

AN6535

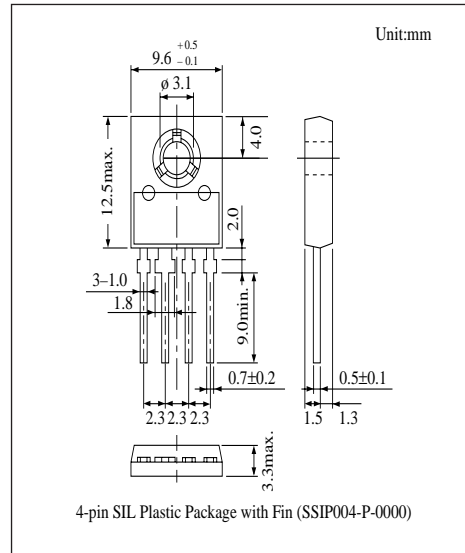
4-pin Negative Adjustable Voltage Regulator

■ Overview

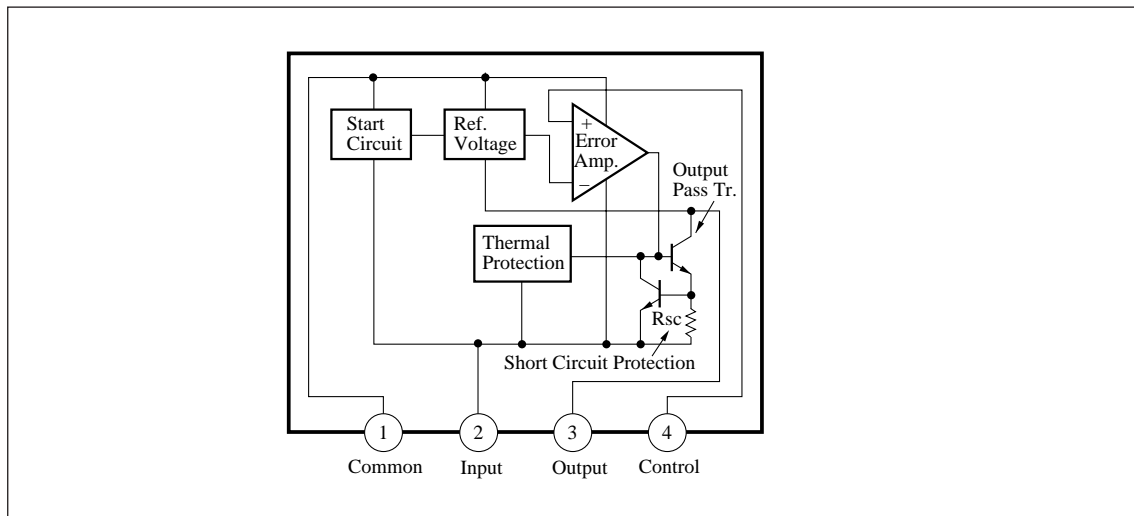
The AN6535 is a monolithic 4-pin negative adjustable voltage regulator. With an external resistor, it provides any stabilized output voltages between $-5V$ and $-30V$, and is optimum for the power circuits with a current capacitance of up to $0.5A$. With various protective circuits built in, it has high reliability and is provided in a 4-lead SIL plastic package.

■ Features

- Wide range of output voltages: $V_{O} = -5$ to $-30V$
- Internal thermal overload protection
- Internal short-circuit protection
- Output transistor safe area compensation



■ Block Diagram



■ Absolute Maximum Ratings (Ta=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	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 dissipation state)

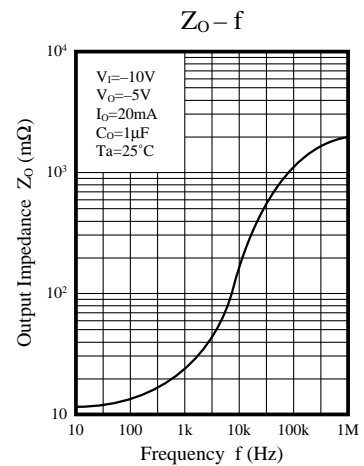
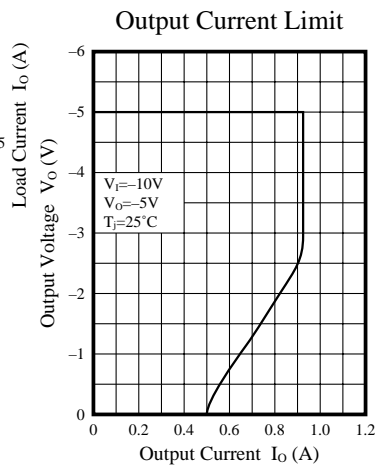
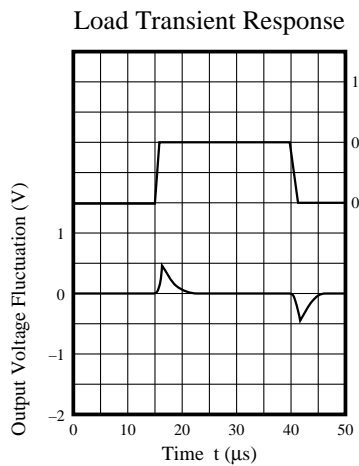
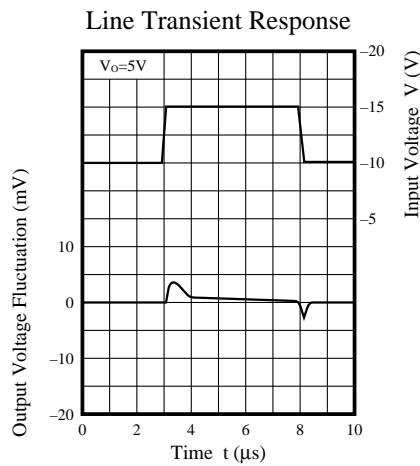
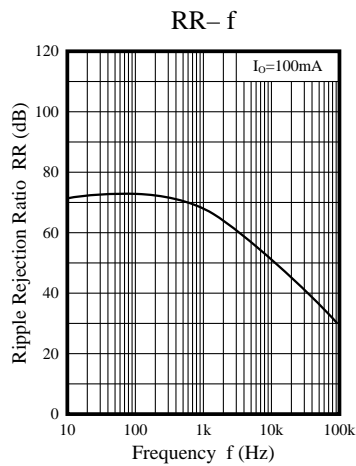
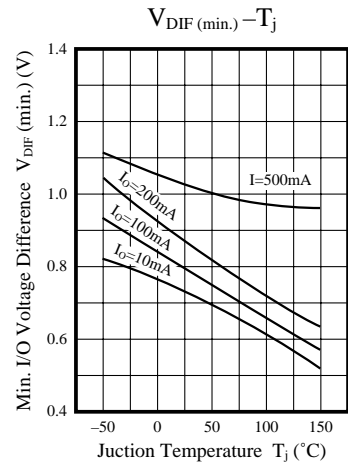
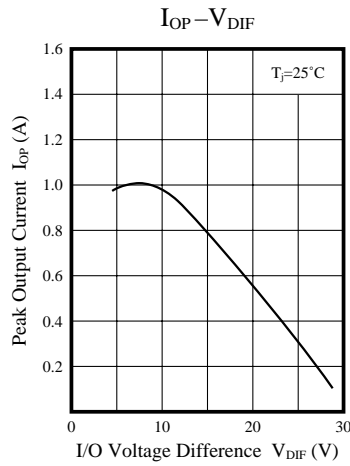
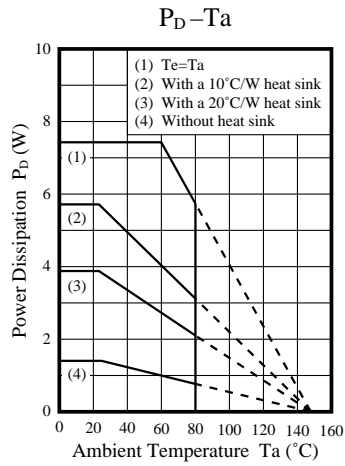
■ Electrical Characteristics (Ta=25°C)

Parameter	Symbol	Condition	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		
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	ΔV _O /Ta	V _O =-5V I _O =5mA	T _j =-20 to +25°C	—	0.2	—	mV/°C	
			T _j =25 to 150°C	—	-0.3	—		
Control pin voltage	V _{cont}	T _j =25°C	-3.12	-3	-2.88	V		

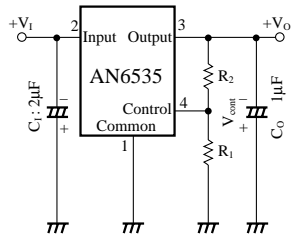
Note 1) The specified condition T_j=25°C means that the test should be conducted with each test time reduced (within 10 ms) so that the drift in the characteristic value due to a temperature rise at chip junction can be ignored.

Note 2) Unless otherwise specified, V_I=-10V, V_O=-5V, I_O=350mA, C_I=2μF, and C_O=1μF

■ Characteristics Curve



Basic Regulator Circuit



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

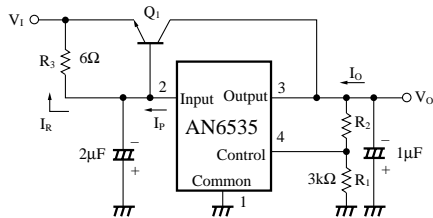
$$(V_{\text{cont}} \cong 3\text{V}, R_1 = 3\text{k}\Omega)$$

C_1 : Necessary when the V_1 line is long.

C_0 : Improves the transient response.

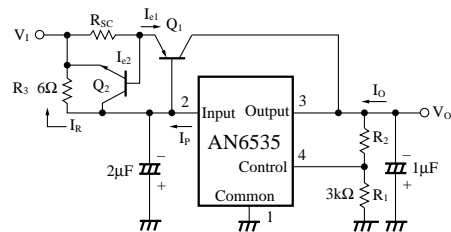
Application Circuits

(1) Current Boost Circuit



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

(2) Current Boost Circuit (With Current Limiting Circuit)



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

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

$$I_{e1(\text{max.})} = I_P(\text{max.}) - \frac{V_{BE(Q1)} + V_{BE(Q2)}}{R_3}$$