

ADJUSTABLE PRECISION SHUNT REGULATOR

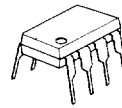
■ GENERAL DESCRIPTION

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 $\sim$ 100mA)
- Low Dynamic Output Impedance (0.2 Ω typ.)
- Package Outline DIP8, DMP8, TO-92, SOT-89
- Bipolar Technology

■ PACKAGE OUTLINE



NJM431D

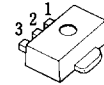


NJM431M



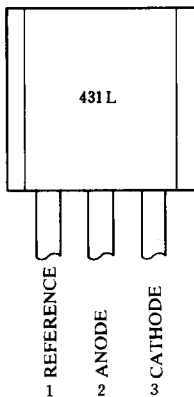
NJM431L (TO-92)

1. REF
2. ANODE
3. CATHODE

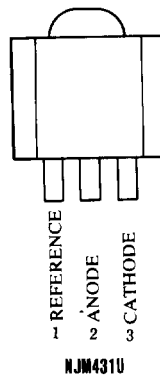


NJM431U (SOT-89)

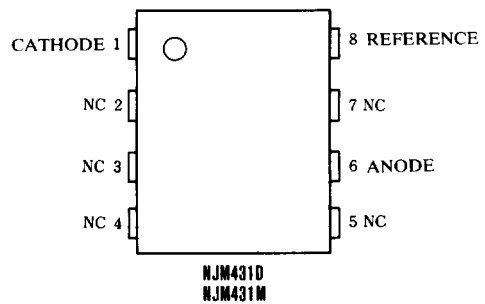
■ PIN CONFIGURATION



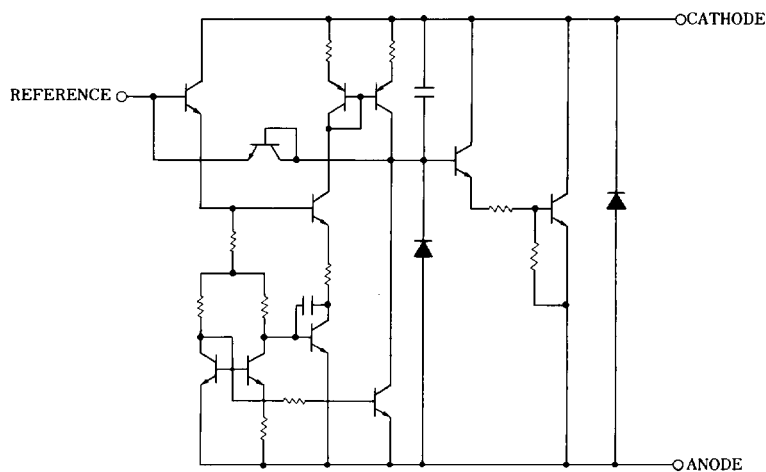
NJM431L



NJM431U

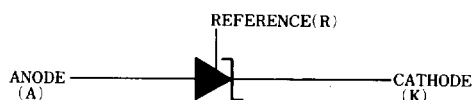
NJM431D
NJM431M

■ 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}	-20 ~ +85	°C
Storage Temperature	T_{sig}	-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	1	—	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 = 10mA (note 1)	2440	2495	2550	mV	
Reference Voltage Change (Full Oper. Temp. Range)	V _{REF} (dev)	V _{KA} = V _{REF} , I _K = 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 _K = 10mA (note 2)	$\Delta V_{KA} = 10V - V_{REF}$		-1.4	-2.7	mV/V
			$\Delta V_{KA} = 36V - 10V$		—	-1	-2
Reference Input Current	I _{REF}	I _K = 10mA, R ₁ = 10kΩ, R ₂ = ∞ (note 2)	—	2	4	μA	
Reference Input Current Change (Full Oper. Temp. Range)	I _{REF} (dev)	I _K = 10mA, R ₁ = 10kΩ, R ₂ = ∞ (note 2) Ta = -20°C ~ +85°C	—	0.4	1.2	μA	
Minimum Input Current	I _{MIN}	V _{KA} = V _{REF} (note 1)	—	0.4	1.0	mA	
Cathode Current (Off Cond.)	I _{OFF}	V _{KA} = 36V, V _{REF} = 0 (note 3)	—	0.1	1.0	μA	
Dynamic Impedance	Z _{KA}	V _{KA} = V _{REF} , I _K = 1mA ~ 100mA, f ≤ 1kHz (note 1)	—	0.2	0.5	Ω	

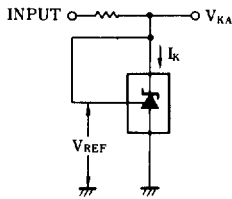
(note 1) TEST CIRCUIT (Fig. 1)

(note 2) TEST CIRCUIT (Fig. 2)

(note 3) TEST CIRCUIT (Fig. 3)



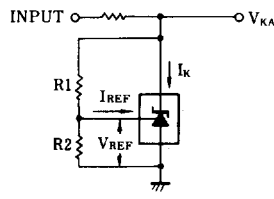
■ TEST CIRCUITS



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

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

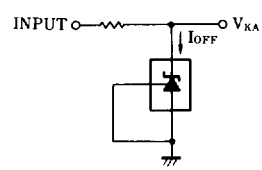
(Fig. 1)



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

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

(Fig. 2)

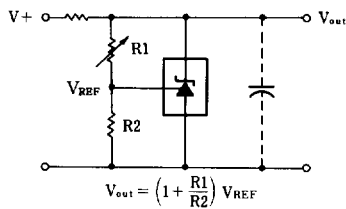


3. I_{OFF}

(Fig. 3)

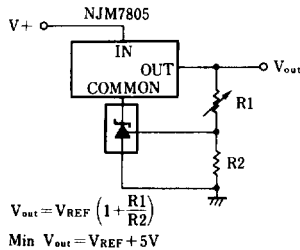
■ TYPICAL APPLICATION

(1) Shunt Regulator



$$V_{out} = \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

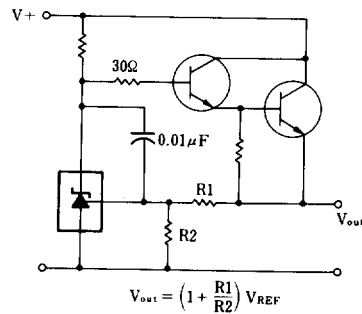
(3) Output Control of a Three-Terminal fixed Regulator



$$V_{out} = V_{REF} \left(1 + \frac{R_1}{R_2}\right)$$

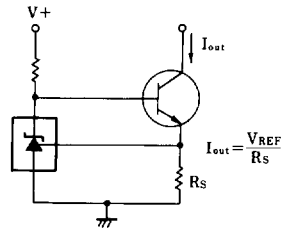
Min $V_{out} = V_{REF} + 5V$

(2) Series Regulator



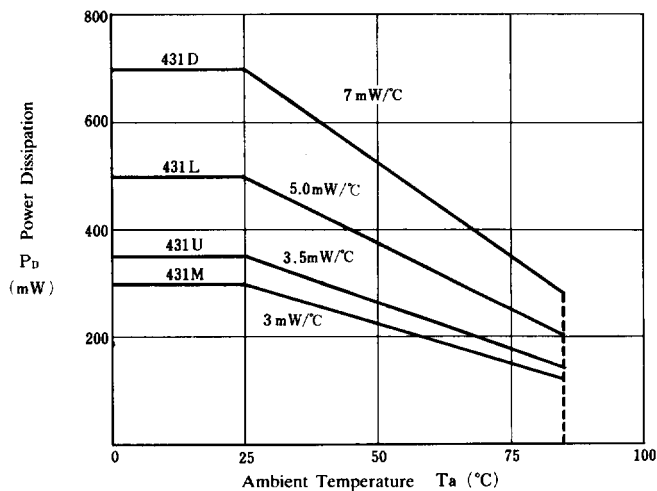
$$V_{out} = \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

(4) Constant Current Source



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

■ POWER DISSIPATION VS. AMBIENT TEMPERATURE

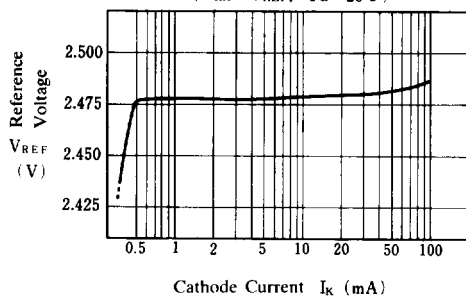




■ TYPICAL CHARACTERISTICS

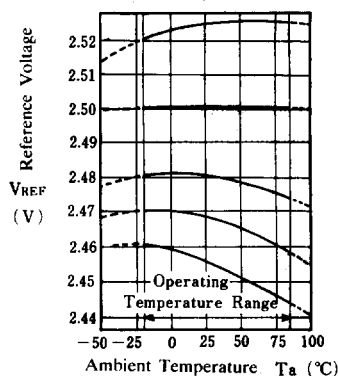
Reference Voltage

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



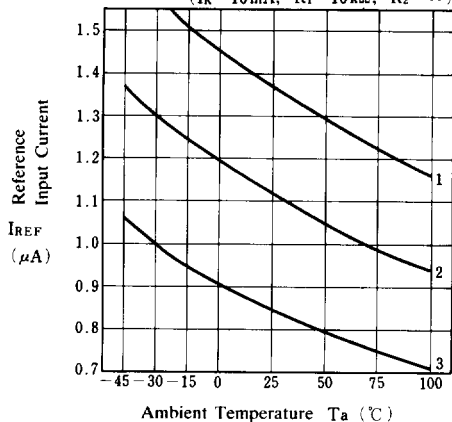
Reference Voltage

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



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 - $0.27\mu\text{A}$

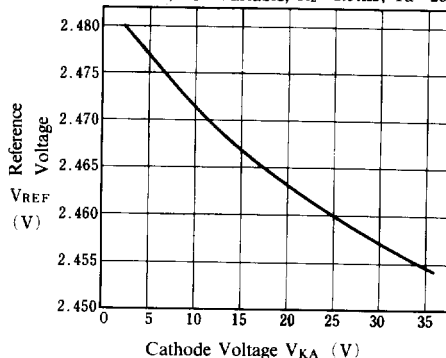
No. 3 - $0.21\mu\text{A}$

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

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

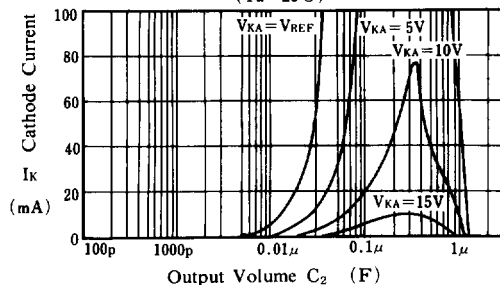
Reference Voltage

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



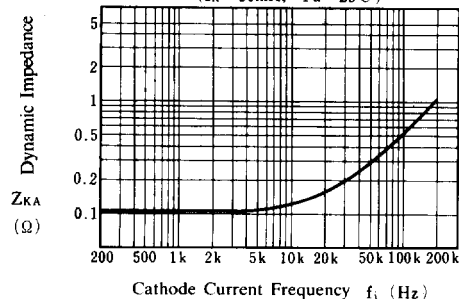
Safety Operating Boundary Condition

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



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.