AN6500, AN6500S, AN6501

Built-in Reference Voltage Operational Amplifiers

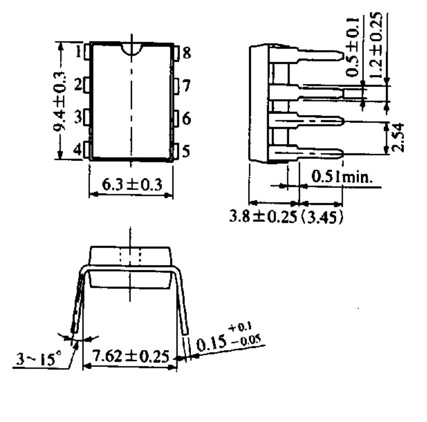
■ Overview

The AN6500, the AN6500S, and the AN6501 are high-performance operational amplifiers with reference voltage built-in, allowing single power supply voltage operation and wide application with reference voltage.

■ Features

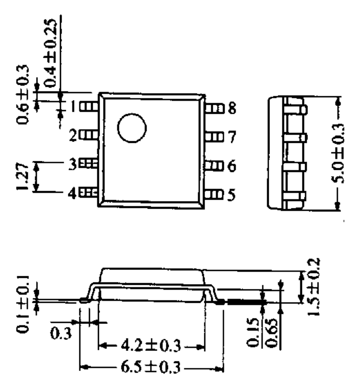
- Wide range of operating voltage : 3 to 24V
- Single power supply voltage operation
- Large output current : $I_O = +120mA$ typ. / $-110mA$ typ.
- Low reference voltage : $V_{REF} = 1.33V$ typ.
- Easy to compose variable regulator with reference voltage
- 3 types of packages are available
- Little cross-over distortion in operational amplifier circuit

AN6500 Unit : mm



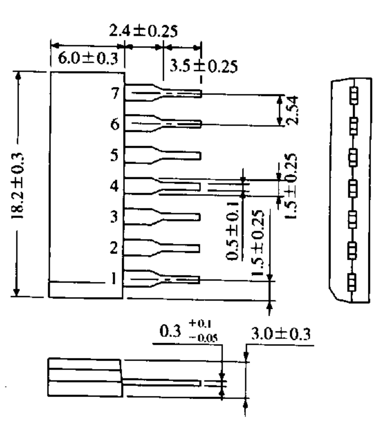
8-pin DIL Plastic Package (DIP008-P-0300B)

AN6500S Unit : mm



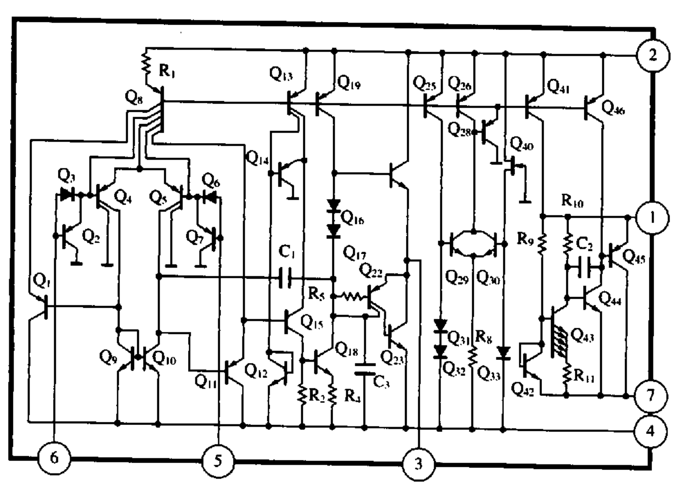
8-pin PANAFLAT Plastic Package (SOP008-P-0225A)

AN6501 Unit : mm



7-pin SIL Plastic Package (SIP007-P-0000)

■ Schematic Diagram



Operational Amplifiers

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Pin Descriptions

Pin No.	Pin name
1	Ref. voltage (+)
2	Supply voltage
3	OP. amp. output
4	GND
5	OP. amp. input (+)
6	OP. amp. input (−)
7	Ref. voltage (−)
8	NC

Absolute Maximum Ratings (Ta=25℃)

Parameter		Symbol	Rating	Unit
Supply voltage		V_{CC}	24	V
Supply current		I_{CC}	160	mA
Reference voltage outflow current		$(V_{REF})-I$ *1	−100	μA
Reference voltage inflow current		$(V_{REF})+I$ *2	500	μA
Common-mode input voltage range		V_{ICM}	−0.3 to +24	V
Differential input voltage		V_{ID}	24	V
Output sink current		V_{SINK}	150	mA
Power dissipation	AN6500	P_D *3	750	mW
	AN6500S		360	mW
	AN6501		925	mW
Operating ambient temperature		T_{opr}	−20 to +75	℃
Storage temperature	AN6500, AN6501	T_{stg}	−55 to +150	℃
	AN6500S		−40 to +125	℃

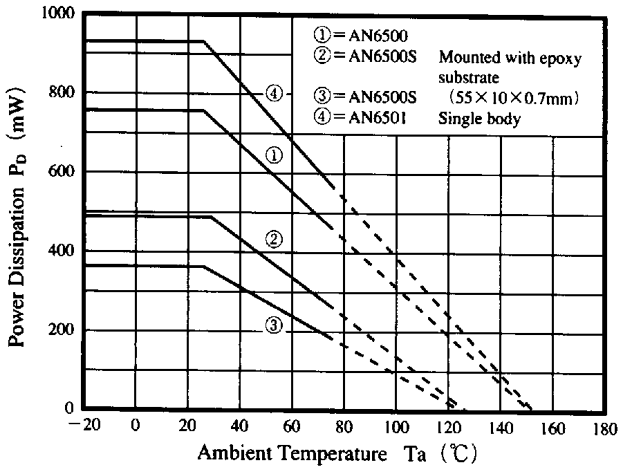
*1 Current flowed out from Pin①. *2 Current flowed into Pin①. *3 When enlarging output current, watch power consumption.

Electrical Characteristics (V_{CC}=5V, Ta=25℃±2℃)

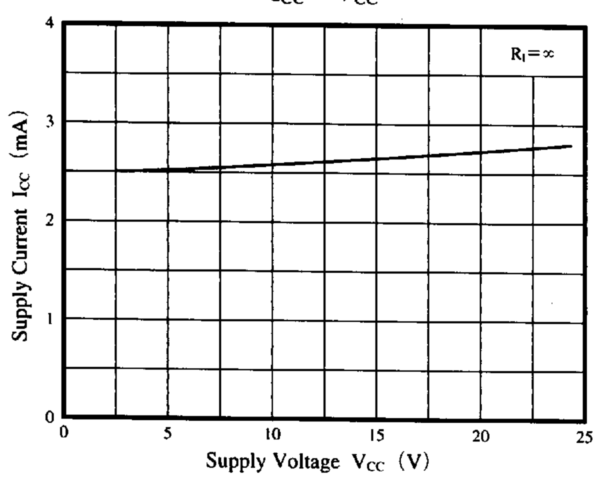
Parameter	Symbol	Condition	min	typ	max	Unit
Reference voltage	V_{REF}		1.25	1.33	1.45	V
Reference voltage temperature variation characteristics	$\Delta V_{REF}/Ta$	Ta=0 to 50℃	—	−30	—	ppm/℃
Input offset voltage	$V_{I(offset)}$	$R_S=50\Omega$	—	2	7	mV
Input bias current	I_{Bias}		—	100	500	nA
Input offset current	I_{IO}		—	5	300	nA
Common-mode input voltage range	V_{CM}		—	—	3.5	V
Supply current	I_{CC}	$R_L=\infty$	—	2.5	3.5	mA
Voltage gain	G_V	$R_L \geqq 2k\Omega$	80	108	—	dB
Maximum output voltage (1)	$V_{O(max)1}$	$R_L \geqq 2k\Omega$	3.5	—	—	V
Maximum output voltage (2)	$V_{O(max)2}$	$V_{CC}=5V, I_O=70mA$	3	4.1	—	V
Common-mode rejection ratio	CMR		—	85	—	dB
Supply voltage rejection ratio	SVR		—	90	—	dB
Output source current	$I_{O(source)}$	$V_{IN}^+=1V, V_{IN}^-=0V$	70	110	—	mA
Output sink current	I_{SINK}	$V_{IN}^+=0V, V_{IN}^-=1V$	70	120	—	mA
Zero-cross frequency	$f_{(T)}$		—	1	—	MHz

■ Characteristics Curve

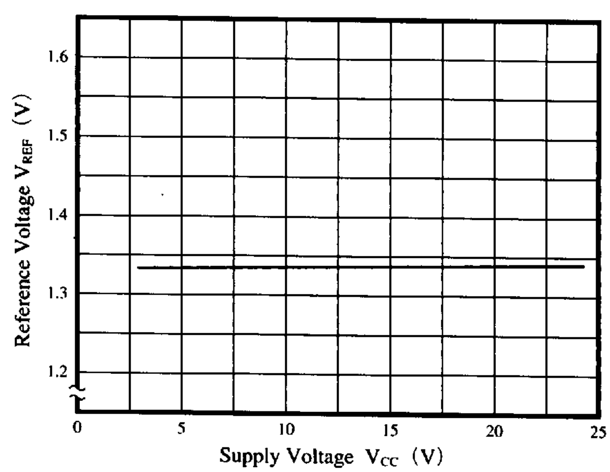
$P_D - Ta$



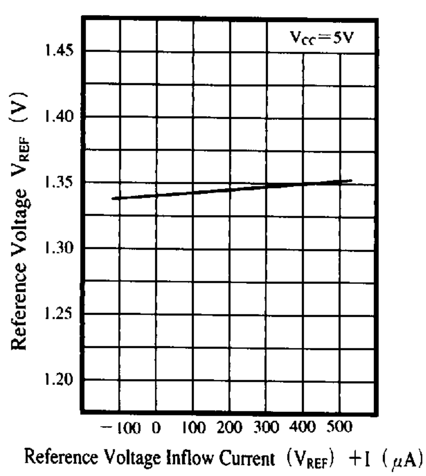
$I_{CC} - V_{CC}$



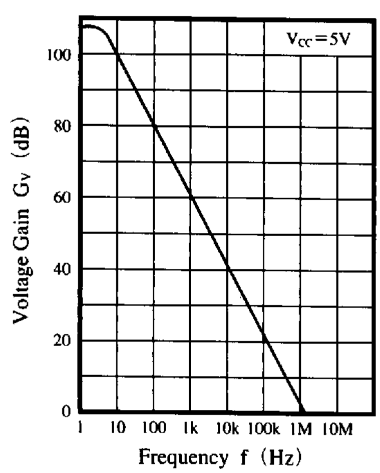
$V_{REF} - V_{CC}$



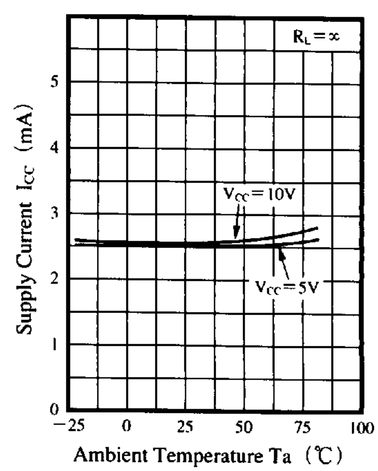
$V_{REF} - (V_{REF}) + I$



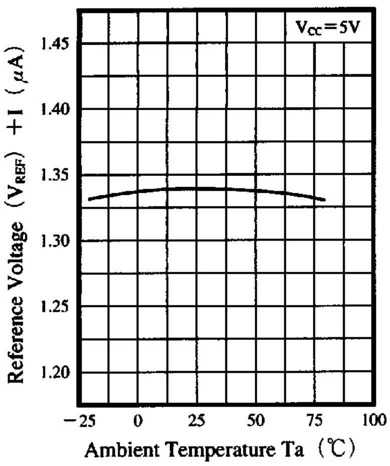
$G_V - f$



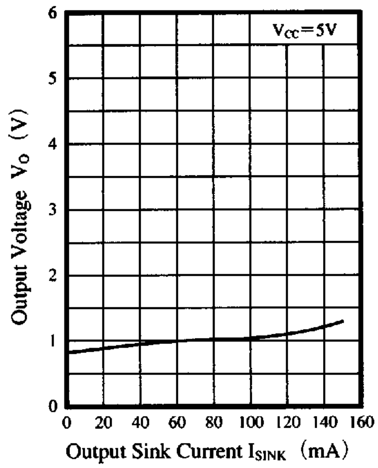
$I_{CC} - Ta$



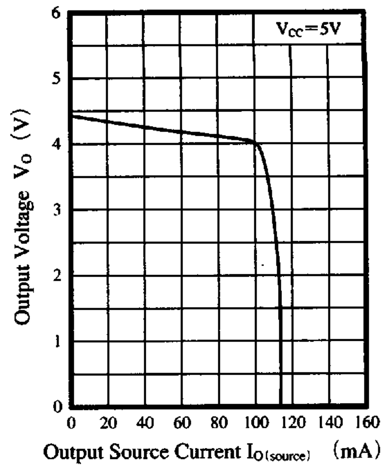
$V_{REF} - Ta$



$V_O - I_{SINK}$

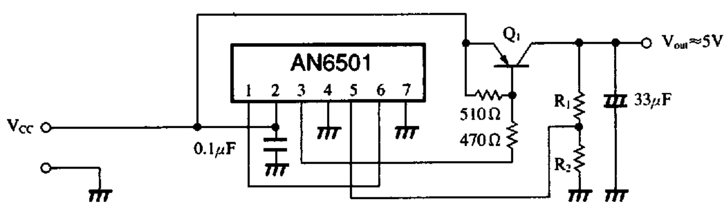


$V_O - I_{O(source)}$



Application Circuits

1. Voltage Regulator Circuit
   High efficiency circuit with small I/O voltage difference



- Output voltage (V_{out}) is calculated by the following formula.

$$V_{out} = \frac{R_1 + R_2}{R_2} V_{REF}$$

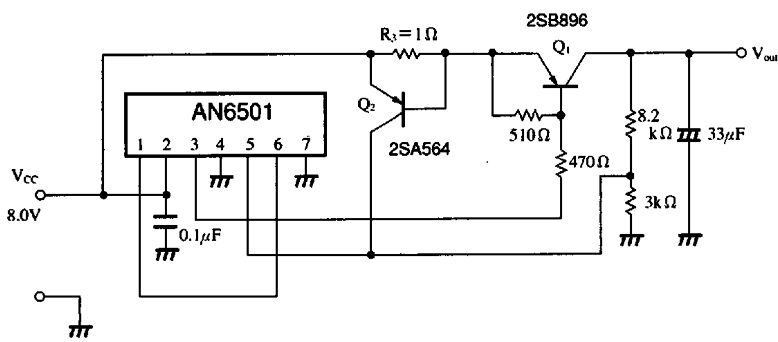
$$\fallingdotseq \frac{R_1 + R_2}{R_2} \times 1.33\,(V)$$

- I/O Voltage difference

  2SB896 is applied for Q_1 when output current is 330mA. The minimum I/O voltage difference is 0.2V.

Parameter	Symbol	Condition		typ	Unit
Line regulation	REG_{IN}	V_{CC}=6 to 20V, I_O=1A	R_1=8.2kΩ R_2=3kΩ	16	mV
Load regulation	REG_L	V_{CC}=10V, I_O=5mA to 1A		9	mV
Ripple rejection ratio	RR	V_{CC}=8 to 18V, I_O=100mA, f=120Hz		57.4	dB

2. Voltage Regulator Circuit
   With output current limiter



- Limit Current $I_{O(Lim)}$ is calculated by the following formula

$$I_{O(Lim)} = \frac{V_{BE}\,(Q_2)}{R_3}$$

When $V_{BE}\,(Q_2)$ = 0.7V, and R_3 = 1Ω,

$$I_{O(Lim)} = \frac{0.7}{1} = 0.7A$$