

## ADJUSTABLE PRECISION SHUNT REGULATOR

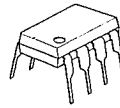
### GENERAL DESCRIPTION

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

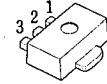


NJM431M



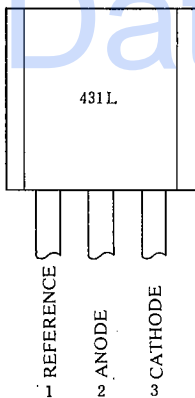
NJM431L (TO-92)

1. REF
2. ANODE
3. CATHODE

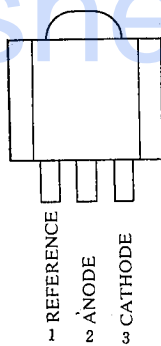


NJM431U (SOT-89)

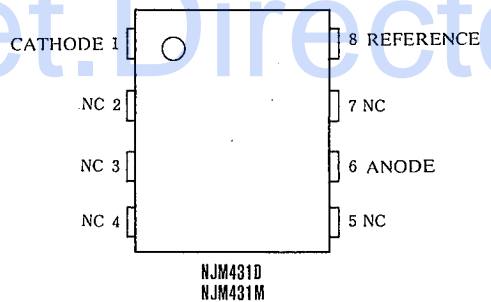
### PIN CONFIGURATION



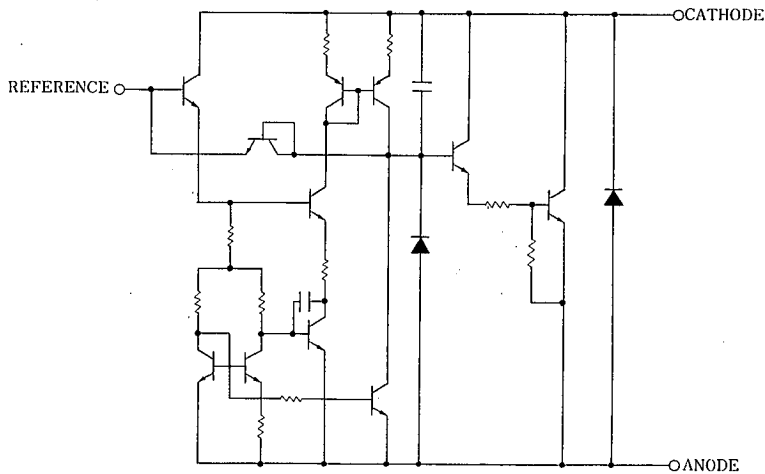
NJM431L



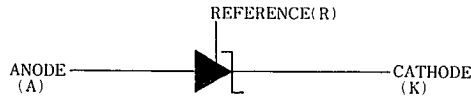
NJM431U



### 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)

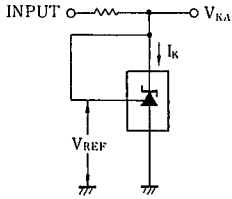
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reference Voltage	V <sub>REF</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>K</sub> =10mA (note 1)	2440	2495	2550	mV
Reference Voltage Change (Full Oper. Temp. Range)	V <sub>REF</sub> (dev)	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>K</sub> =10mA (note 1), Ta=-20°C~+85°C	—	8	17	mV
Reference Voltage Change 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 (Full Oper. Temp. Range)	I <sub>REF</sub> (dev)	I <sub>K</sub> =10mA, R <sub>1</sub> =10kΩ, R <sub>2</sub> =∞ (note 2), 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, 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)

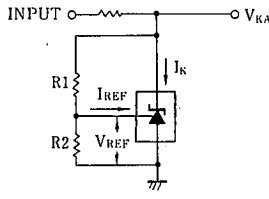
## TEST CIRCUITS



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

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

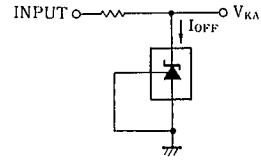
(Fig. 1)



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

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

(Fig. 2)

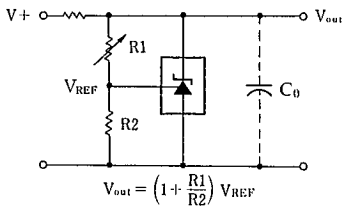


3.  $I_{OFF}$

(Fig. 3)

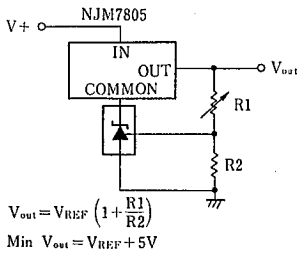
## TYPICAL APPLICATION

### (1) Shunt Regulator



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

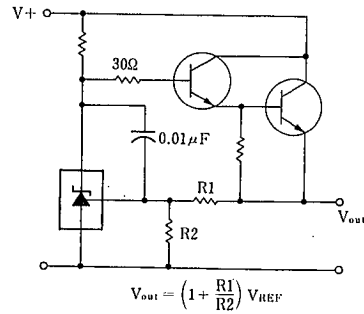
### (3) Output Control of a Three-Terminal fixed Regulator



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

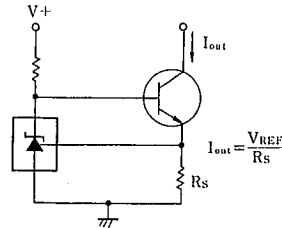
Min  $V_{out} = V_{REF} + 5V$

### (2) Series Regulator



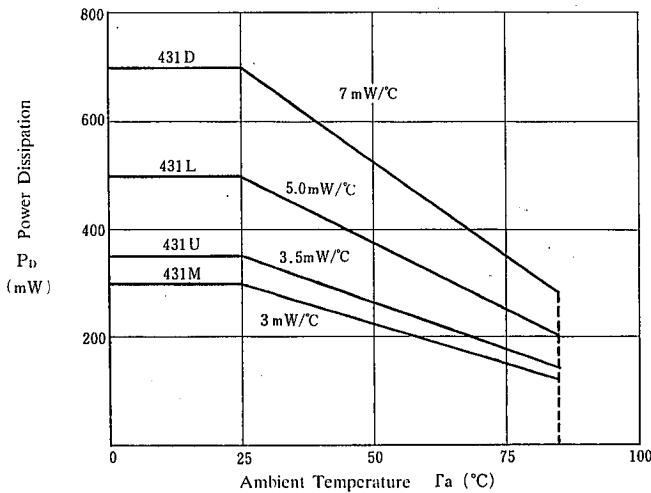
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

### (4) Constant Current Source



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

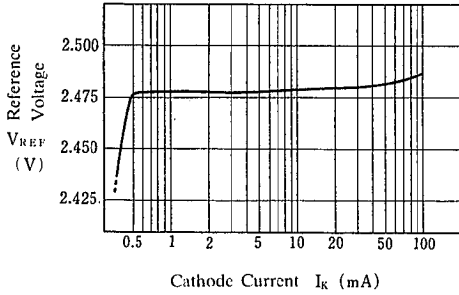
## POWER DISSIPATION VS. AMBIENT TEMPERATURE



## ■ TYPICAL CHARACTERISTICS

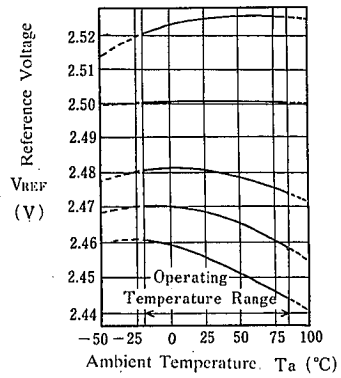
### Reference Voltage

( $V_{KA} = V_{REF}$ ,  $T_a = 25^\circ\text{C}$ )



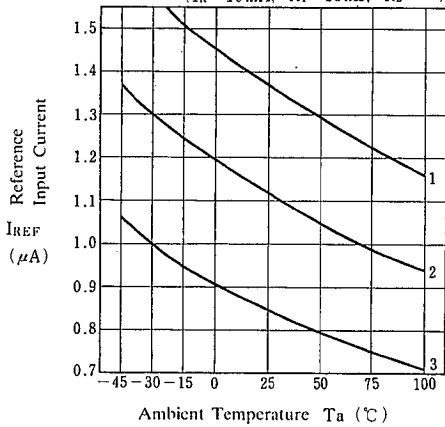
### Reference Voltage

( $V_{KA} = V_{REF}$ ,  $I_K = 10\text{mA}$ )



### Reference Input Current

( $I_K = 10\text{mA}$ ,  $R_1 = 10\text{k}\Omega$ ,  $R_2 = \infty$ )



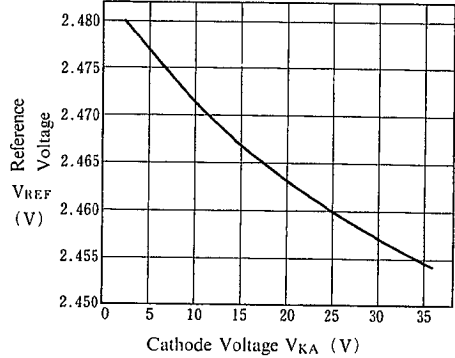
$I_{REF}(\text{dev})$   
 No.1 -  $0.38\mu\text{A}$   
 No.2 -  $0.27\mu\text{A}$   
 No.3 -  $0.21\mu\text{A}$

$V_{REF}(\text{dev})$  ( $T_a = -20 \sim 25^\circ\text{C}$ ) ( $T_a = 25 \sim 85^\circ\text{C}$ ) ( $T_a = 25^\circ\text{C}$ )

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

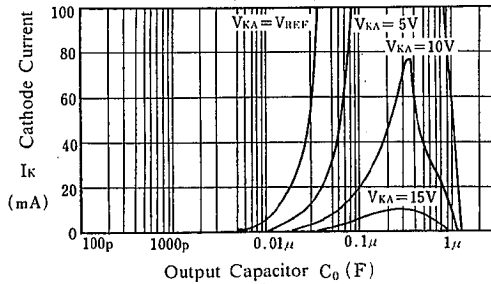
### Reference Voltage

( $I_K = 10\text{mA}$ ,  $R_1$ : Variable,  $R_2 = 2.5\text{k}\Omega$ ,  $T_a = 25^\circ\text{C}$ )



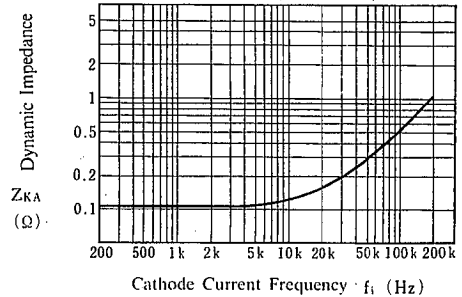
### Safety Operating Boundary Condition

( $T_a = 25^\circ\text{C}$ )



### Dynamic Impedance

( $I_K = 10\text{mA}$ ,  $T_a = 25^\circ\text{C}$ )



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

**[CAUTION]**

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