

## ADJUSTABLE PRECISION SHUNT REGULATOR

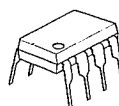
## ■ GENERAL DESCRIPTION

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

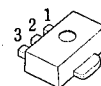


NJM431M



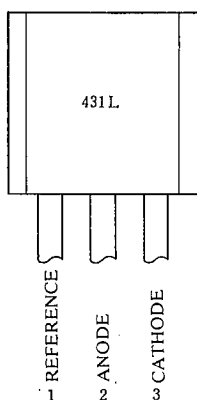
NJM431L (TO-92)

1. REF
2. ANODE
3. CATHODE

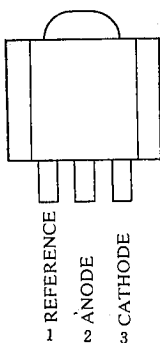


NJM431U (SOT-89)

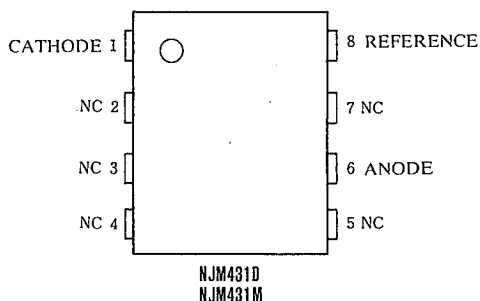
## ■ PIN CONFIGURATION



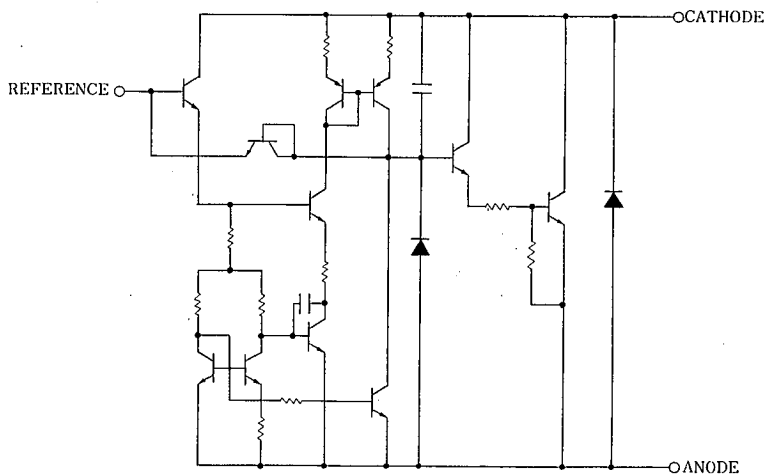
NJM431L



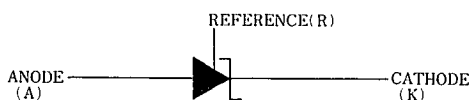
NJM431U

NJM431D  
NJM431M

## ■ EQUIVALENT CIRCUIT



■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

| PARAMETER                  | SYMBOL    | RATINGS     | UNIT |
|----------------------------|-----------|-------------|------|
| Cathode Voltage (note).    | $V_{KA}$  | 37          | V    |
| Continuous Cathode Current | $I_{KA}$  | -100 ~ 150  | mA   |
| Reference Input Current    | $I_{REF}$ | -0.05 ~ 10  | mA   |
| Power Dissipation          | $P_D$     | (DIP8) 700  | mW   |
|                            |           | (DMP8) 300  | mW   |
|                            |           | (TO92) 500  | mW   |
|                            |           | (SOT89) 350 | mW   |
| Operating Temperature      | $T_{opr}$ | -40 ~ +85   | °C   |
| Storage Temperature        | $T_{stg}$ | -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 | $V_{KA}$ | $V_{REF}$ | —    | 36   | V    |
| Cathode Current | $I_K$    | I         | —    | 100  | mA   |

■ ELECTRICAL CHARACTERISTICS (Ta=25°C)

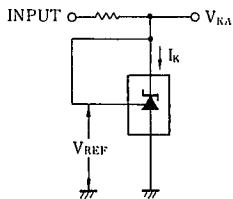
| PARAMETER                                                  | SYMBOL                                 | TEST CONDITION                                                                                                      | MIN. | TYP.       | MAX.       | UNIT          |
|------------------------------------------------------------|----------------------------------------|---------------------------------------------------------------------------------------------------------------------|------|------------|------------|---------------|
| Reference Voltage                                          | $V_{REF}$                              | $V_{KA}=V_{REF}$ , $I_K=10\text{mA}$ (note 1)                                                                       | 2440 | 2495       | 2550       | mV            |
| Reference Voltage Change<br>(Full Oper. Temp. Range)       | $V_{REF}$<br>(dev)                     | $V_{KA}=V_{REF}$ , $I_K=10\text{mA}$ (note 1).<br>$T_a=-20^\circ\text{C}\sim+85^\circ\text{C}$                      | —    | 8          | 17         | mV            |
| Reference Voltage Change<br>vs. Cathode Voltage Change     | $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | $I_K=10\text{mA}$ (note 2) $\frac{\Delta V_{KA}=10\text{V}-V_{REF}}{\Delta V_{KA}=36\text{V}-10\text{V}}$           | —    | -1.4<br>-1 | -2.7<br>-2 | mV/V<br>mV/V  |
| Reference Input Current                                    | $I_{REF}$                              | $I_K=10\text{mA}$ , $R_1=10\text{k}\Omega$ , $R_2=\infty$ (note 2)                                                  | —    | 2          | 4          | $\mu\text{A}$ |
| Reference Input Current Change<br>(Full Oper. Temp. Range) | $I_{REF}$<br>(dev)                     | $I_K=10\text{mA}$ , $R_1=10\text{k}\Omega$ , $R_2=\infty$ (note 2).<br>$T_a=-20^\circ\text{C}\sim+85^\circ\text{C}$ | —    | 0.4        | 1.2        | $\mu\text{A}$ |
| Minimum Input Current                                      | $I_{MIN}$                              | $V_{KA}=V_{REF}$ (note 1)                                                                                           | —    | 0.4        | 1.0        | mA            |
| Cathode Current (Off Cond.)                                | $I_{OFF}$                              | $V_{KA}=36\text{V}$ , $V_{REF}=0$ (note 3)                                                                          | —    | 0.1        | 1.0        | $\mu\text{A}$ |
| Dynamic Impedance                                          | $ Z_{KA} $                             | $V_{KA}=V_{REF}$ , $I_K=1\text{mA}\sim100\text{mA}$ ,<br>$f\leq 1\text{kHz}$ (note 1)                               | —    | 0.2        | 0.5        | $\Omega$      |

(note 1) TEST CIRCUIT (Fig. 1)

(note 2) TEST CIRCUIT (Fig. 2)

(note 3) TEST CIRCUIT (Fig. 3)

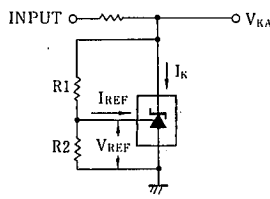
## ■ TEST CIRCUITS



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

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

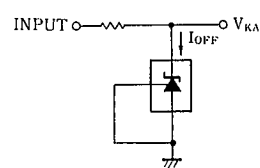
(Fig. 1)



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

$$V_O = V_{KA} = V_{REF} \cdot \left(1 + \frac{R_1}{R_2}\right) + I_{REF} \cdot R_1$$

(Fig. 2)

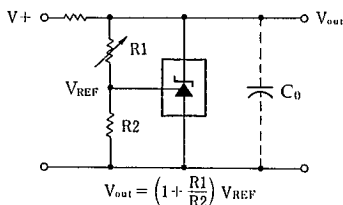


3.  $I_{OFF}$

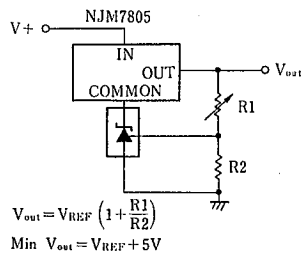
(Fig. 3)

## ■ TYPICAL APPLICATION

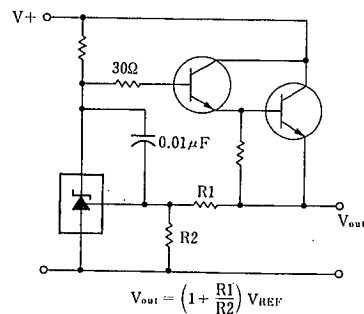
### (1) Shunt Regulator



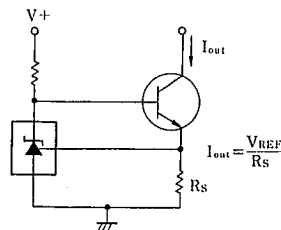
### (3) Output Control of a Three-Terminal fixed Regulator



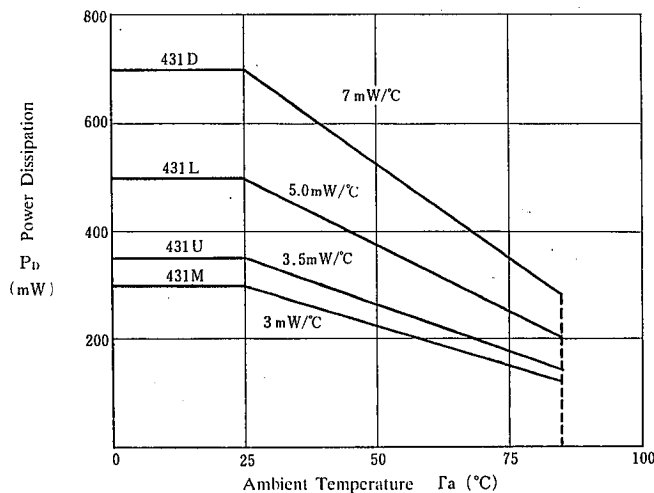
### (2) Series Regulator



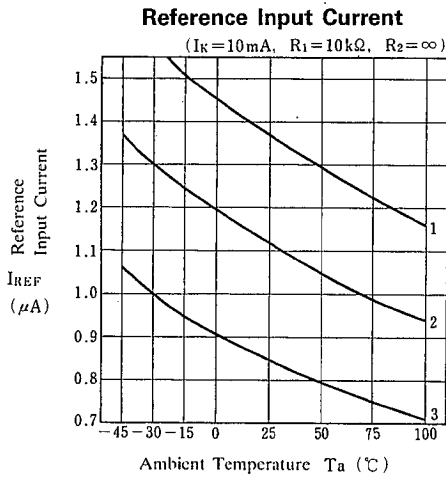
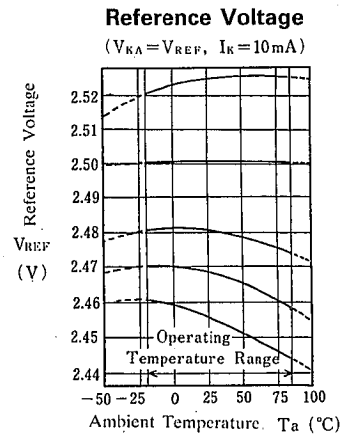
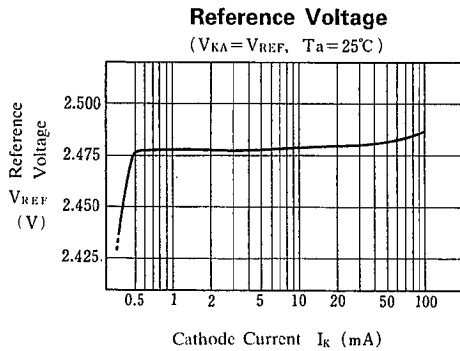
### (4) Constant Current Source



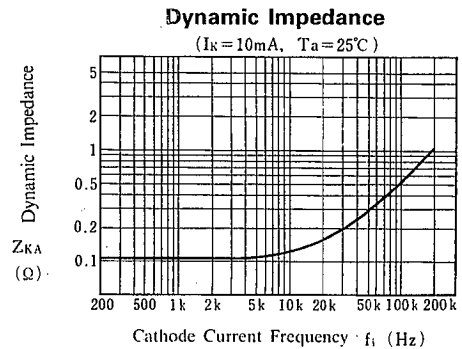
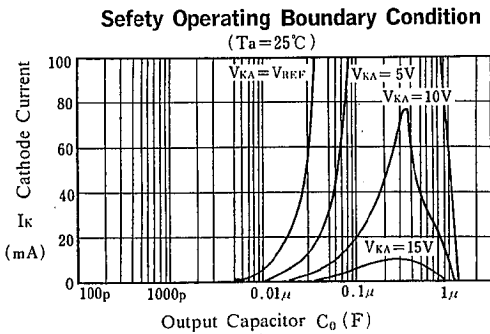
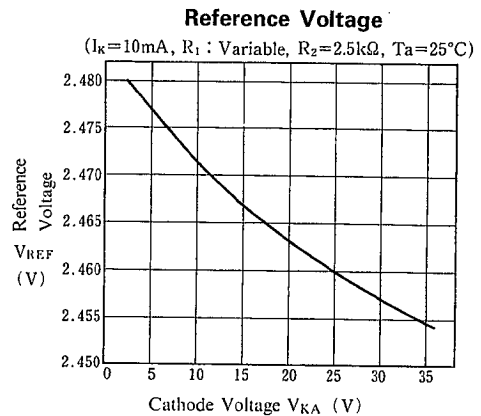
## ■ POWER DISSIPATION VS. AMBIENT TEMPERATURE



■ 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                     |



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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