

**VARIABLE OUTPUT VOLTAGE REGULATOR(DUAL TRACKING TYPE)****DESCRIPTION**

The M5230 is a semiconductor integrated circuit which is designed for variable output voltage regulator of dual tracking type.

It is housed in an 8-pin SIP and SOP. The output voltage can be adjusted over a wide range from  $\pm 3 \sim \pm 30V$  by adjusting the value of the voltage setting external resistors. By adjusting the resistance of the external balance setting resistors the positive/negative output voltage ratio can also be set freely. Again by attaching power transistors high current gains can be achieved, making the device suitable for use in the power supplies of a wide variety of equipment.

**FEATURES**

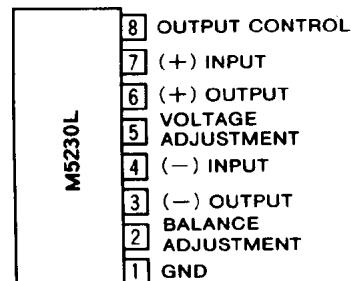
- High input voltage .....  $V_i = \pm 35V$
- Wide range of output voltage .....  $V_o = \pm 3 \sim \pm 30V$
- Low output noise voltage .....  $V_{NO} = 12 \mu V_{rms}$  (typ.)
- Built-in current limiting and thermal shutdown circuit
- The output voltage rise time constant of the coefficients can be adjusted by the value of the external capacitor.
- Capability of operation control by the external control signal (Pin ⑧).

**APPLICATION**

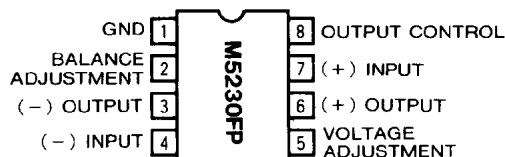
Dual voltage power supplies for stereo preamplifiers, for the power supplies of other equipment, including operational amplifiers.

**RECOMMENDED OPERATING CONDITIONS**

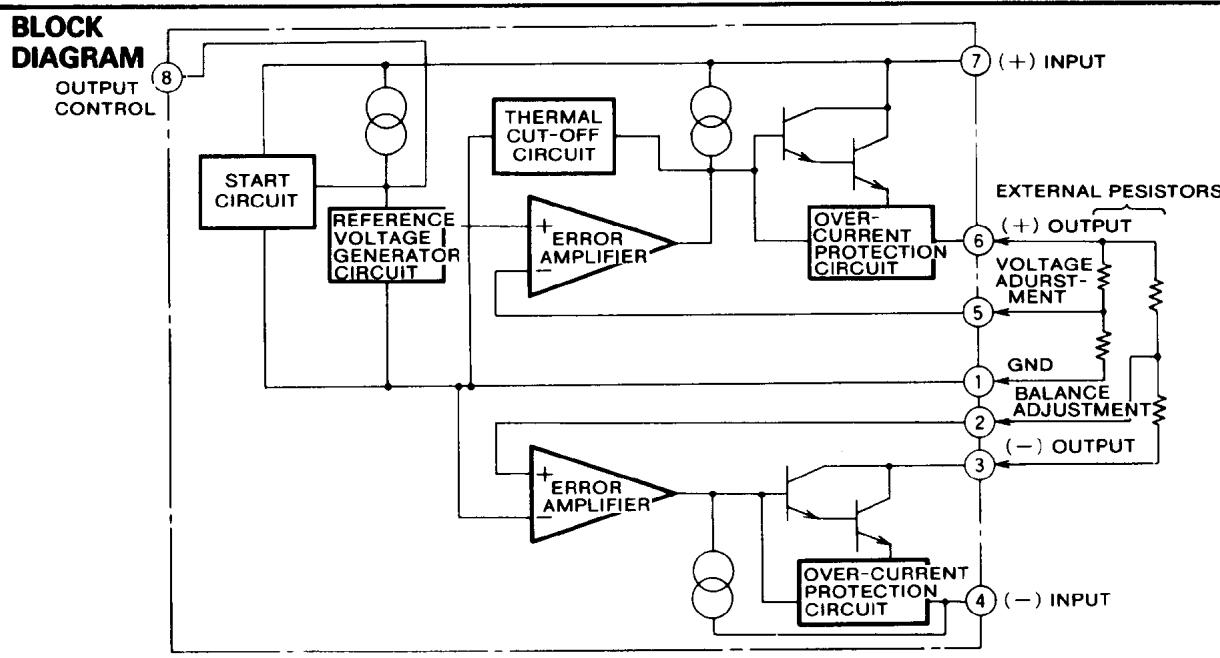
- Supply voltage range .....  $\pm 8 \sim \pm 35V$
- Rated supply voltage .....  $\pm 20V$

**PIN CONFIGURATION (TOP VIEW)**

Outline 8P5



Outline 8P2S-A

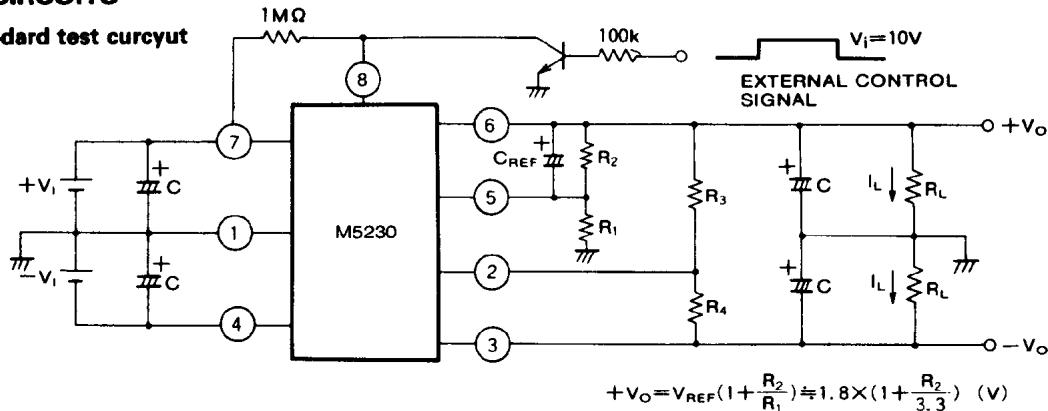


**VARIABLE OUTPUT VOLTAGE REGULATOR(DUAL TRACKING TYPE)****ABSOLUTE MAXIMUM RATINGS ( $T_a=25^\circ\text{C}$ )**

Symbol	Parameter	Ratings	Unit
$V_i$	Input voltage	$\pm 35$	V
$I_L$	Load current	$\pm 30$	mA
$V_i - V_o$	Input-output voltage difference	$\pm 32$	V
$P_d$	Power dissipation	800(L)/440(FP)	mW
$T_{opr}$	Ambient temperature	$-20 \sim +75$	°C
$T_{stg}$	Storage temperature	$-55 \sim +125$	°C

**ELECTRICAL CHARACTERISTICS** (measurement circuit (a) is used with,  $T_a=25^\circ\text{C}$ ,  $V_i=\pm 20\text{V}$ ,  $V_o=\pm 15\text{V}$ ,  $I_L=10\text{mA}$ ,  $C=10\mu\text{F}$ ,  $C_{REF}=1\mu\text{F}$ ,  $R_1=3.3\text{k}\Omega$ )

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$V_i$	Input voltage		$\pm 8$		$\pm 35$	V
$V_o$	Output voltage	$R_2 \approx 1.5 \sim 55\text{k}\Omega$	$\pm 3$		$\pm 30$	V
$V_{REF}$	Reference voltage	(between pin ⑤ and pin ①)	1.66	1.8	1.95	V
$V_i - V_o$	Minimum input-output voltage difference		2.5	3	V	
$\Delta V_o \pm$	Dual voltage tracking			1	%	
Reg.in	Input regulation	$V_i = \pm 18 \sim \pm 30\text{V}$	0.02	0.1	%/V	
Reg.L	Load regulation	$I_L = 0 \sim 20\text{mA}$	0.02	0.1	%	
$I_B$	Bias current	$I_L = 0$ (disregarding the current in resistors $R_1, R_2, R_3, R_4$ )	1.3	3.0	mA	
$TC_{V_o}$	Temperature coefficient of output voltage	$T_a = 0 \sim 75^\circ\text{C}$ , $V_o = \pm 3 \sim \pm 30\text{V}$	0.01		%/°C	
RR	Ripple rejection	$f = 120\text{Hz}$ (measured with circuit (b))	68		dB	
$V_{NO}$	Output noise voltage	$f = 20\text{Hz} \sim 100\text{kHz}$ (between the output terminal and ground)	12		$\mu\text{Vrms}$	
$V_{O(OFF)}$	Output cut-off voltage	$V_i = 10\text{V}$			$\pm 0.1$	V

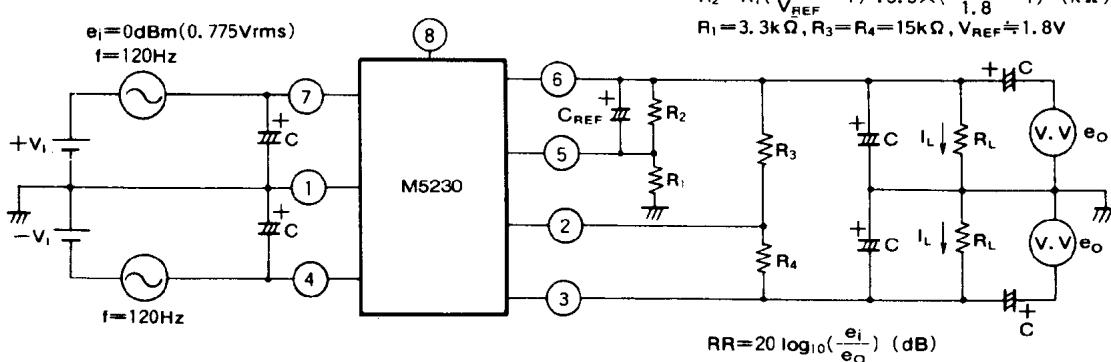
**TEST CIRCUITS****(a) Standard test circuit**

$$+V_o = V_{REF}(1 + \frac{R_2}{R_1}) \approx 1.8 \times (1 + \frac{R_2}{3.3}) \text{ (V)}$$

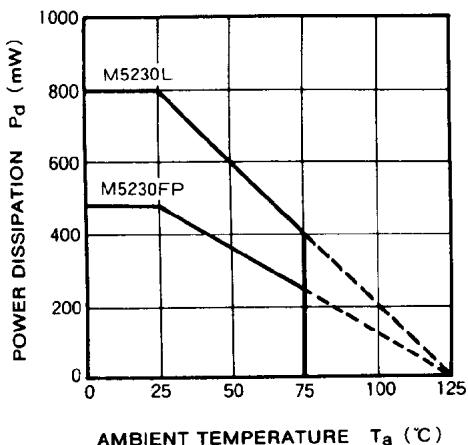
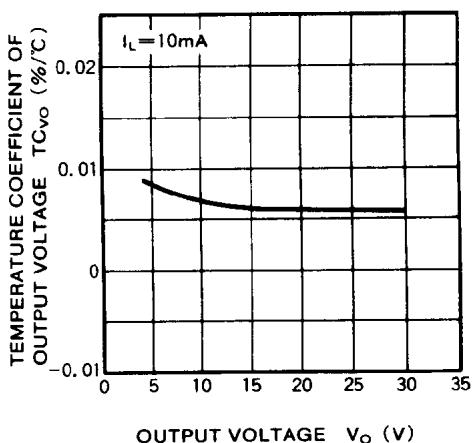
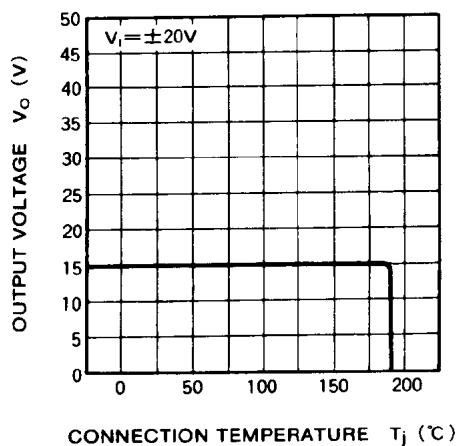
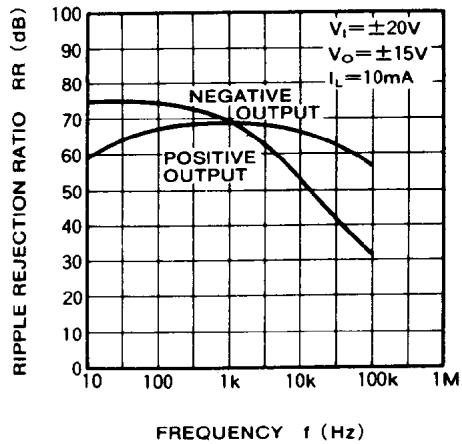
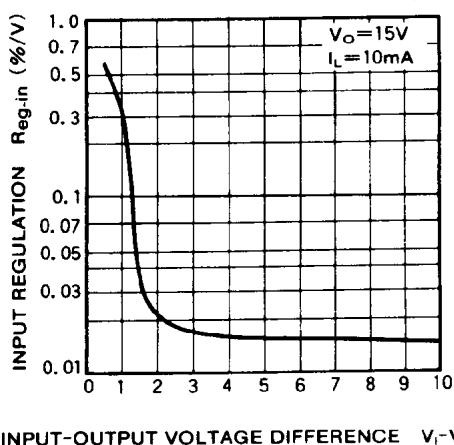
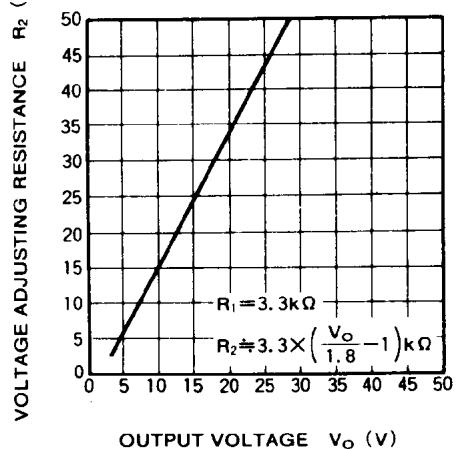
$$-V_o = +V_o \cdot \frac{R_4}{R_3} \text{ (V)}$$

$$R_2 = R_1 \left( \frac{V_o}{V_{REF}} - 1 \right) \approx 3.3 \times \left( \frac{+V_o}{1.8} - 1 \right) \text{ (k}\Omega\text{)}$$

$$R_1 = 3.3\text{k}\Omega, R_3 = R_4 = 15\text{k}\Omega, V_{REF} = 1.8\text{V}$$

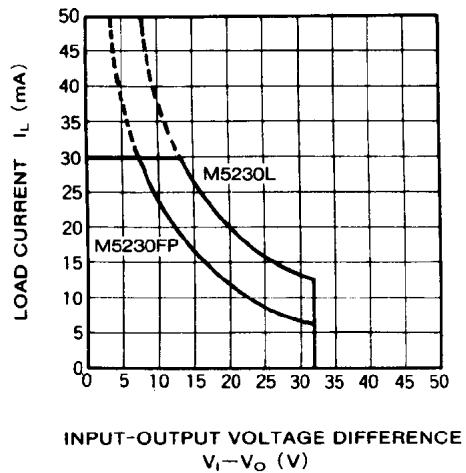
**(b) Ripple rejection test circuit**

$$RR = 20 \log_{10} \left( \frac{e_i}{e_o} \right) \text{ (dB)}$$

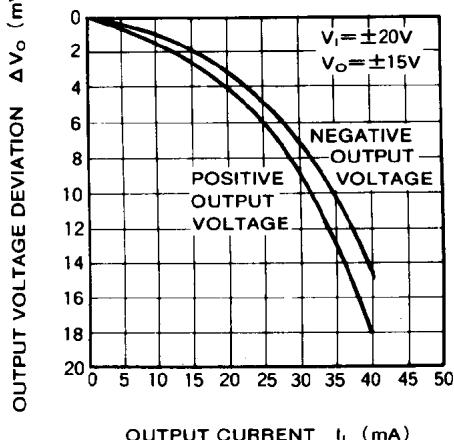
**VARIABLE OUTPUT VOLTAGE REGULATOR(DUAL TRACKING TYPE)****TYPICAL CHARACTERISTICS** **THERMAL DERATING (MAXIMUM RATING)** **TEMPERATURE COEFFICIENT OF OUTPUT VOLTAGE VS. OUTPUT VOLTAGE CHARACTERISTICS** **THERMAL CUTOFF** **RIPPLE EJECTION** **INPUT REGULATION VS. INPUT-OUTPUT VOLTAGE DIFFERENCE** **VOLTAGE ADJUSTMENT RESISTANCE VS. OUTPUT VOLTAGE**

**VARIABLE OUTPUT VOLTAGE REGULATOR(DUAL TRACKING TYPE)**

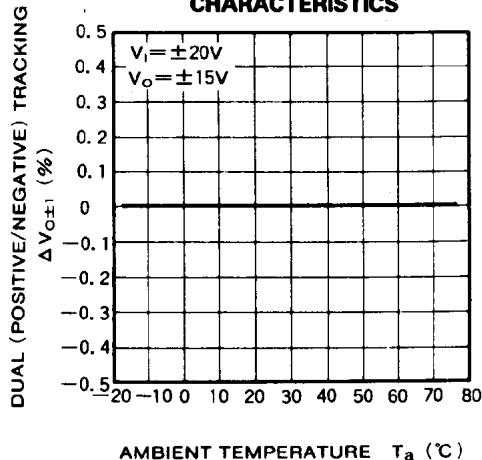
**LOAD CURRENT VS.  
INPUT-OUTPUT VOLTAGE DIFFERENCE**



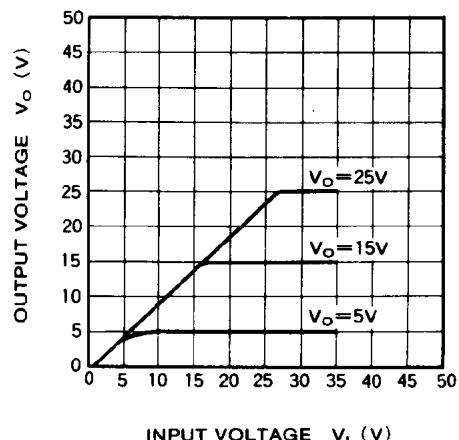
**OUTPUT VOLTAGE REGULATION**



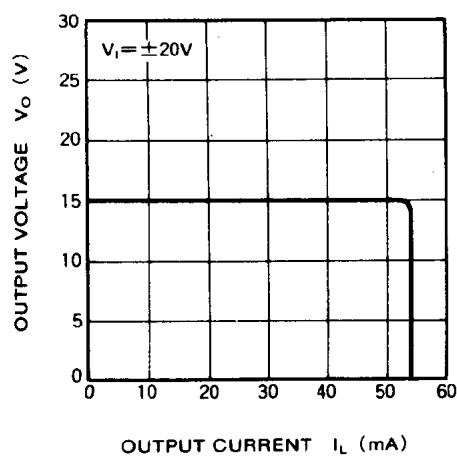
**DUAL-TRACKING TEMPERATURE  
CHARACTERISTICS**



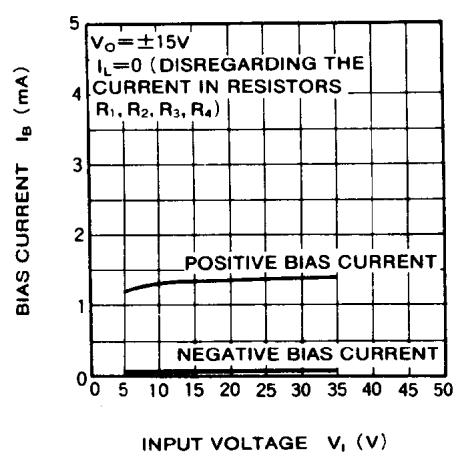
**OUTPUT VOLTAGE CHARACTERISTICS**

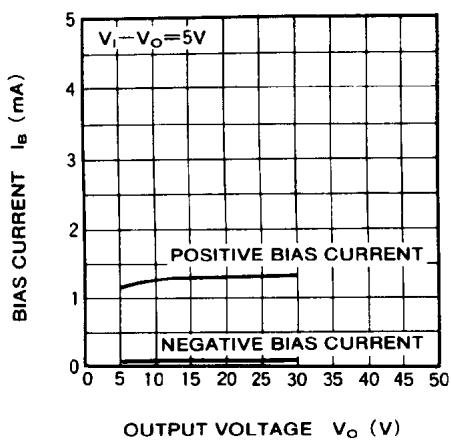
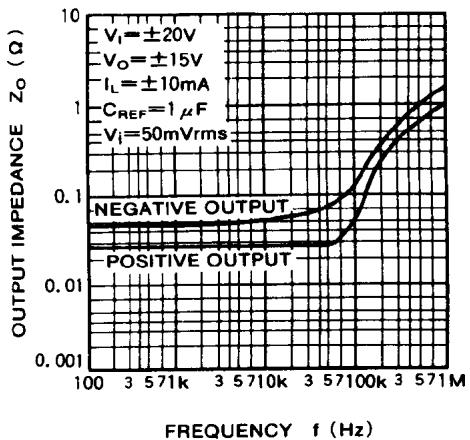
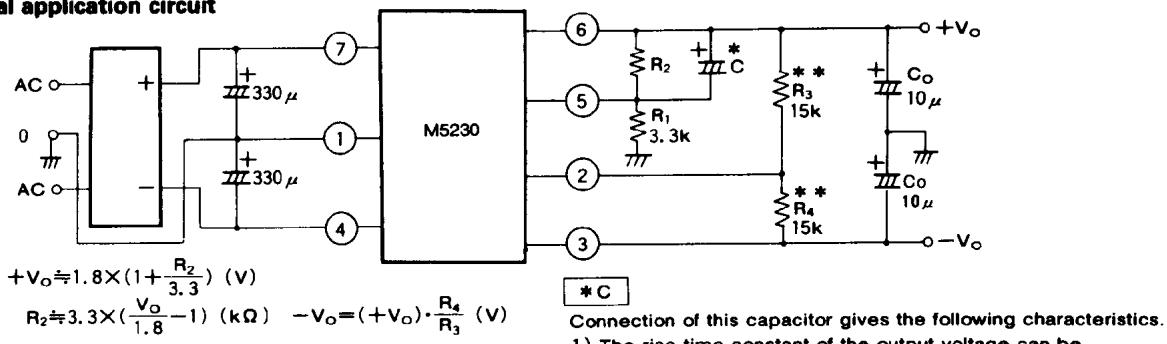


**LOAD CHARACTERISTICS**



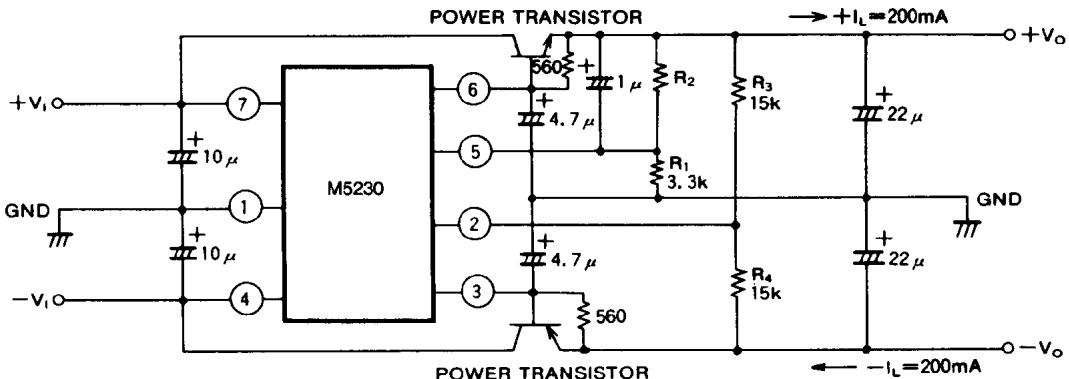
**BIAS CURRENT VS. INPUT VOLTAGE**



**VARIABLE OUTPUT VOLTAGE REGULATOR(DUAL TRACKING TYPE)****BIAS CURRENT VS. OUTPUT VOLTAGE****OUTPUT IMPEDANCE VS. FREQUENCY****APPLICATION EXAMPLES****(1) Typical application circuit**

Note: When the input power supply lines become long, a 0.1 μF capacitor should be connected between input power supply pins ⑦ and ④ and ground.

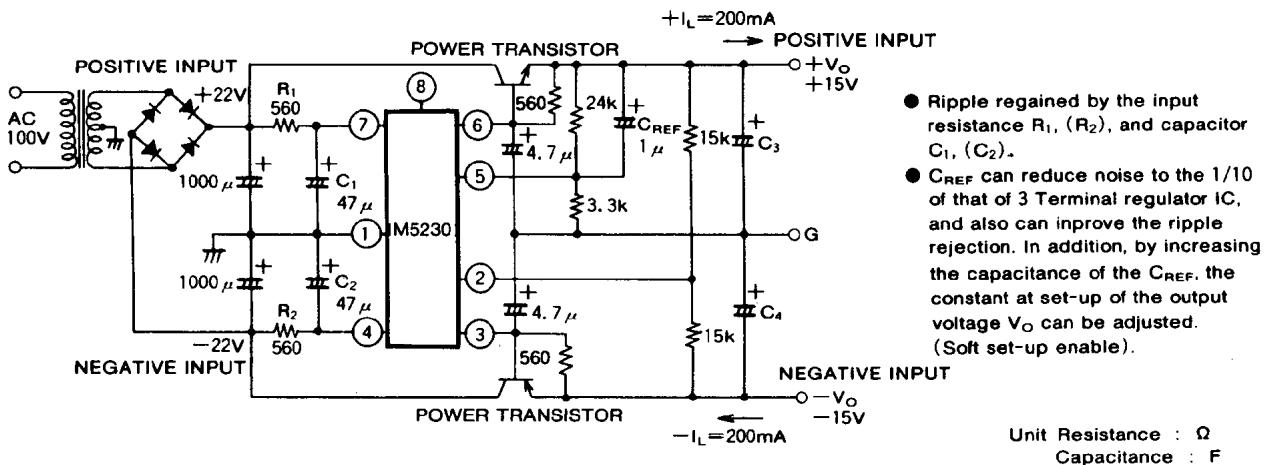
Unit Resistance : Ω  
Capacitance : F

**(2) Typical application circuit with power transistors connected**

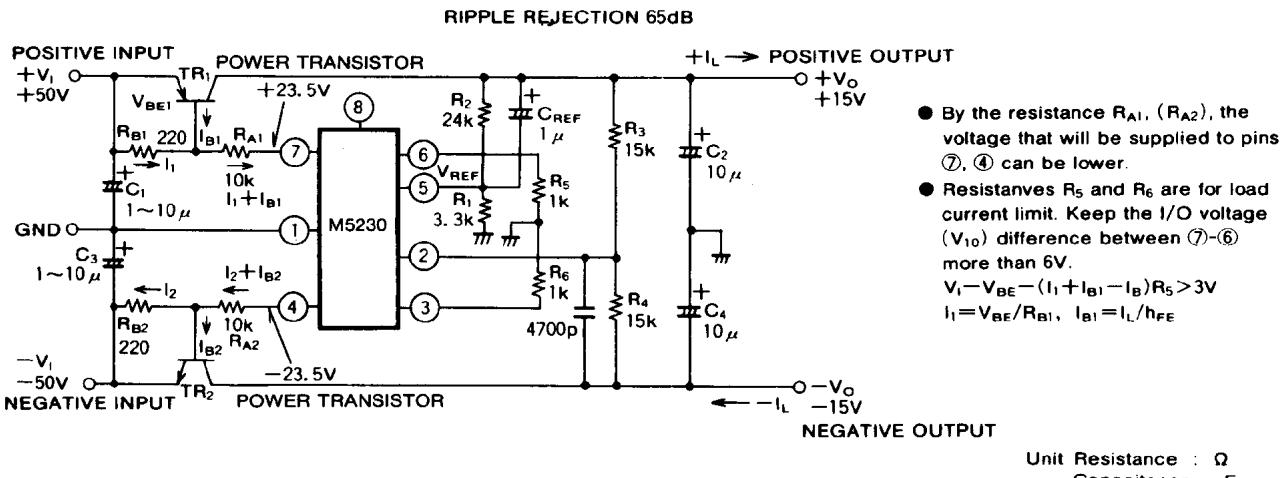
Unit Resistance : Ω  
Capacitance : F

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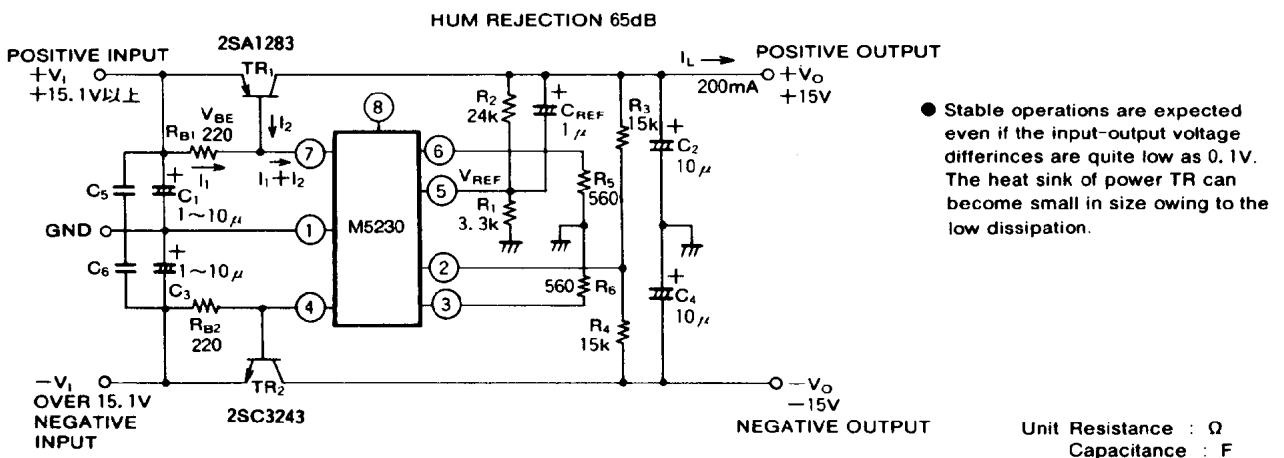
(3) High ripple rejection circuit (80dB)



(4) High input voltage (V<sub>I</sub>=±50V)



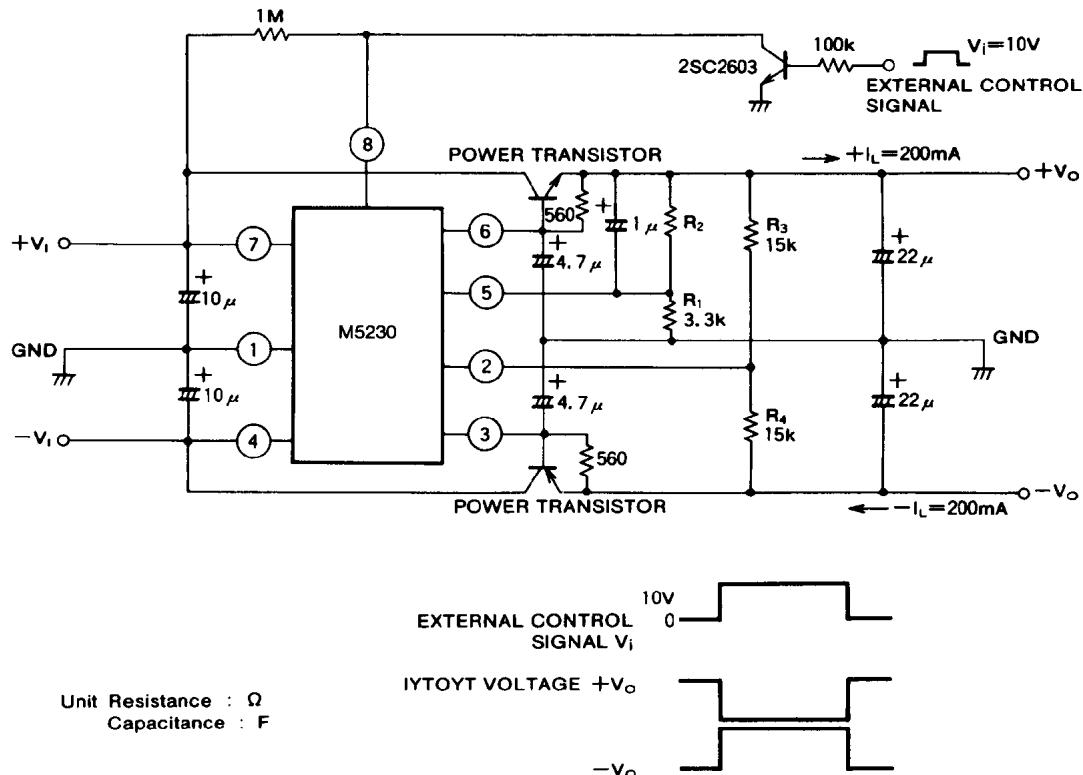
(5) Supper low dropout regulator circuit (V<sub>IO</sub>=100mW)



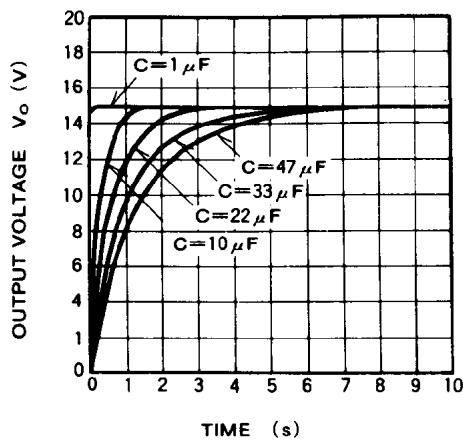
(Note) The load current can be over 1A by connecting the external power TR.

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## (6) ON/OFF control of output voltage circuit

**EXAMPLES OF THE CHARACTERISTICS ACHIEVED**

**Fig. 1 OUPUT VOLTAGE CHARACTERISTICS FOR EXTERNAL CAPACITORS (\*C)**



**Fig. 2 OUTPUT VOLTAGE RATIO VS. BALANCE VOLTAGE ADJUSTING RESISTANCE CHARACTERISTICS**

