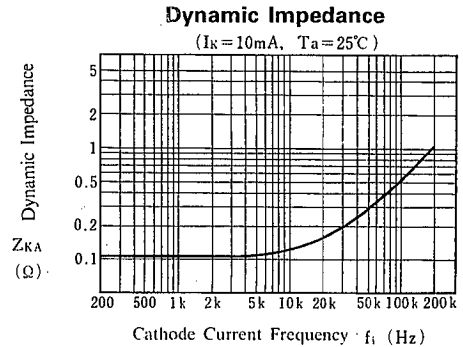
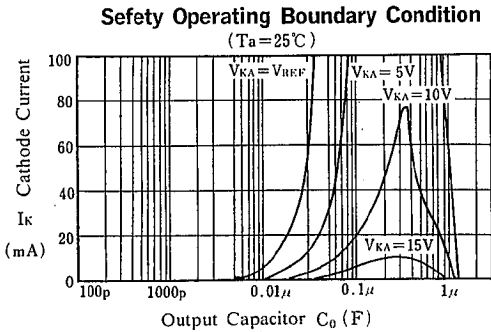
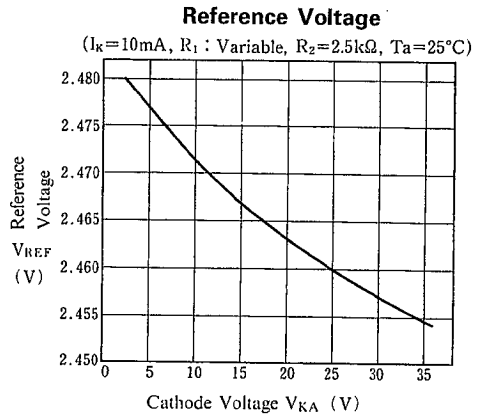


## ■ TYPICAL CHARACTERISTICS



| $V_{REF}(\text{dev})$ | ( $T_a = -20 \sim 25^\circ\text{C}$ ) | ( $T_a = 25 \sim 85^\circ\text{C}$ ) | ( $T_a = 25^\circ\text{C}$ ) |
|-----------------------|---------------------------------------|--------------------------------------|------------------------------|
| No.1                  | + 5 mV                                | + 1 mV                               | 2525mV                       |
| No.2                  | 0 mV                                  | 0 mV                                 | 2501mV                       |
| No.3                  | 0 mV                                  | - 6 mV                               | 2481mV                       |
| No.4                  | - 2 mV                                | - 9 mV                               | 2468mV                       |
| No.5                  | - 5 mV                                | -12mV                                | 2456mV                       |

$I_{REF}(\text{dev})$   
 No.1 -  $0.38\mu\text{A}$   
 No.2 -  $0.27\mu\text{A}$   
 No.3 -  $0.21\mu\text{A}$



Note) Oscillation might occur while operating within the range of safety curve. So that, it is necessary to make ample margins by taking considerations of fluctuation of the device.

## MEMO

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