

# AN1431T, AN1431M

## Variable output shunt regulator

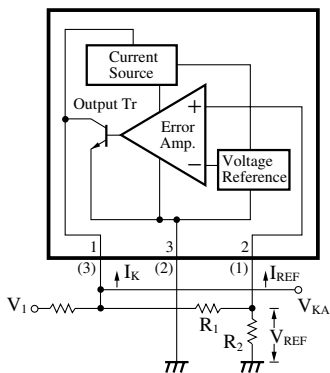
### ■ Overview

The AN1431T and AN1431M are highly accurate stabilized power supplies in which the output voltage can be adjusted in the range from approximately 2.5 to 36V under the operating temperature by using the external resistor. Because of its fast rising characteristic, it can be used as a Zener diode and has the wide application.

### ■ Features

- High precision reference voltage: 2.5V (allowance:  $\pm 2\%$ )
- High temperature stability: 17ppm/°C typ.
- Output voltage externally adjustable: 2.5 to 36V
- Fast rising output
- Low input impedance: 0.2Ω typ.
- Low output noise voltage

### ■ Block Diagram (AN1431T)



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

$$R_2 = 2.5k\Omega$$

Note) The number in ( ) shows the pin number for the AN1431M.

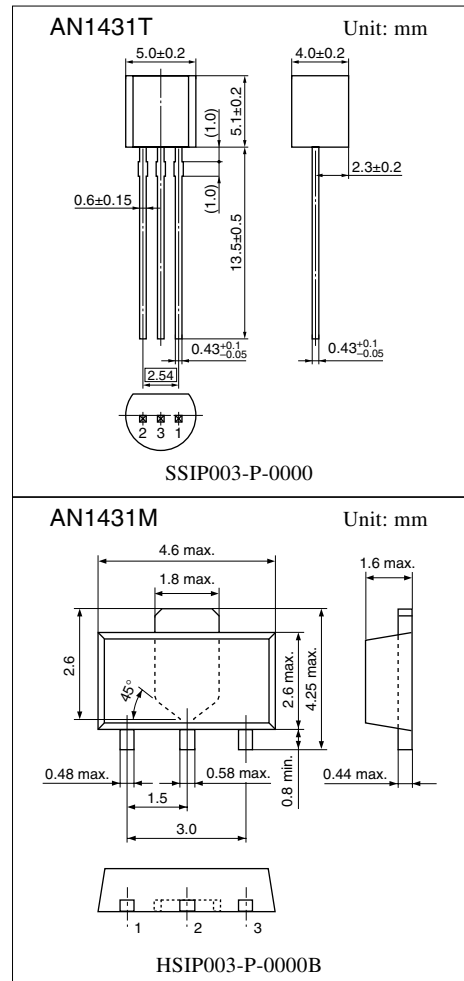
### ■ Pin Descriptions

#### • AN1431T

Pin No.	Description
1	Cathode
2	Reference pin
3	Anode

#### • AN1431M

Pin No.	Description
1	Reference pin
2	Anode
3	Cathode



### ■ Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Rating	Unit	
Supply voltage	$V_{CC}$	37	V	
Supply current	$I_{CC}$	-100 to +150	mA	
Power dissipation	$P_D$	650 *	mW	
Reference input current	$I_{REF}$	-0.05 to +10	mA	
Operating ambient temperature	AN1431T	$T_{opr}$	-20 to +85	°C
	AN1431M		-25 to +80	
Storage temperature	AN1431T	$T_{stg}$	-55 to +150	°C
	AN1431M		-55 to +125	

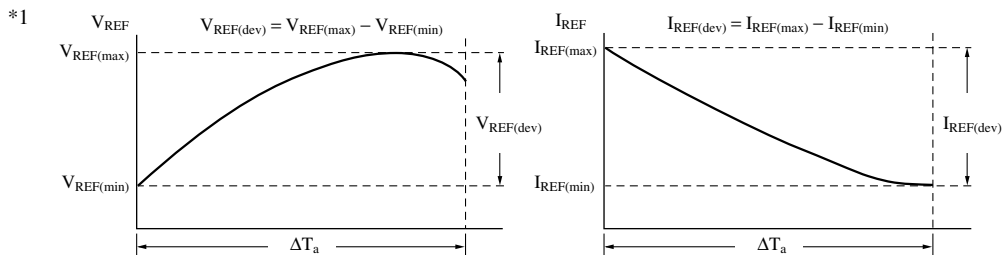
\* AN1431M is mounted on a standard board (glass epoxy: 20mm × 20mm × t1.7mm with Cu foil of 1cm<sup>2</sup> or more).

### ■ Recommended Operating Range at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Range
Supply voltage	$V_{KA}$	$V_{REF}$ (2.5 to 36V)

### ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reference voltage	$V_{REF}$	$V_{KA} = V_{REF}, I_K = 10\text{mA}$	2.45	2.50	2.55	V
Reference voltage change to temperature	$V_{REF(dev)}$ *1, 2	$V_{KA} = V_{REF}, I_K = 10\text{mA}, T_a = 0 \text{ to } +70^\circ\text{C}$	—	3	17	mV
Reference voltage power supply characteristic	$\Delta V_{REF}$	$I_K = 10\text{mA}, \Delta V_{KA} = 10\text{V to } V_{REF}$	—	-1.2	-2.7	mV/V
	$\Delta V_{KA}$	$I_K = 10\text{mA}, \Delta V_{KA} = 36\text{V to } 10\text{V}$	—	-1	-2	mV/V
Reference input current	$I_{REF}$	$I_K = 10\text{mA}, R_1 = 10\text{k}\Omega, R_2 = \infty$	—	2	4	$\mu\text{A}$
Reference input current change to temperature	$I_{REF(dev)}$ *2	$I_K = 10\text{mA}, R_1 = 10\text{k}\Omega, R_2 = \infty, T_a = 0 \text{ to } +70^\circ\text{C}$	—	0.4	1.2	$\mu\text{A}$
Minimum cathode current	$I_{min}$	$V_{KA} = V_{REF}$	—	0.4	1.0	mA
Off-state cathode current	$I_{OFF}$	$V_{KA} = 36\text{V}, V_{REF} = 0\text{V}$	—	0.1	1.0	$\mu\text{A}$
Dynamic impedance	$ Z_{KA} $ *3	$V_{KA} = V_{REF}, I_K = 1 \text{ to } 100\text{mA}, f \leq 1\text{kHz}$	—	0.2	0.5	$\Omega$



The temperature coefficient  $aV_{REF}$  for the reference input voltage is equivalently given by the following expression.

$$|aV_{REF}| = \frac{V_{REF(dev)}}{V_{REF} \Delta T_a} \times 10^6 \text{ (ppm/}^\circ\text{C)} \quad \dagger V_{REF} \text{ at } T_a = 25^\circ\text{C}$$

For example, assuming  $V_{REF(max)} = 2500\text{mV}$  ( $T_a = 30^\circ\text{C}$ ),  $V_{REF(min)} = 2497\text{mV}$  ( $T_a = 0^\circ\text{C}$ ), ( $V_{REF(dev)} = 3\text{mV}$ ) and

$$V_{REF} = 2499\text{mV} \text{ (} T_a = 25^\circ\text{C) } \Delta T_a = 70^\circ\text{C}$$

$$\text{then, } |aV_{REF}| = \frac{3\text{mV}}{2499\text{mV}} \times 10^6 = 17.1 \text{ (ppm/}^\circ\text{C)}$$

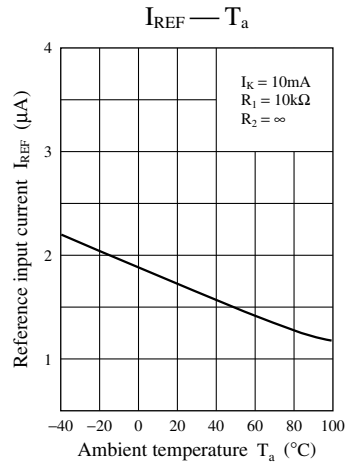
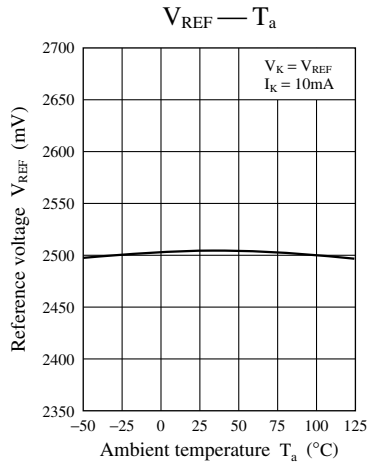
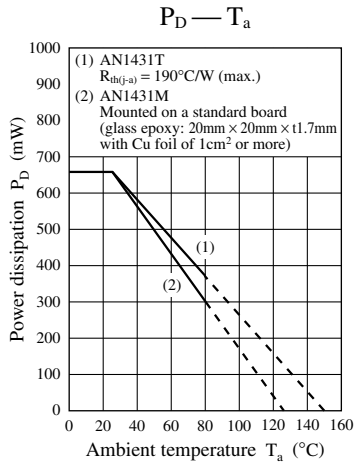
\*2 These values are design reference values, not guaranteed ones.

\*3 The dynamic impedance is defined by the following expression.  $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_K}$

The total dynamic impedance at  $\Delta V_{REF}$ ,  $\Delta V_{KA}$ ,  $I_{REF}$  and  $I_{REF(dev)}$  is as follows.

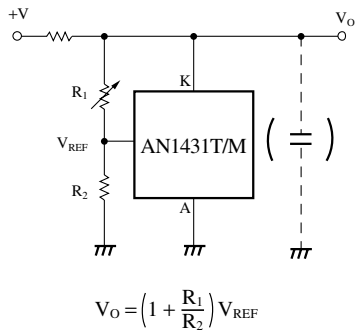
$$|Z| = \frac{\Delta V}{\Delta I} = |Z_{KA}| \left(1 + \frac{R_1}{R_2}\right)$$

■ Main Characteristics

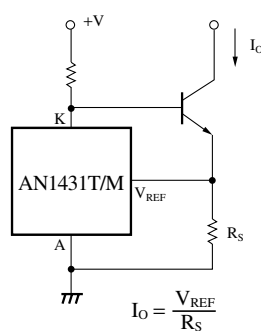


■ Application Circuit Examples

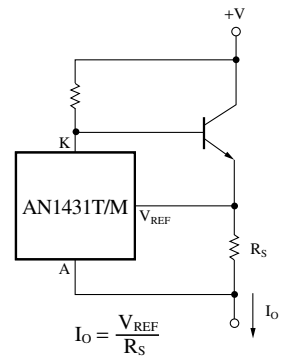
1. Shunt regulator



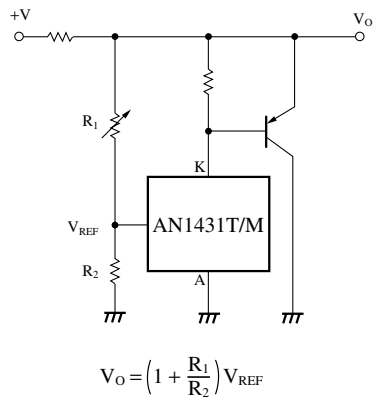
2. Constant current power supply



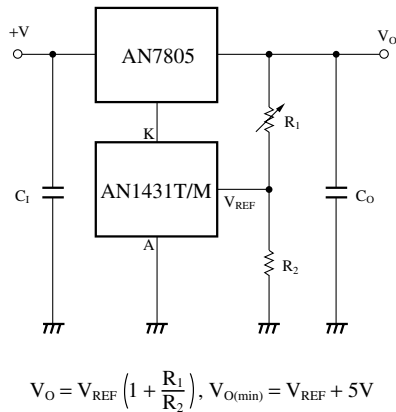
3. Constant current source



4. Current bootstrap



5. Adjustable output regulator combined with 3-pin regulator



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