AN6535

4-pin variable negative output voltage regulator

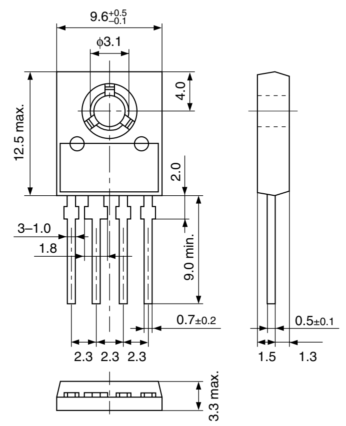
■ Overview

The AN6535 is a monolithic 4-pin variable negative 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

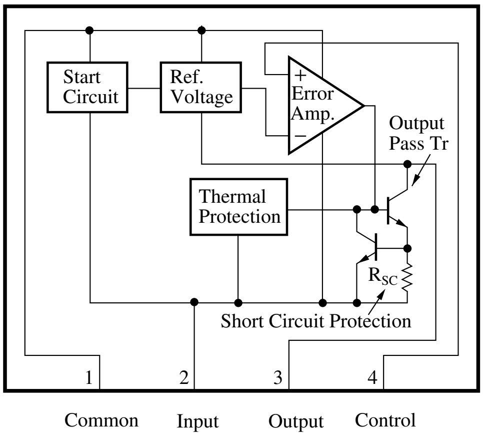
- Wide range of output voltages: V_O = −5 to −30V
- Built-in thermal overload protection circuit
- Built-in overcurrent protection circuit
- Built-in ASO (area of safe operation) protection circuit

Unit: mm



SSIP004-P-0000

■ Block Diagram



■ Absolute Maximum Ratings at T_a = 25°C

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	–40	V
Supply current	I_{CC} *1	1	A
Power dissipation	P_D	7.5	W
Operating ambient temperature	T_{opr}	–20 to +80	°C
Storage temperature	T_{stg}	–55 to +150	°C

*1 The internal circuit is provided with a current limiting circuit.
*2 Maximum power dissipation value when there is no heat sink (The value varies depending on the external heat radiation state)

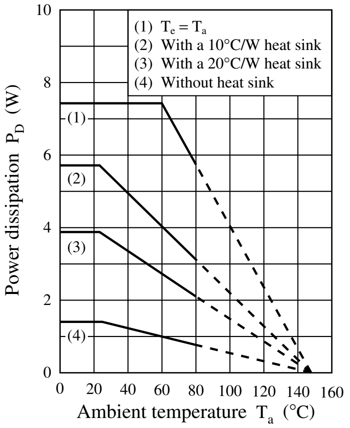
■ Electrical Characteristics at T_a = 25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output voltage tolerance	V_O	$V_I = V_O$ – 3V to V_O – 15V, I_O = 5 to 350mA, T_j = 25°C	—	—	4	%
Line regulation	REG_{IN}	V_O = –5V, I_O = 200mA, V_I = –7.5 to –25V, T_j = 25°C	—	—	1	%
		V_O = –18V, I_O = 5mA, V_I = –21 to –33V, T_j = 25°C	—	—	0.75	%
		V_O = –18V, I_O = 200mA, V_I = –21 to –25V, T_j = 25°C	—	—	0.67	%
Load regulation	REG_L	I_O = 5 to 500mA, T_j = 25°C; V_O = –5V, V_I = –12V / V_O = –18V, V_I = –25V	—	—	1	%
Bias current	I_{Bias}	T_j = 25°C	—	1.5	3	mA
Control pin current	I_{cont}	T_j = 25°C	—	—	3	µA
Ripple rejection ratio	RR	V_I = –8 to –18V, V_O = –5V, f = 120Hz	60	—	—	dB
Output noise voltage	V_{no}	V_O = –5V, f = 10Hz to 100kHz	—	40	—	µV
Minimum input/output voltage difference	$V_{DIF(min)}$	I_O = 500mA, T_j = 25°C	—	1.1	—	V
Output short-circuit current	I_{OS}	V_I = –35V, V_O = –5V, T_j = 25°C	—	100	600	mA
Peak output current	I_{OP}	V_O = –5V, T_j = 25°C	0.4	0.8	1.4	A
Output voltage temperature coefficient	$\Delta V_O/T_a$	V_O = –5V, I_O = 5mA, T_j = –20 to +25°C	—	0.2	—	mV/°C
		V_O = –5V, I_O = 5mA, T_j = 25 to 150°C	—	– 0.3	—	mV/°C
Control pin voltage	V_{cont}	T_j = 25°C	–3.12	–3	–2.88	V

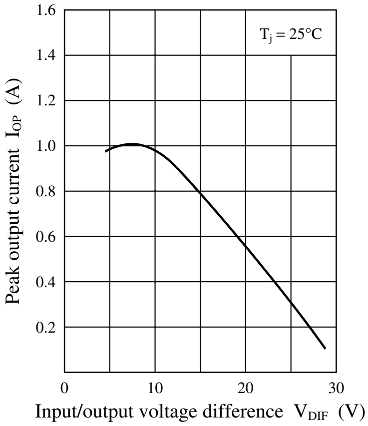
Note 1) The specified condition T_j = 25°C means that the test should be carried out within so short a test time (within 10ms) that the characteristic value drift due to the chip junction temperature rise can be ignored.
Note 2) Unless otherwise specified, V_I = –10V, V_O = –5V, I_O = 350mA, C_I = 2µF and C_O = 1µF

■ Main Characteristics

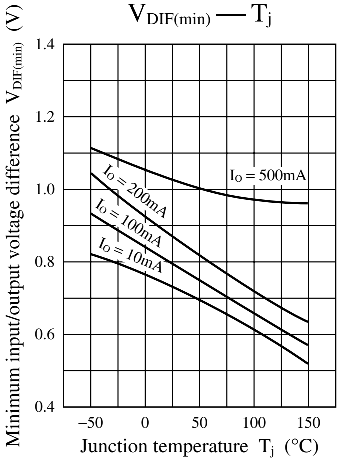
P_D — T_a



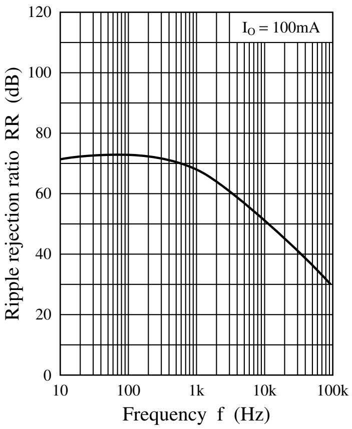
I_{OP} — V_{DIF}



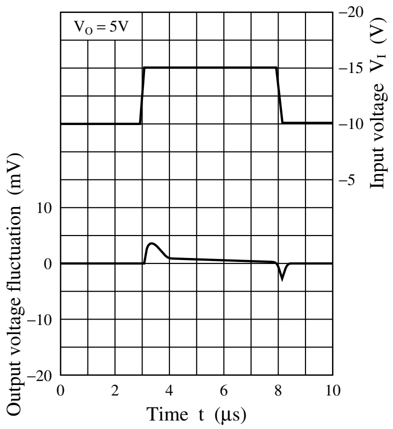
$V_{DIF(min)}$ — T_j



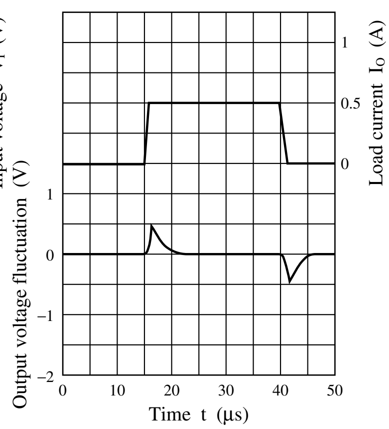
RR — f



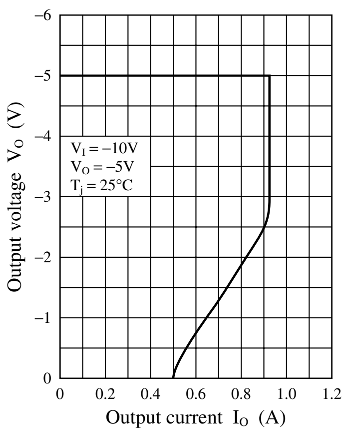
Transient response to input variation



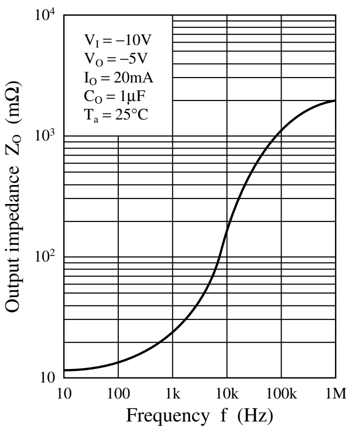
Transient response to load variation



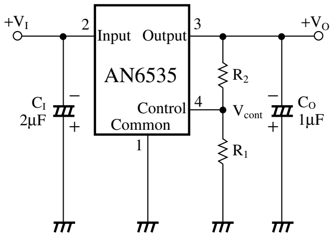
Current limiting characteristic



Z_O — f



■ Basic Regulator Circuit



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

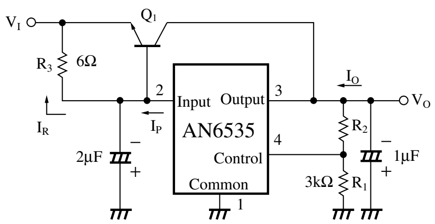
($V_{cont} \cong 3V$, $R_1 = 3k\Omega$)

C_I is necessary when the V_I line is long.

C_O improves the transient response.

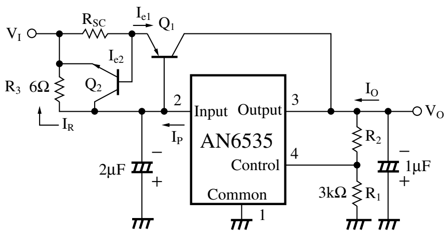
■ Application Circuit Example

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)



$$R_{SC} = \frac{V_{BE(Q1)}}{I_{e1(max)}}$$

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

$$I_{e1(max)} = I_{P(max)} - \frac{V_{BE(Q1)} + V_{BE(Q1)}}{R_3}$$

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