To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

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 ±3~±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 ········· $V_{NO} = 12\mu Vrms$ (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

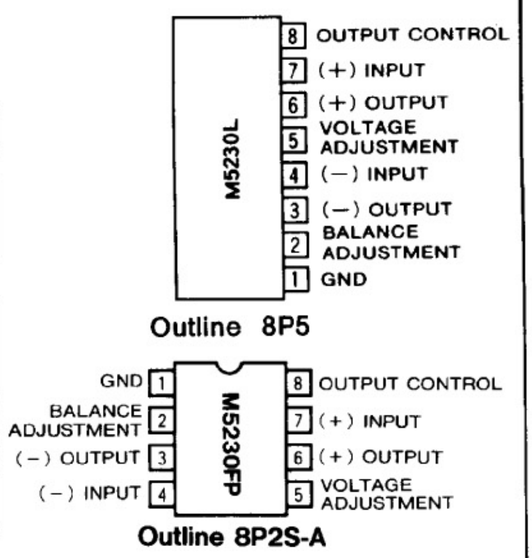
Dual voltage power supplies for stereo preamplifiers, for the power supplies of other equipment, including operational amplifiers.

RECOMMENDED OPERATING CONDITIONS

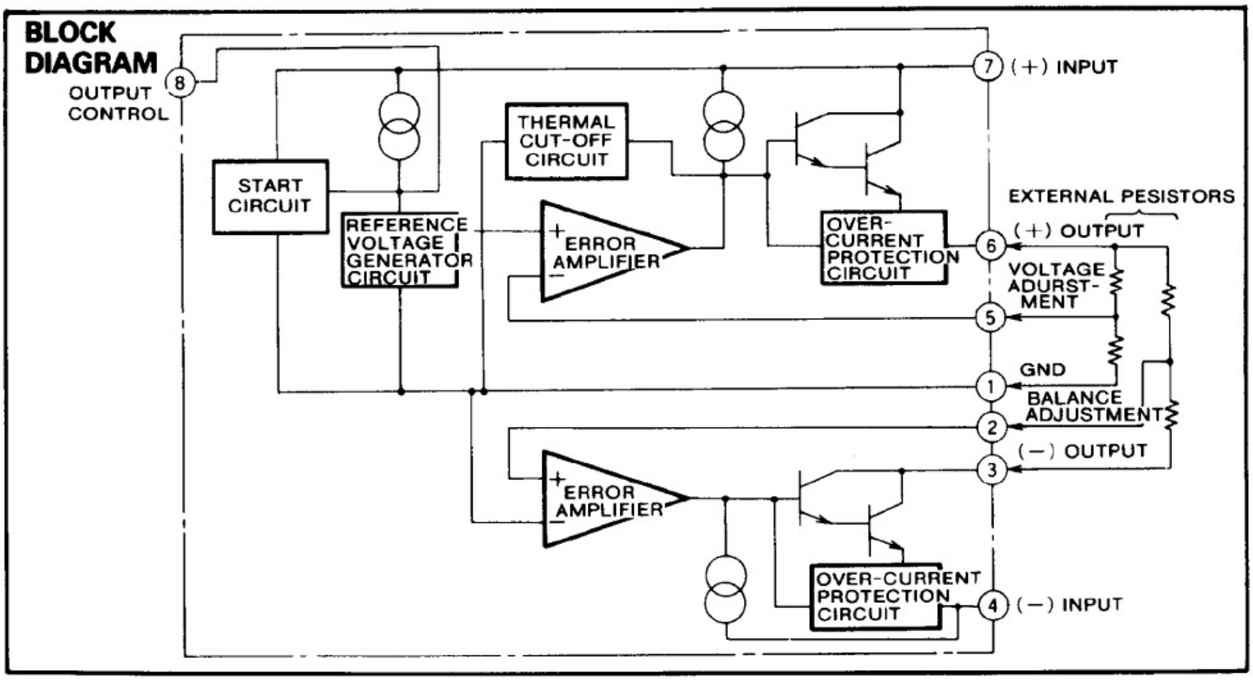
Supply voltage range ········· ±8~±35V

Rated supply voltage ········· ±20V

PIN CONFIGURATION (TOP VIEW)



BLOCK DIAGRAM



VARIABLE OUTPUT VOLTAGE REGULATOR (DUAL TRACKING TYPE)

ABSOLUTE MAXIMUM RATINGS (T_a=25℃)

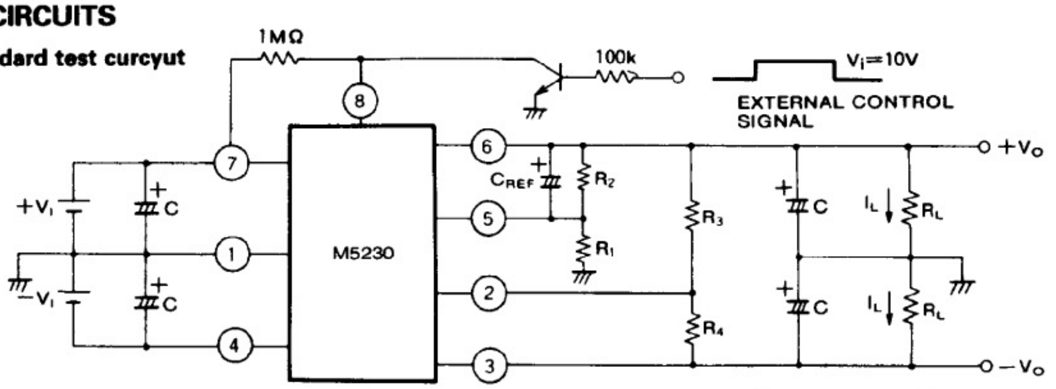
Symbol	Parameter	Ratings	Unit
V_I	Input voltage	±35	V
I_L	Load current	±30	mA
V_I-V_O	Input-output voltage difference	±32	V
P_d	Power dissipation	800(L)/440(FP)	mW
T_{opr}	Ambient temperature	−20～+75	℃
T_{stg}	Storage temperature	−55～+125	℃

ELECTTICAL CHARACTERISTICS (measurement circuit (a) is used with, T_a=25℃, V_I=±20V, V_O=±15V, I_L=10mA, C=10μF, C_{REF}=1μF, R_1=3.3kΩ)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_I	Input voltage		±8		±35	V
V_O	Output voltage	R_2≈1.5～55kΩ	±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	%
$R_{eg\text{-}in}$	Input regulation	V_I=±18～±30V		0.02	0.1	%/V
$R_{eg\text{-}L}$	Load regulation	I_L=0～20mA		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_{VO}	Temperature coefficient of output voltage	T_a=0～75℃, V_O=±3～±30V		0.01		%/℃
RR	Ripple rejection	f=120Hz (measured with circuit (b))		68		dB
V_{NO}	Output noise voltage	f=20Hz～100kHz (between the output terminal and ground)		12		μVrms
$V_{O(OFF)}$	Output cut-off voltage	V_I=10V			±0.1	V

TEST CIRCUITS

(a) Stabdard test curcyut



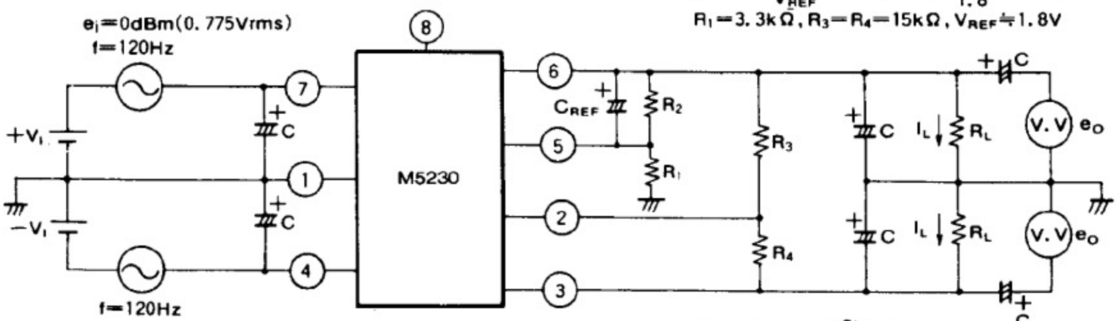
$$+V_O=V_{REF}\left(1+\frac{R_2}{R_1}\right)\doteqdot 1.8\times\left(1+\frac{R_2}{3.3}\right)\ \text{(V)}$$

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

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

R_1=3.3kΩ, R_3=R_4=15kΩ, V_{REF}≒1.8V

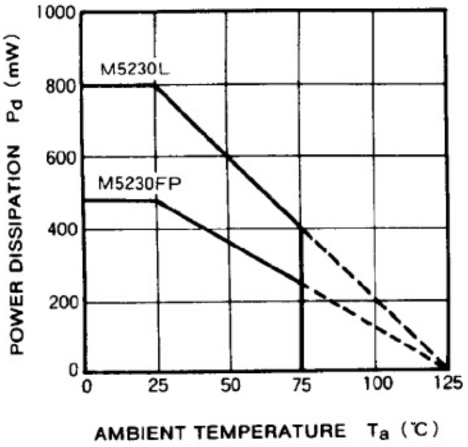
(b) Ripple rejection test circuit



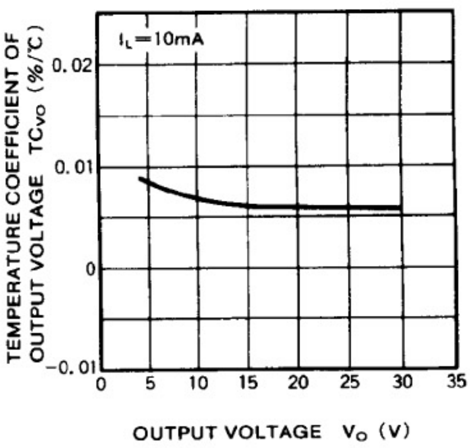
$$RR=20\log_{10}\left(\frac{e_i}{e_O}\right)\ \text{(dB)}$$

TYPICAL CHARACTERISTICS

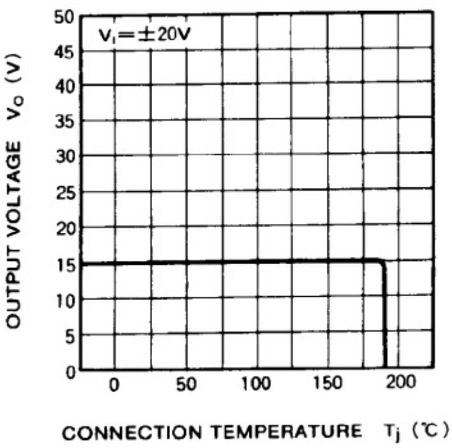
THERMAL DERATING (MAXIMUM RATING)



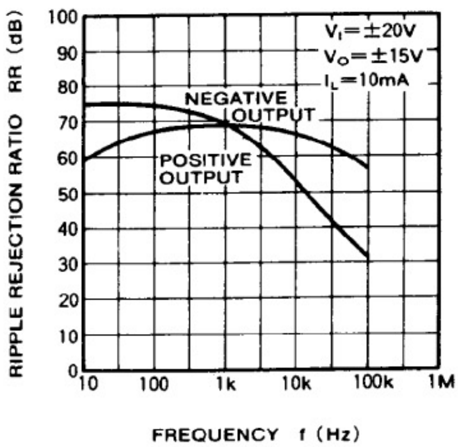
TEMPERATURE COEFFICIENT OF OUTPUT VOLTAGE VS. OUTPUT VOLTAGE CHARACTERISTICS



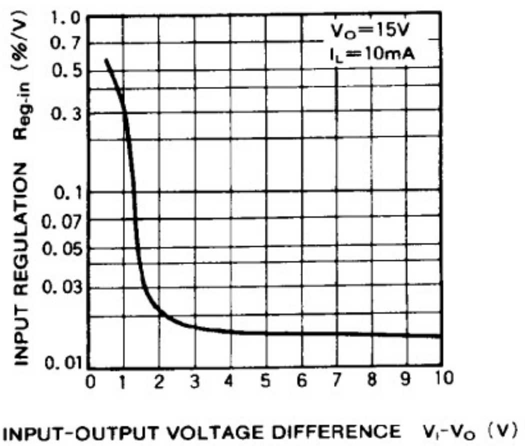
THERMAL CUTOFF



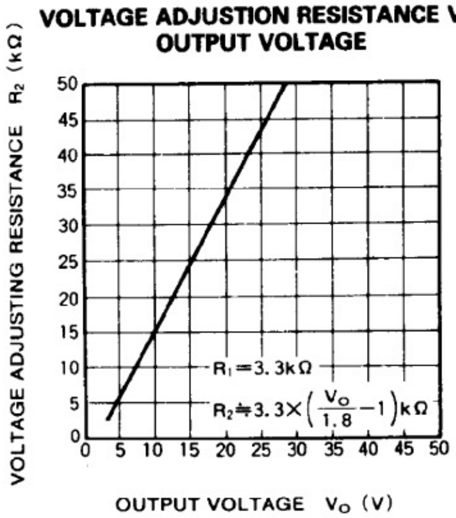
RIPPLE ERJECTION



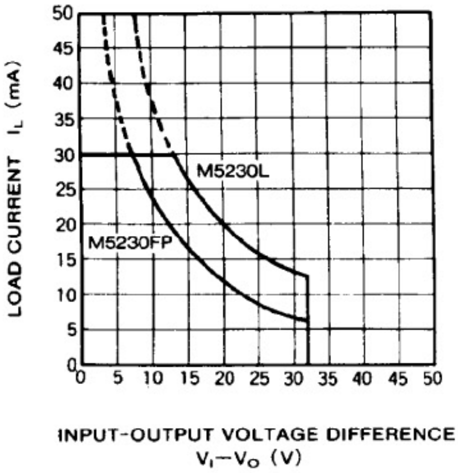
INPUT REGULATION VS. INPUT-OUTPUT VOLTAGE DIFFERENCE



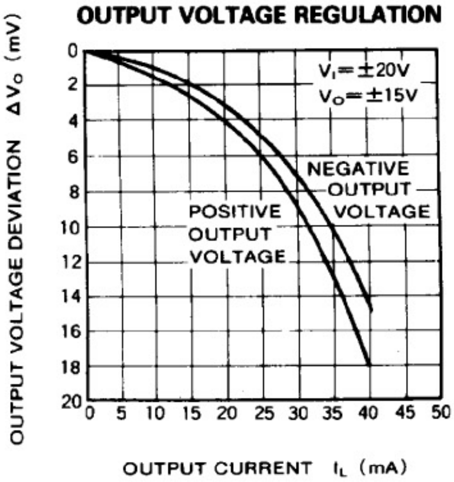
VOLTAGE ADJUSTION RESISTANCE VS. OUTPUT VOLTAGE



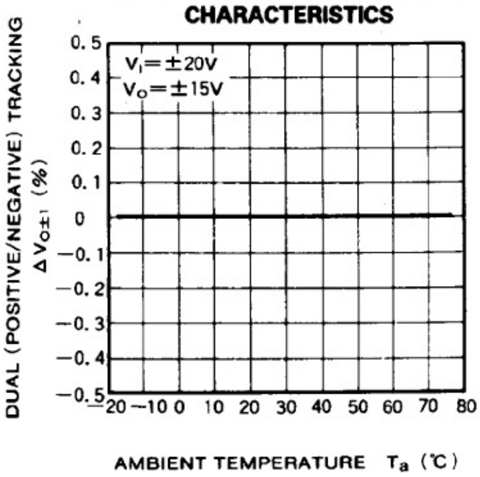
LOAD CURRENT VS. INPUT-OUTPUT VOLTAGE DIFFERENCE



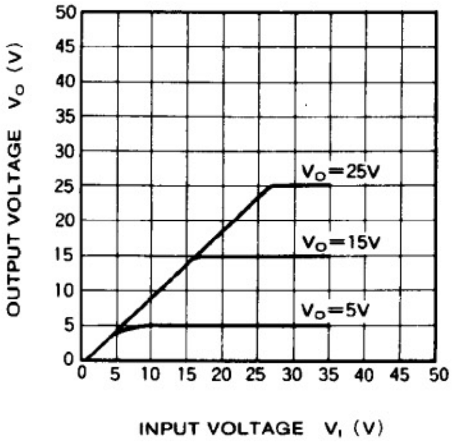
OUTPUT VOLTAGE REGULATION



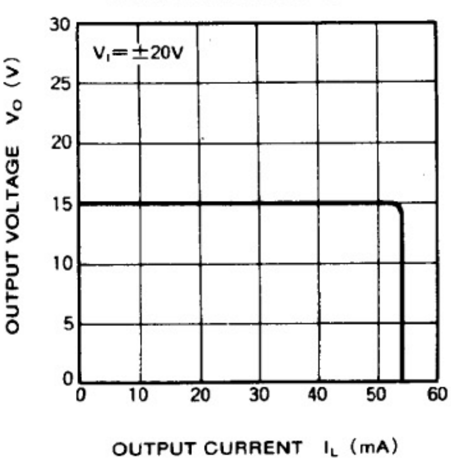
DUAL-TRACKING TEMPERATURE CHARACTERISTICS



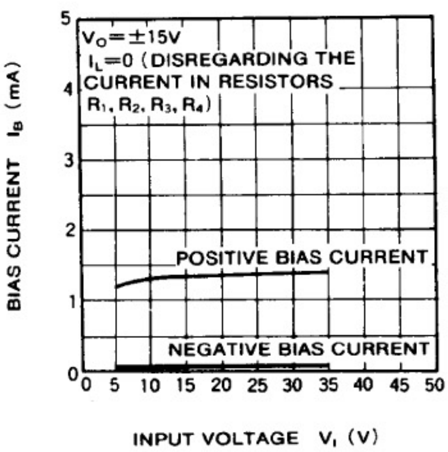
OUTPUT VOLTAGE CHARACTERISTICS



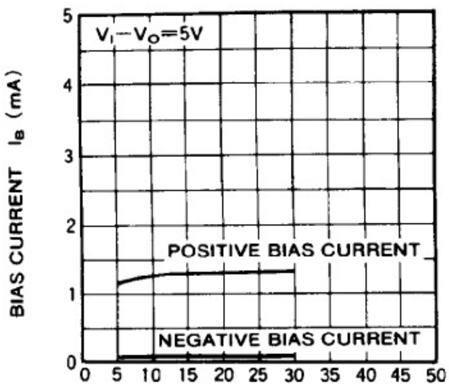
LOAD CHARACTERISTICS



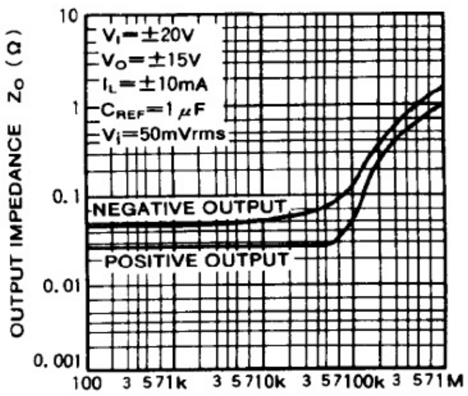
BIAS CURRENT VS. INPUT VOLTAGE



BIAS CURRENT VS. OUTPUT VOLTAGE

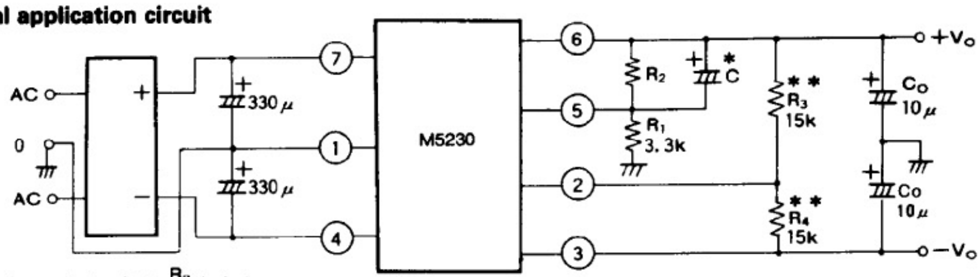


OUTPUT IMPEDANCE VS. FREQUENCY



APPLICATION EXAMPLES

(1) Typical application circuit



$+V_O \fallingdotseq 1.8 \times (1 + \frac{R_2}{3.3})$ (V)

$R_2 \fallingdotseq 3.3 \times (\frac{V_O}{1.8} - 1)$ (kΩ) $\quad -V_O = (+V_O) \cdot \frac{R_4}{R_3}$ (V)

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**

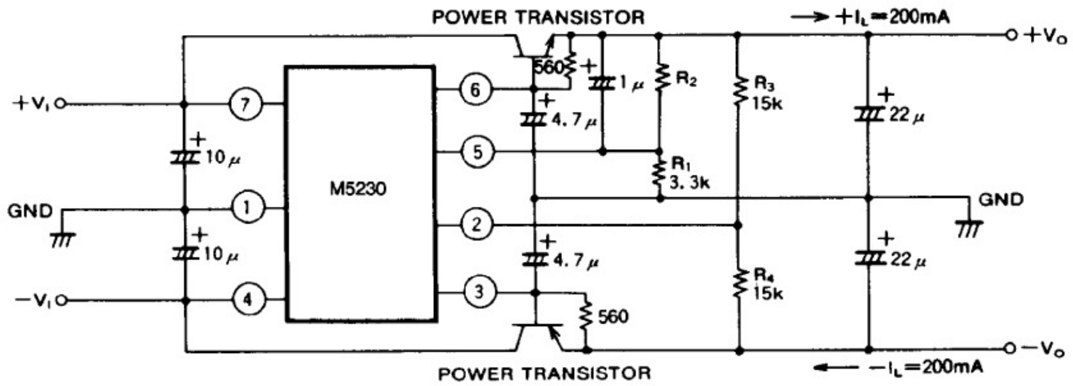
Connection of this capacitor gives the following characteristics.

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

****R3, R4**

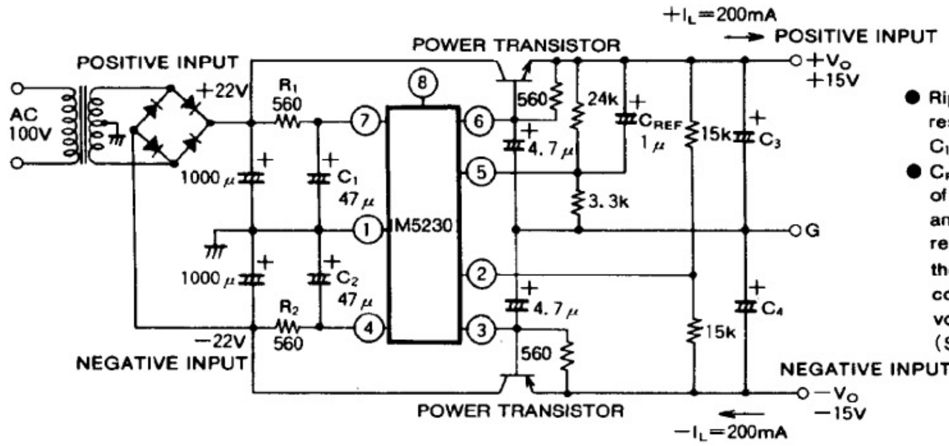
By changing the ratio of these two resistances the positive/negative voltage retio can also be set freely. (See Fig. 2)

(2) Typical application circuit with power transistors connected



Unit Resistance : Ω
Capacitance : F

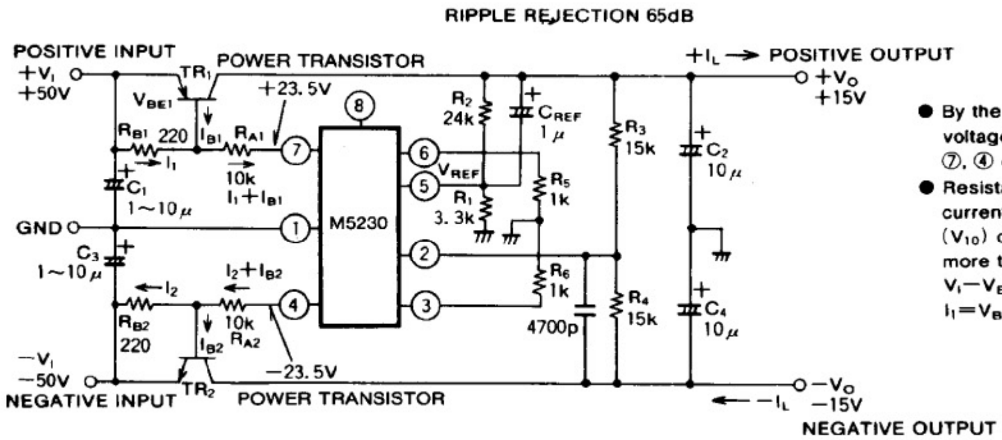
(3) High ripple rejection circuit (80dB)



- Ripple regained by the input resistance R_1, (R_2), and capacitor C_1, (C_2).
- C_{REF} can reduce noise to the 1/10 of that of 3 Terminal regulator IC, and also can inprove the ripple rejection. In addition, by increasing the capacitance of the C_{REF}, the constant at set-up of the output voltage V_O can be adjusted. (Soft set-up enable).

Unit Resistance : Ω
Capacitance : F

(4) High input voltage (V_I=±50V)



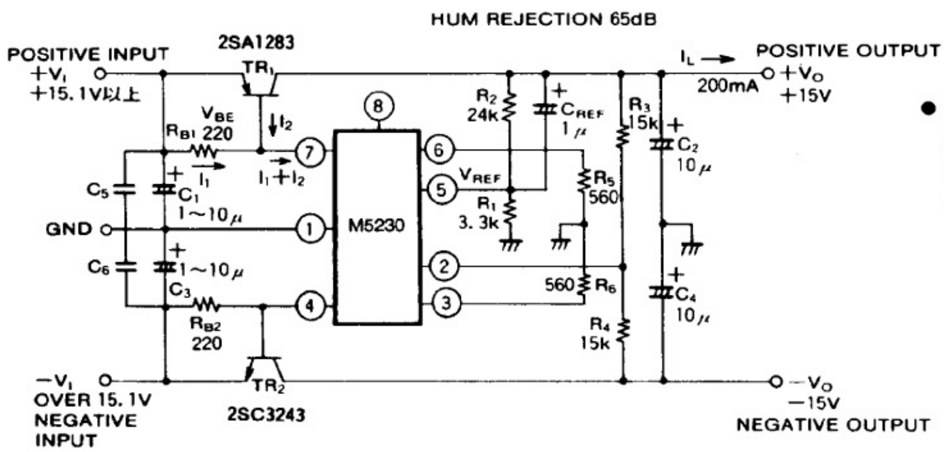
- By the resistance R_{A1}, (R_{A2}), the voltage that will be supplied to pins ⑦, ④ can be lower.
- Resistanves R_5 and R_6 are for load current limit. Keep the I/O voltage (V_{IO}) difference between ⑦-⑥ more than 6V.

$V_I-V_{BE}-(I_1+I_{B1}-I_B)R_5>3V$

$I_1=V_{BE}/R_{B1}$, $I_{B1}=I_L/h_{FE}$

Unit Resistance : Ω
Capacitance : F

(5) Supper low dropout regulator circuit (V_{IO}=100mW)

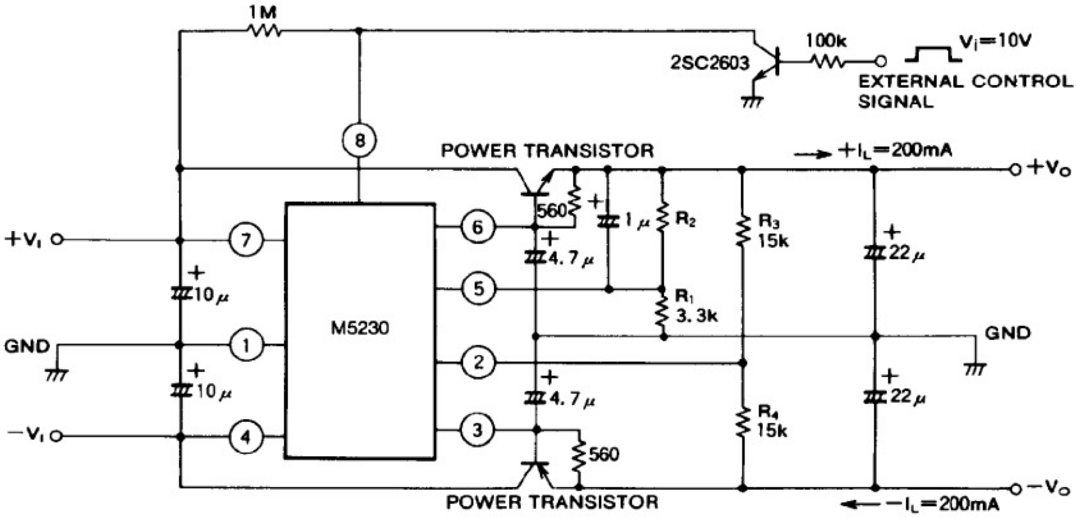


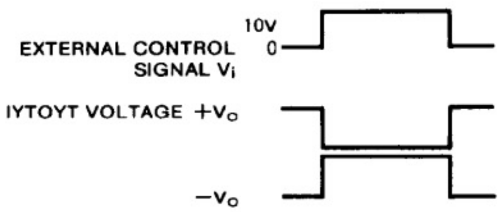
- Stable operations are expected even if the input-output voltage differinces are quite low as 0.1V. The heat sink of power TR can become small in size owing to the low dissipation.

Unit Resistance : Ω
Capacitance : F

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

(6) ON/OFF control of output voltage circuit





Unit Resistance : Ω
Capacitance : F

EXAMPLES OF THE CHARACTERISTICS ACHIEVED

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

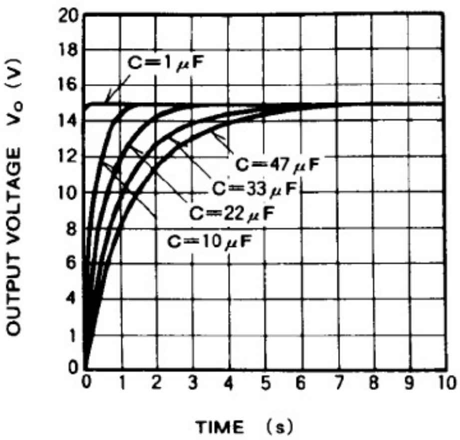


Fig. 2 OUTPUT VOLTAGE RATIO VS. BALNCE VOLTAGE ADJUSTING RESISTANCE CHARACTERISTICS