

# AN6531

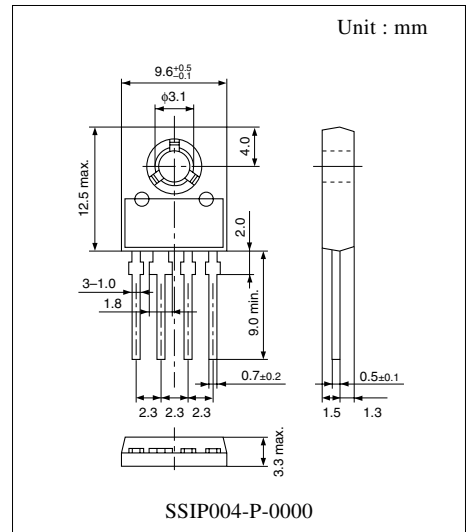
## 4-pin variable positive output voltage regulator

### ■ Overview

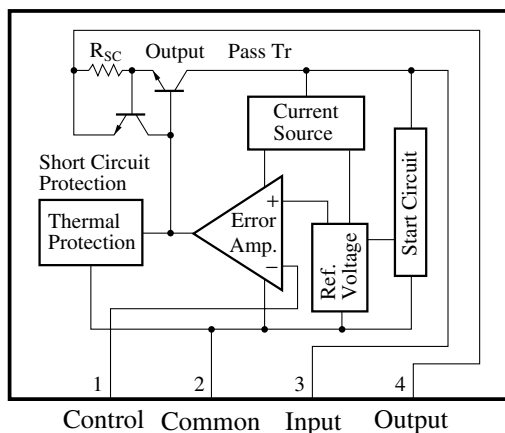
The AN6531 is a monolithic 4-pin variable positive output voltage regulator. With an external resistor, it provides any stabilized output voltages between 5V and 30V, and is optimum for the power circuits with a current capacity of up to 0.5A. This IC incorporates various protection circuits.

### ■ Features

- Wide range of output voltages:  $V_O = 5$  to 30V
- Built-in thermal overload protection circuit
- Built-in overcurrent protection circuit
- Built-in ASO (area of safe operation) protection circuit



### ■ Block Diagram



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

Parameter	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	40	V
Supply current	$I_{CC}^*$	1.5	A
Power dissipation	$P_D$	7.5	W
Operating ambient temperature	$T_{opr}$	-20 to +75	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$

\* The internal circuit is provided with a current limiting circuit.

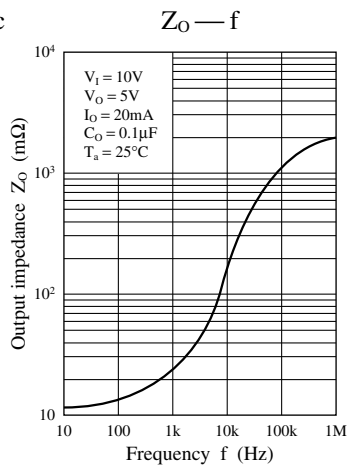
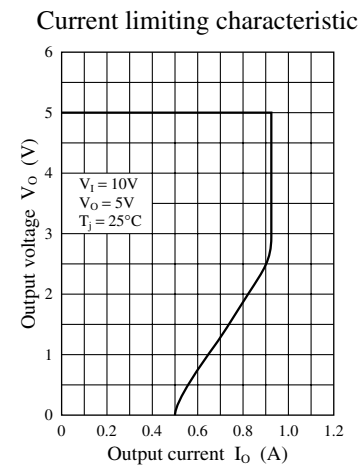
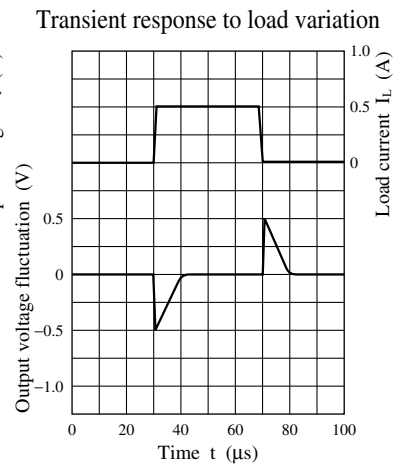
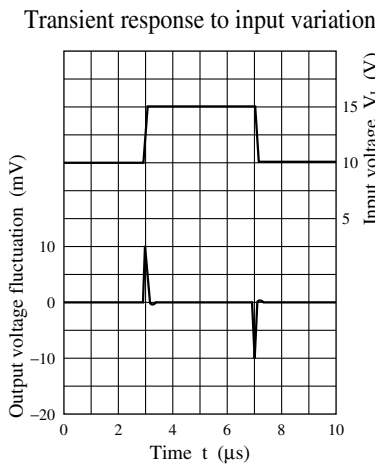
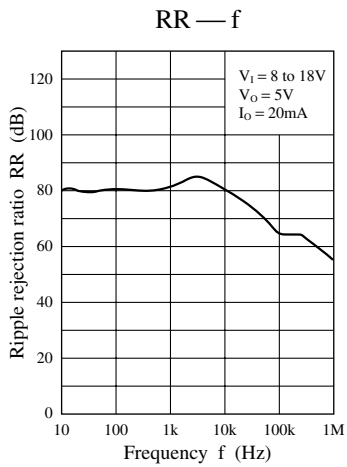
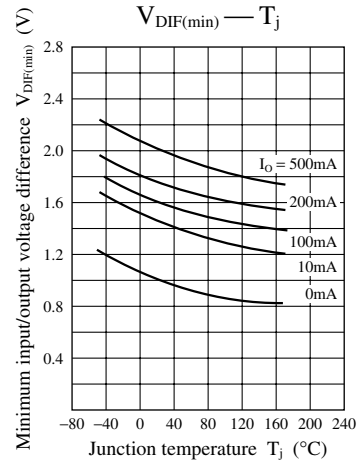
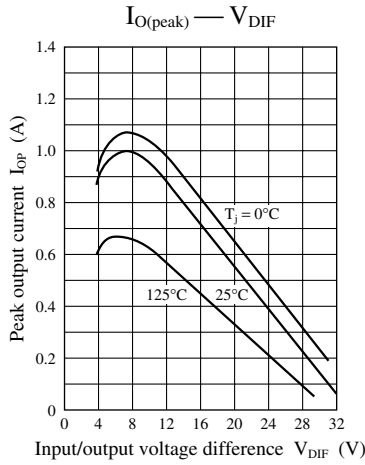
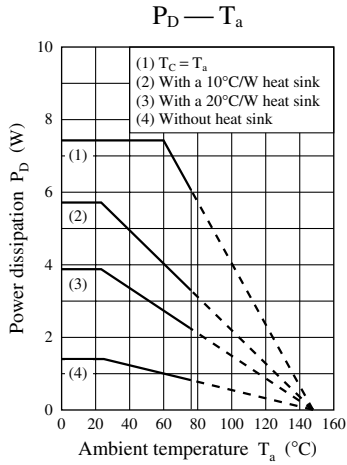
### ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
Output voltage tolerance	$V_O$	$V_I = V_O + 3\text{V to } V_O + 15\text{V}$ , $I_O = 5 \text{ to } 350\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	4	%	
Line regulation	$REG_{IN}$	$V_O = 5\text{V}$ , $I_O = 200\text{mA}$ , $V_I = 7.5 \text{ to } 25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	1	%	
		$V_O = 18\text{V}$ , $I_O = 5\text{mA}$ , $V_I = 21 \text{ to } 33\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.75	%	
		$V_O = 18\text{V}$ , $I_O = 200\text{mA}$ , $V_I = 21 \text{ to } 25\text{V}$ , $T_j = 25^\circ\text{C}$	—	—	0.67	%	
Load regulation	$REG_L$	$V_O = 5\text{V}$ , $V_I = 12\text{V}$ , $I_O = 5 \text{ to } 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	—	1	%	
Bias current	$I_{Bias}$	$T_j = 25^\circ\text{C}$	—	3	5	mA	
Control pin current	$I_{cont}$	$T_j = 25^\circ\text{C}$	—	1	8	$\mu\text{A}$	
Ripple rejection ratio	RR	$V_I = 8 \text{ to } 18\text{V}$ , $V_O = 5\text{V}$ , $f = 120\text{Hz}$	62	80	—	dB	
Output noise voltage	$V_{no}$	$V_O = 5\text{V}$ , $f = 10\text{Hz to } 100\text{kHz}$	—	40	—	$\mu\text{V}$	
Minimum input/output voltage difference	$V_{DIF(min)}$	$I_O = 500\text{mA}$ , $T_j = 25^\circ\text{C}$	—	2	—	V	
Output short-circuit current	$I_{OS}$	$V_I = 35\text{V}$ , $V_O = 5\text{V}$ , $T_j = 25^\circ\text{C}$	—	50	600	mA	
Peak output current	$I_{OP}$	$V_O = 5\text{V}$ , $T_j = 25^\circ\text{C}$	0.4	1	1.4	A	
Output voltage temperature coefficient	$\Delta V_O/T_a$	$V_O = 5\text{V}$	—	$T_j = -55 \text{ to } +25^\circ\text{C}$	0.5	—	mV/ $^\circ\text{C}$
		$I_O = 5\text{mA}$		$T_j = 25 \text{ to } 150^\circ\text{C}$	-0.5		
Control pin voltage	$V_{cont}$	$T_j = 25^\circ\text{C}$	4.8	5	5.2	V	

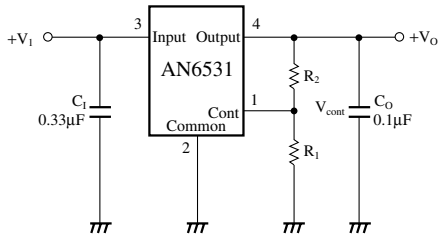
Note 1) The specified condition  $T_j = 25^\circ\text{C}$  means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

Note 2) Unless otherwise specified,  $V_I = 10\text{V}$ ,  $V_O = 5\text{V}$ ,  $I_O = 350\text{mA}$ ,  $C_1 = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$

■ Main Characteristics



■ Basic Regulator Circuit



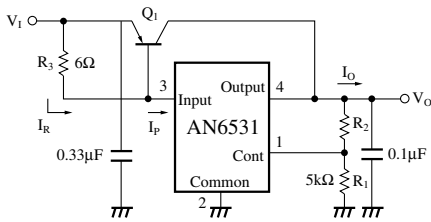
$$V_O = V_{cont} \left( \frac{R_1 + R_2}{R_1} \right)$$

$$(V_{cont} \cong 5V, R_1 = 5k\Omega)$$

$C_1$  is necessary when the  $V_1$  line is long.  
 $C_0$  improves the transient response.

■ Application Circuit Examples

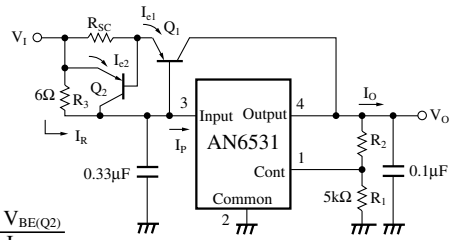
1. Current bootstrap circuit



$$R_3 = \frac{V_{BE(Q1)} \cdot \beta}{(\beta + 1) I_p - I_O}$$

2. Current bootstrap circuit

(with current limiting circuit)



$$R_{SC} = \frac{V_{BE(Q2)}}{I_{e1(max)}}$$

$$R_3 = \frac{V_{BE(Q1)} + I_{e1} R_{SC}}{I_O - I_{e1}}$$

$$I_{e2(max)} = I_{p(max)} - \frac{V_{BE(Q1)} + V_{BE(Q2)}}{R_3}$$

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