

AN6531

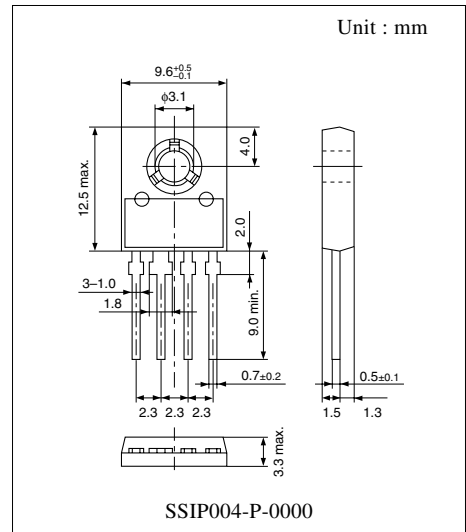
4-pin variable positive output voltage regulator

■ Overview

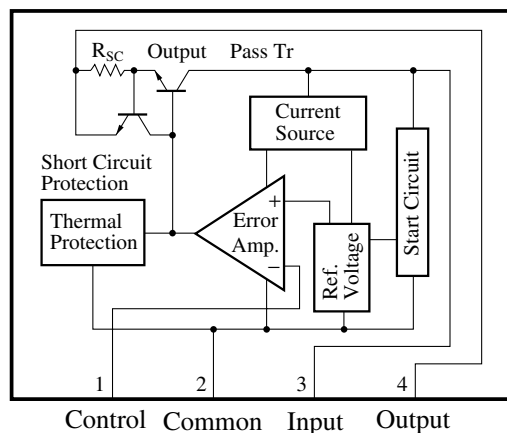
The AN6531 is a monolithic 4-pin variable positive output voltage regulator. With an external resistor, it provides any stabilized output voltages between 5V and 30V, and is optimum for the power circuits with a current capacity of up to 0.5A. This IC incorporates various protection circuits.

■ 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.

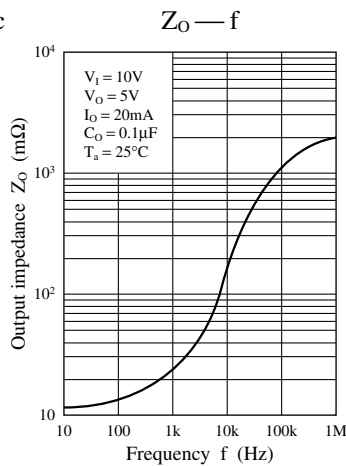
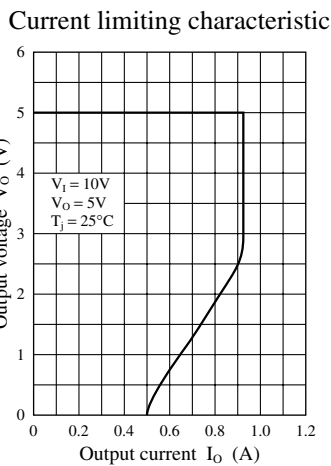
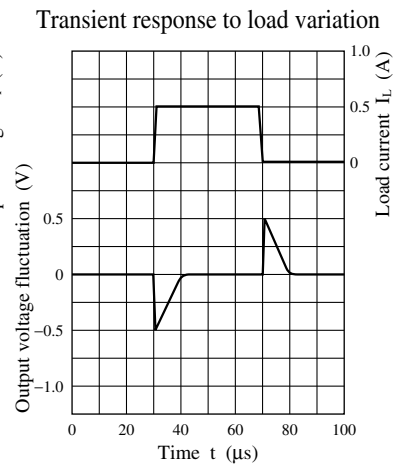
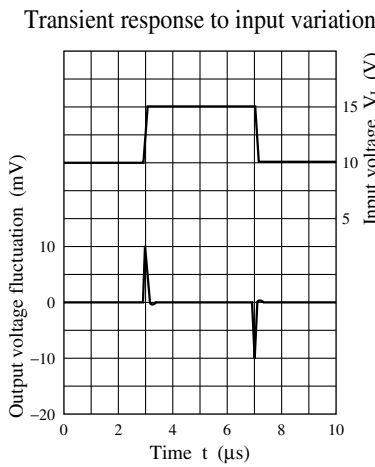
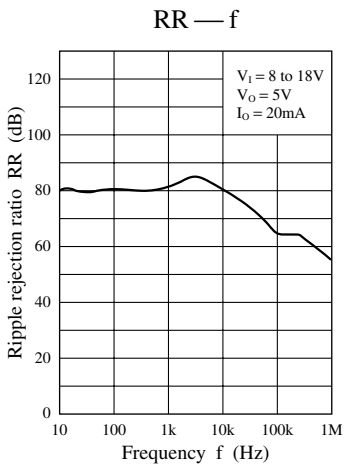
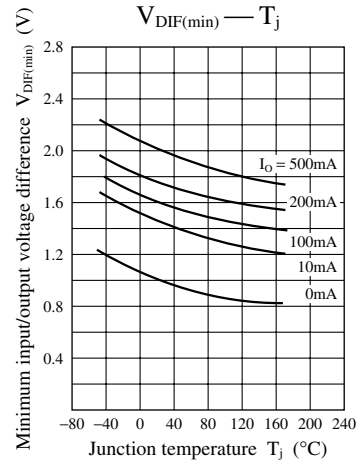
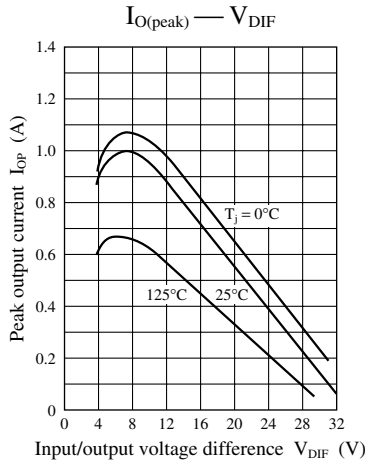
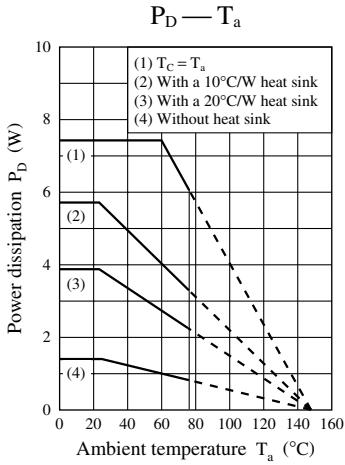
■ Electrical Characteristics at $T_a = 25^\circ\text{C}$

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	μA	
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	—	μV	
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	

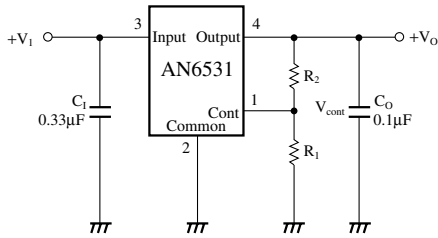
Note 1) The specified condition $T_j = 25^\circ\text{C}$ means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.

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

■ Main Characteristics



■ Basic Regulator Circuit



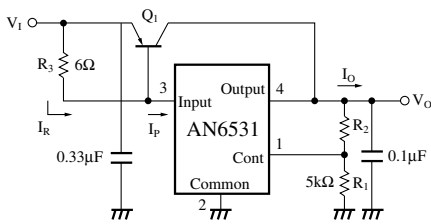
$$V_O = V_{cont} \left(\frac{R_1 + R_2}{R_1} \right)$$

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

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

■ Application Circuit Examples

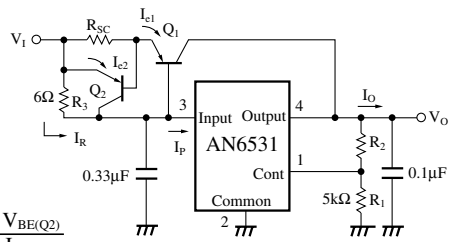
1. Current bootstrap circuit



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

2. Current bootstrap circuit

(with current limiting circuit)



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

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

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

Request for your special attention and precautions in using the technical information and semiconductors described in this material

- (1) An export permit needs to be obtained from the competent authorities of the Japanese Government if any of the products or technologies described in this material and controlled under the "Foreign Exchange and Foreign Trade Law" is to be exported or taken out of Japan.
- (2) The technical information described in this material is limited to showing representative characteristics and applied circuit examples of the products. It does not constitute the warranting of industrial property, the granting of relative rights, or the granting of any license.
- (3) The products described in this material are intended to be used for standard applications or general electronic equipment (such as office equipment, communications equipment, measuring instruments and household appliances).
Consult our sales staff in advance for information on the following applications:
 - Special applications (such as for airplanes, aerospace, automobiles, traffic control equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.
 - Any applications other than the standard applications intended.
- (4) The products and product specifications described in this material are subject to change without notice for reasons of modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.
- (5) When designing your equipment, comply with the guaranteed values, in particular those of maximum rating, the range of operating power supply voltage and heat radiation characteristics. Otherwise, we will not be liable for any defect which may arise later in your equipment.
Even when the products are used within the guaranteed values, redundant design is recommended, so that such equipment may not violate relevant laws or regulations because of the function of our products.
- (6) When using products for which dry packing is required, observe the conditions (including shelf life and after-unpacking standby time) agreed upon when specification sheets are individually exchanged.
- (7) No part of this material may be reprinted or reproduced by any means without written permission from our company.

Please read the following notes before using the datasheets

- A. These materials are intended as a reference to assist customers with the selection of Panasonic semiconductor products best suited to their applications.
Due to modification or other reasons, any information contained in this material, such as available product types, technical data, and so on, is subject to change without notice.
Customers are advised to contact our semiconductor sales office and obtain the latest information before starting precise technical research and/or purchasing activities.
- B. Panasonic is endeavoring to continually improve the quality and reliability of these materials but there is always the possibility that further rectifications will be required in the future. Therefore, Panasonic will not assume any liability for any damages arising from any errors etc. that may appear in this material.
- C. These materials are solely intended for a customer's individual use.
Therefore, without the prior written approval of Panasonic, any other use such as reproducing, selling, or distributing this material to a third party, via the Internet or in any other way, is prohibited.