

M5230L,FP

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).

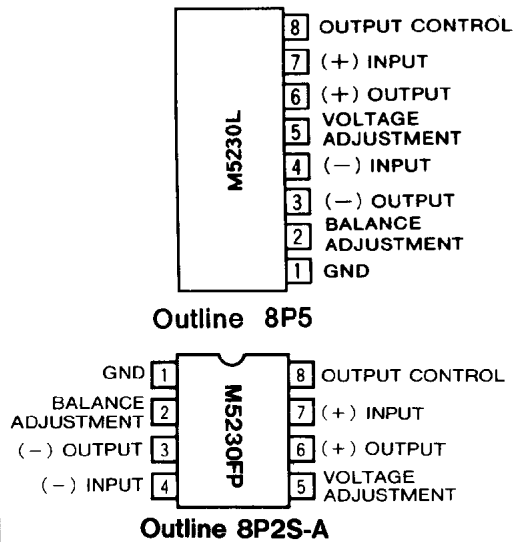
APPLICATION

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

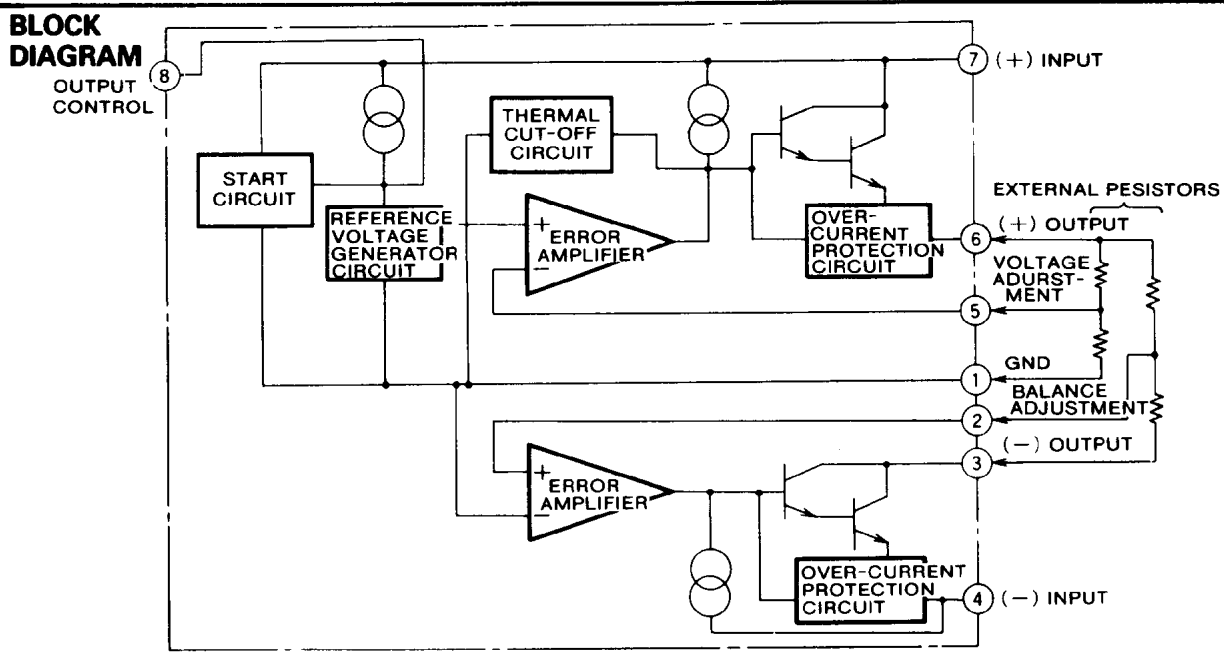
RECOMMENDED OPERATING CONDITIONS

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

PIN CONFIGURATION (TOP VIEW)



BLOCK DIAGRAM

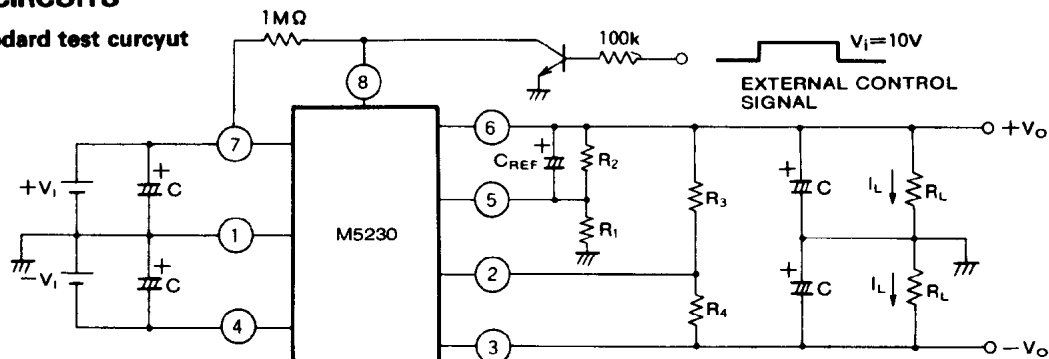


VARIABLE OUTPUT VOLTAGE REGULATOR (DUAL TRACKING TYPE)**ABSOLUTE MAXIMUM RATINGS** ($T_a=25^\circ\text{C}$)

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

ELECTTICAL 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		± 8		± 35	V
V_o	Output voltage	$R_2 \approx 1.5 \sim 55\text{k}\Omega$	± 3		± 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		μVrms
$V_{O(OFF)}$	Output cut-off voltage	$V_i = 10\text{V}$			± 0.1	V

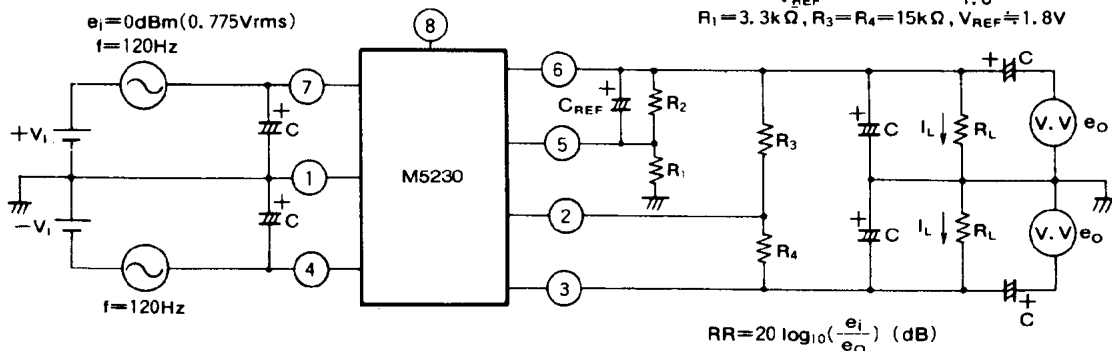
TEST CIRCUITS**(a) Standard test curcyut**

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

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

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

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

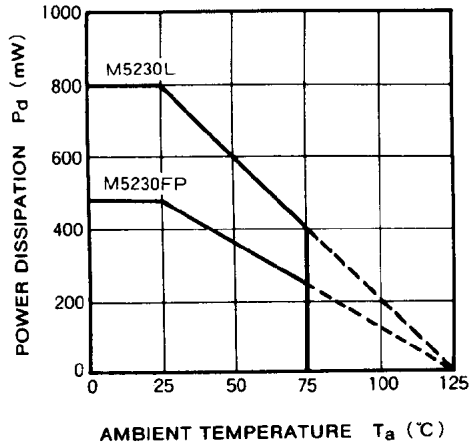
(b) Ripple rejection test circuit

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

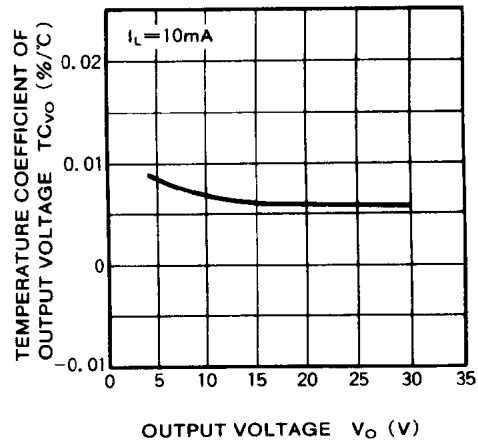
VARIABLE OUTPUT VOLTAGE REGULATOR (DUAL TRACKING TYPE)

TYPICAL CHARACTERISTICS

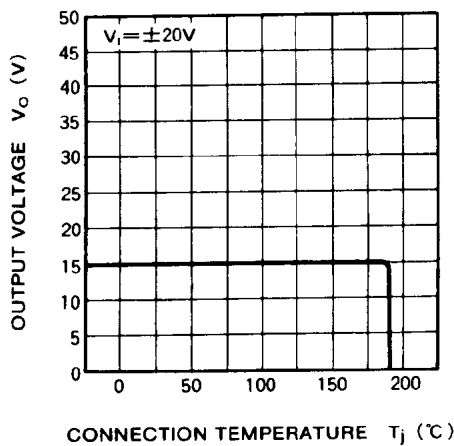
THERMAL DERATING (MAXIMUM RATING)



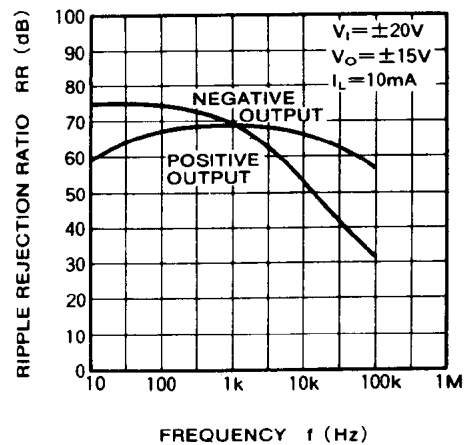
TEMPERATURE COEFFICIENT OF OUTPUT VOLTAGE VS. OUTPUT VOLTAGE CHARACTERISTICS



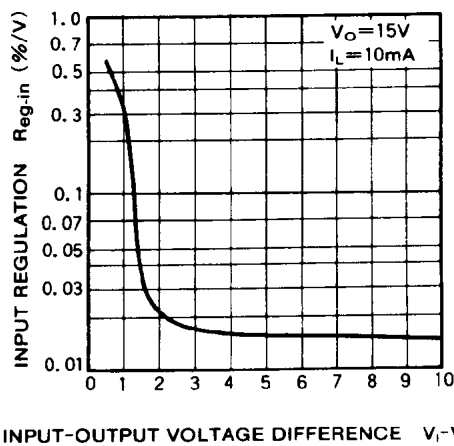
THERMAL CUTOFF



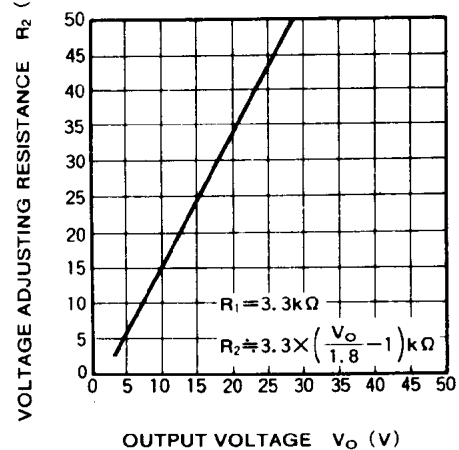
RIPPLE REJECTION



INPUT REGULATION VS. INPUT-OUTPUT VOLTAGE DIFFERENCE

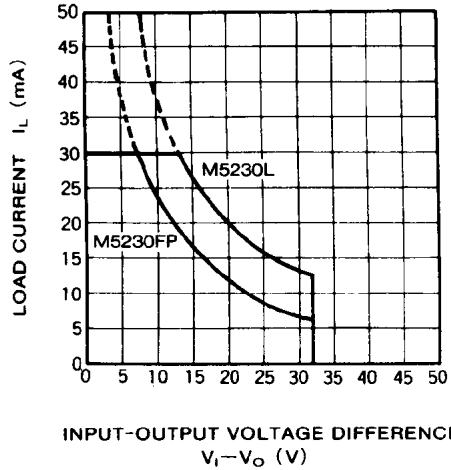


VOLTAGE ADJUSTING RESISTANCE VS. OUTPUT VOLTAGE

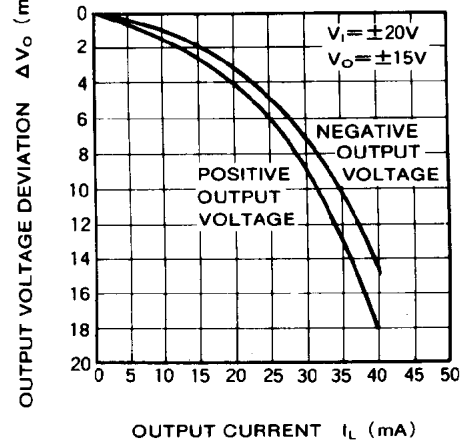


VARIABLE OUTPUT VOLTAGE REGULATOR (DUAL TRACKING TYPE)

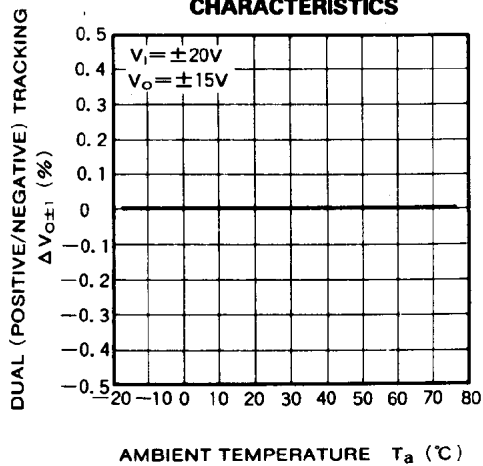
LOAD CURRENT VS. INPUT-OUTPUT VOLTAGE DIFFERENCE



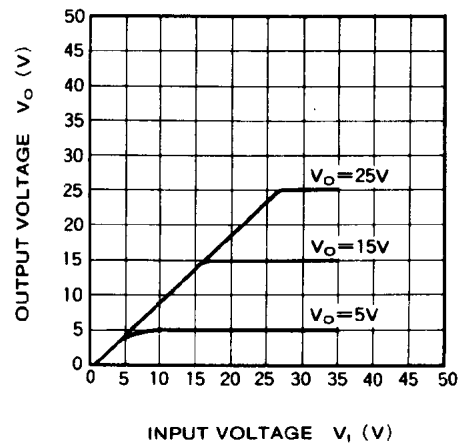
OUTPUT VOLTAGE REGULATION



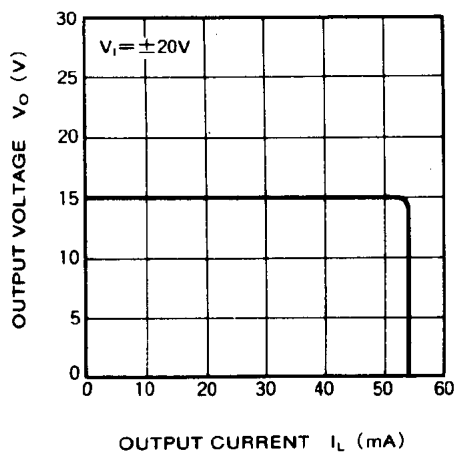
DUAL-TRACKING TEMPERATURE CHARACTERISTICS



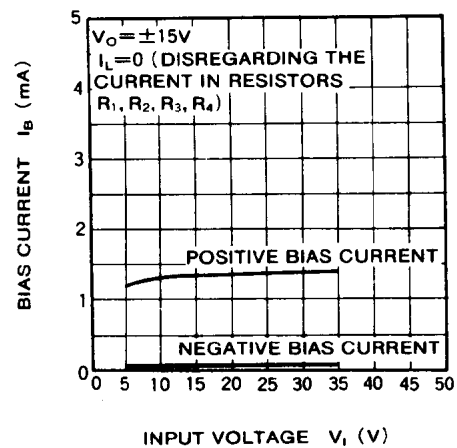
OUTPUT VOLTAGE CHARACTERISTICS



LOAD CHARACTERISTICS

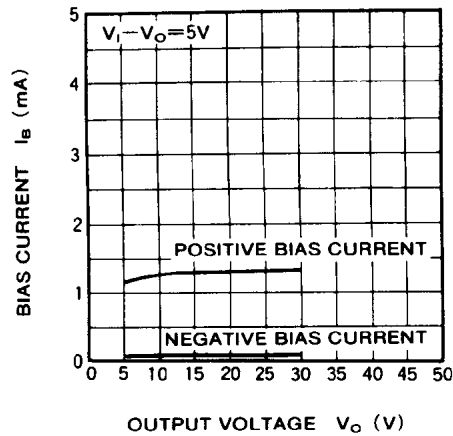


BIAS CURRENT VS. INPUT VOLTAGE

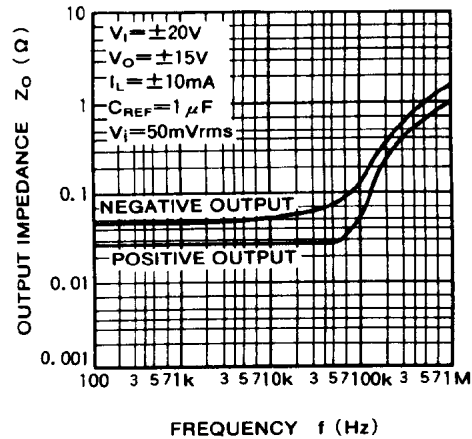


VARIABLE OUTPUT VOLTAGE REGULATOR(DUAL TRACKING TYPE)

BIAS CURRENT VS. OUTPUT VOLTAGE

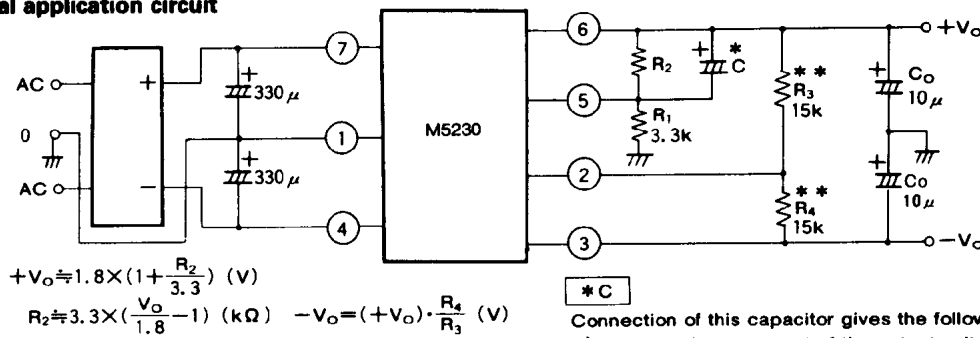


OUTPUT IMPEDANCE VS. FREQUENCY



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

* C

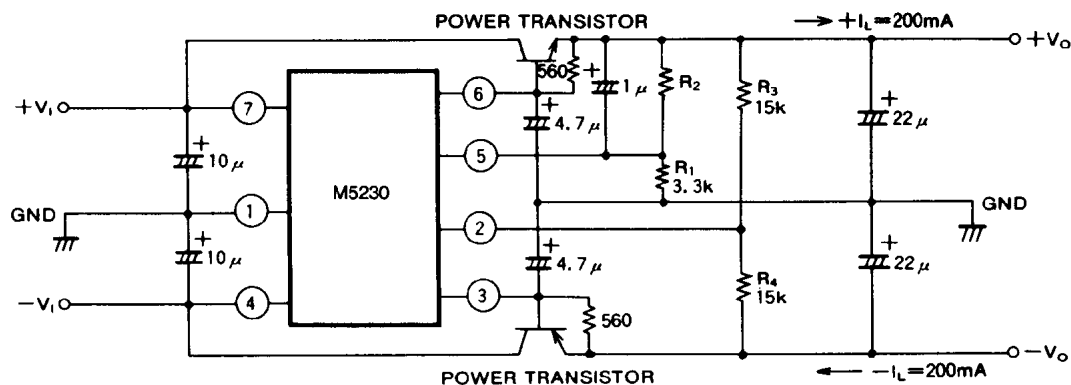
Connection of this capacitor gives the following characteristics.

- 1) The rise time constant of the output voltage can be adjusted (slowed) (See Fig. 1)
- 2) The ripple rejection ratio is improved.
- 3) Noise output voltage is reduced.

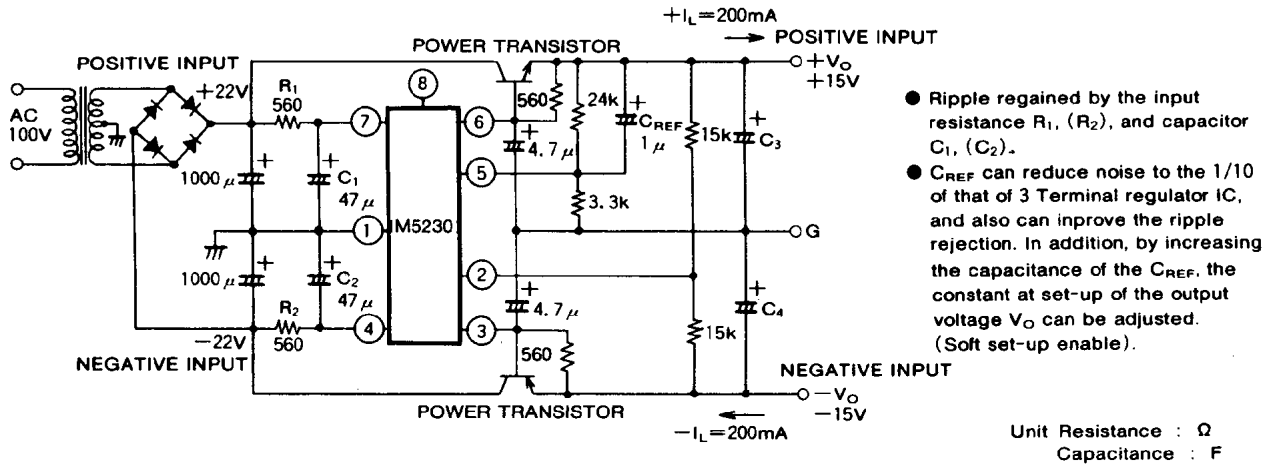
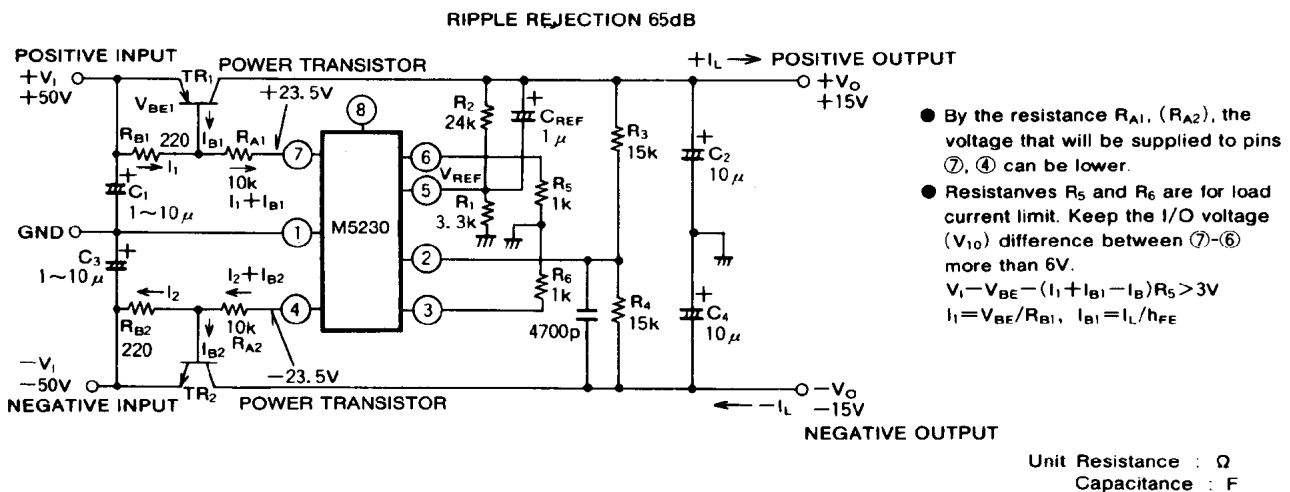
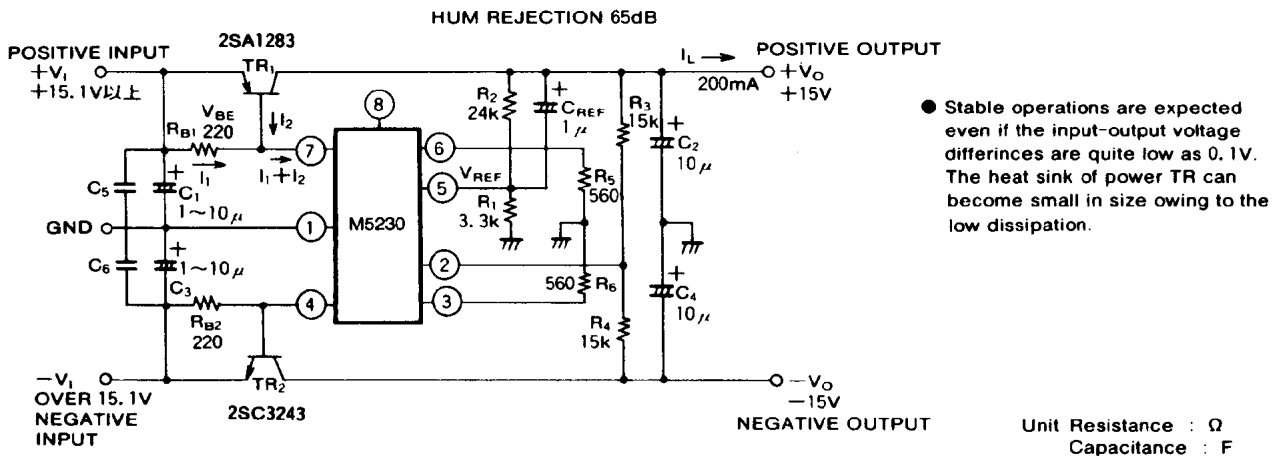
* * R₃, R₄

By changing the ratio of these two resistances the positive/negative voltage ratio can also be set freely. (See Fig. 2)

(2) Typical application circuit with power transistors connected

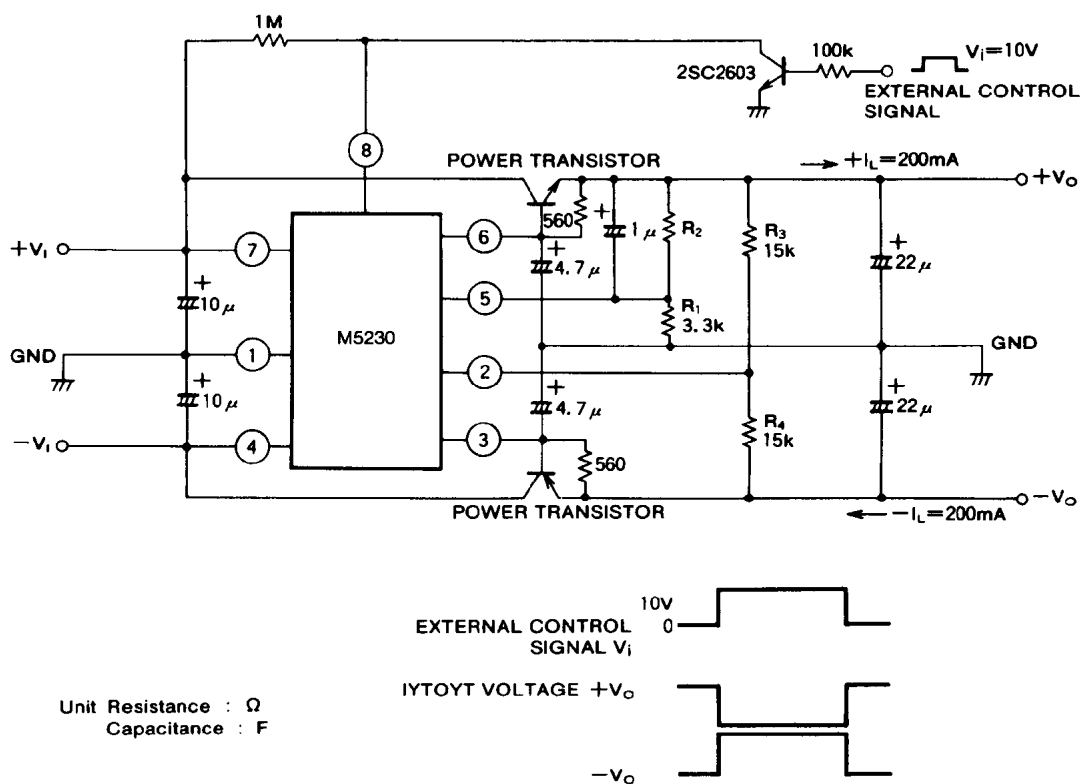


Unit Resistance : Ω
Capacitance : F

VARIABLE OUTPUT VOLTAGE REGULATOR(DUAL TRACKING TYPE)**(3) High ripple rejection circuit (80dB)****(4) High input voltage ($V_I = \pm 50V$)****(5) Supper low dropout regulator circuit ($V_{I0} = 100mW$)**

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

(6) ON/OFF control of output voltage circuit



EXAMPLES OF THE CHARACTERISTICS ACHIEVED

Graph showing Output Voltage V_O (V) versus TIME (s) for various capacitor values C . The curves illustrate the transient response of the output voltage over time for different capacitance values. The output voltage rises from 0V and settles to a steady-state value of approximately 15V. The settling time decreases as the capacitor value C increases.

Curves shown for $C = 1 \mu F$, $C = 47 \mu F$, $C = 33 \mu F$, $C = 22 \mu F$, and $C = 10 \mu F$.

Graph showing the ratio of positive/negative output voltages versus balance resistors R_3 and R_4 .

The Y-axis is labeled "RATIO OF POSITIVE/NEGATIVE OUTPUT VOLTAGES". The top scale is $(+V_o/-V_o)$ (0 to 3), and the bottom scale is $-V_o/+V_o$ (3 to 0).

The X-axis is labeled "BALANCE RESISTORS R_3, R_4 ($k\Omega$)". The top scale is R_3 (5 to 15), and the bottom scale is R_4 (15 to 5).

The curve shows that the ratio of positive/negative output voltages increases as the balance resistors R_3 and R_4 increase, reaching a maximum ratio of 3 at $R_3 = R_4 = 15 k\Omega$.