AN6500, AN6500S, AN6501

Built-in Reference Voltage Operational Amplifiers

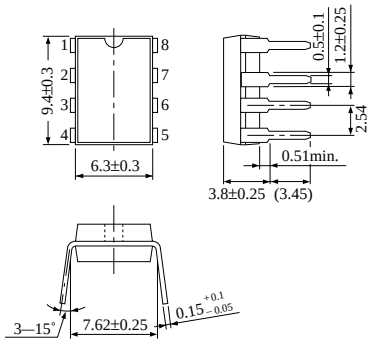
■ Overview

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

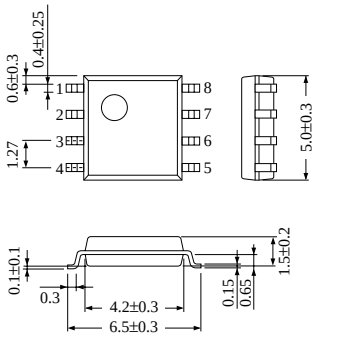
- Wide range of operating voltage:3 to 24V
- Single power supply voltage operation
- Large output current:I_O=$^{+120mA\ typ.}_{-110mA\ typ.}$
- Low reference voltage:V_{REF}=1.33V typ.
- Easy to compose variable regulator with reference volt age
- 3 types of packages are available
- Little cross-over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

AN6500 Unit:mm



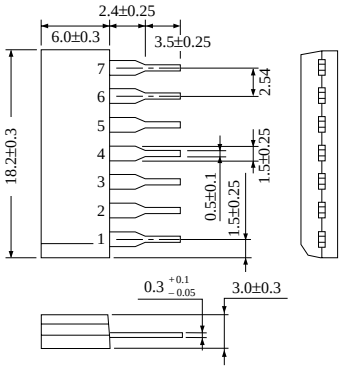
8-pin DIL Plastic Package (DIP008-P-0300B)

AN6500S Unit:mm



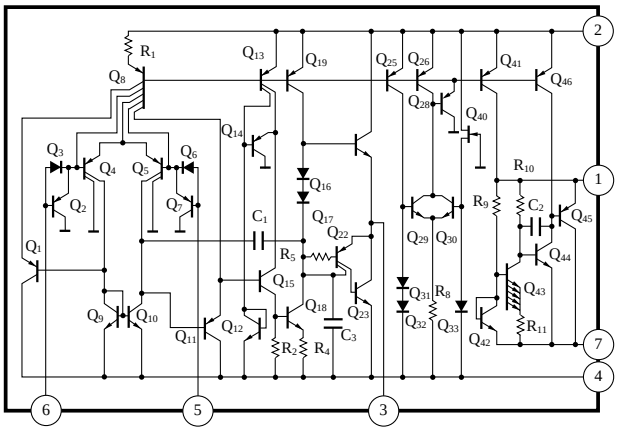
8-pin PANAFLAT Plastic Package (SOP008-P-0225A)

AN6501 Unit:mm



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

■ Block Diagram



■ 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˚C)

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	˚C
Storage temperature	AN6500, AN6501	T_{stg}	–55 to +150	˚C
	AN6500S		–40 to +125	˚C

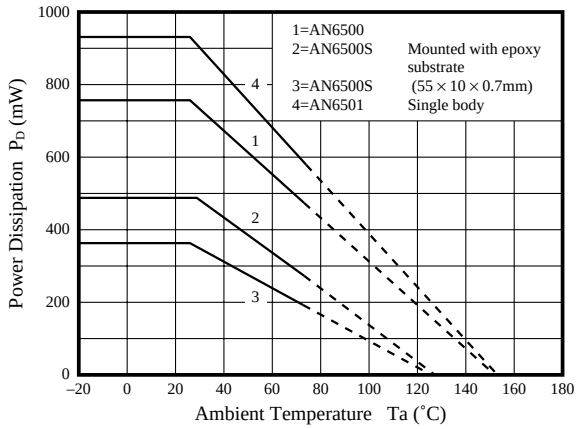
*1 Current flowed out from Pin1. *2 Current flowed into Pin1. *3 When enlarging output current, watch power consumption.

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

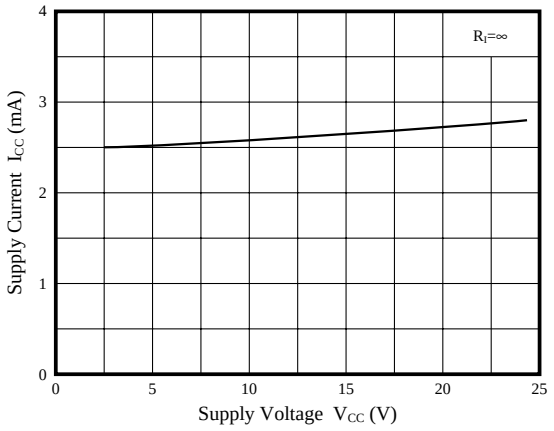
Parameter	Symbol	Condition	min	typ	max	Unit
Reference voltage	V_{REF}		1.25	1.33	1.45	V
Reference voltage temperature variation characteristics	ΔV_{REF} /Ta	Ta=0 to 50˚C	—	–30	—	ppm/˚C
Input offset voltage	$V_{I\ (offset)}$	R_S=50Ω	—	2	7	mV
Input bias current	I_{Bias}		—	100	500	nA
Input offset current	I_{IO}		—	5	300	nA
Common-mode input voltage range	V_{CM}		—	—	3.5	V
Supply current	I_{CC}	R_L= ∞	—	2.5	3.5	mA
Voltage gain	G_V	R_L≧2kΩ	80	108	—	dB
Maximum output voltage (1)	$V_{O\ (max)1}$	R_L≧2kΩ	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

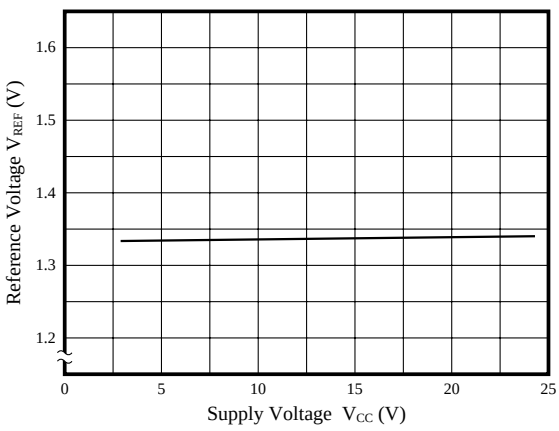
P_D–Ta



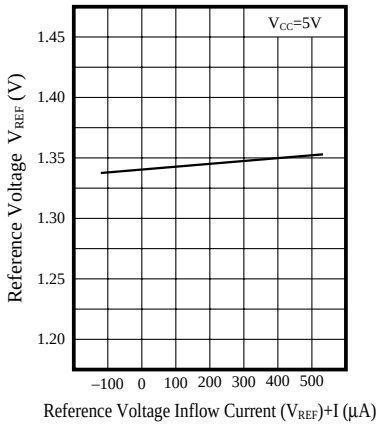
I_{CC}–V_{CC}



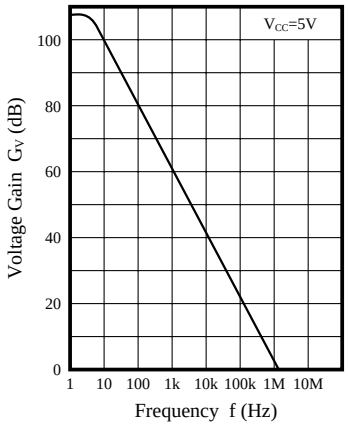
V_{REF}–V_{CC}



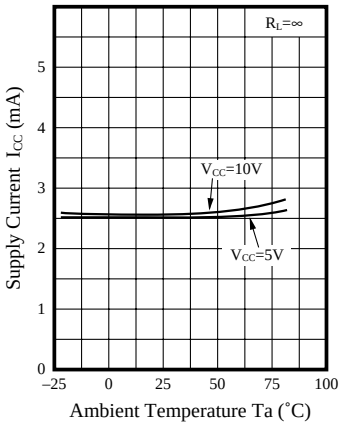
V_{REF}– (V_{REF})+I



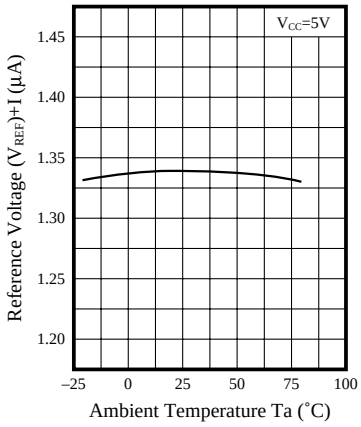
G_V–f



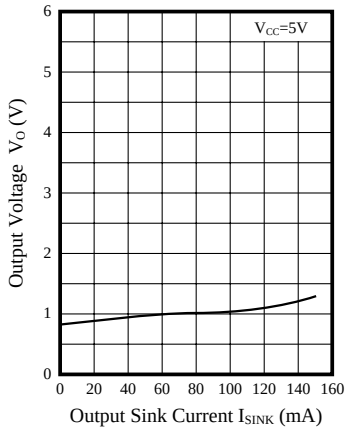
I_{CC}–Ta



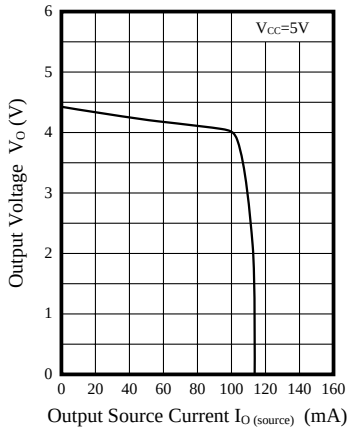
V_{REF}–Ta



V_O–I_{SINK}

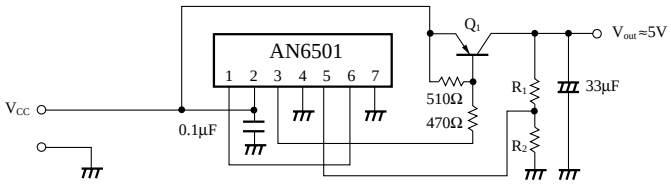


V_O–$I_{O\ (source)}$



■ 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.

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

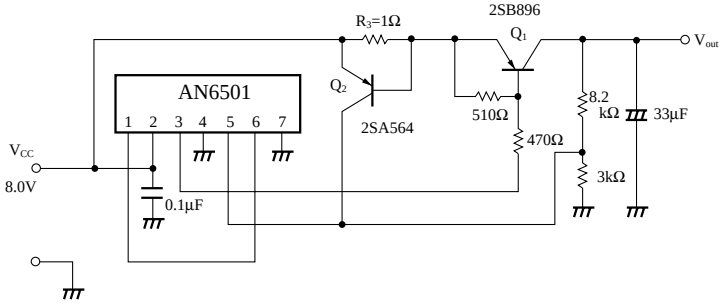
$$\fallingdotseq \frac{R_1+R_2}{R_2} \times 1.33 \ (V)$$

・ 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,

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