

M5231TL**VARIABLE OUTPUT VOLTAGE REGULATOR****DESCRIPTION**

The M5231TL is a semiconductor integrated circuit which is designed for variable output voltage regulator and is housed in a small 5-pin SIP.

The input range 8~70V, and the output voltage range 3~50V can be optionally adjusted by the external resistors. In addition, by attaching power transistors, high current gains can be achieved, making the device suitable for used in the power supplies of a wide variety of equipment.

FEATURES

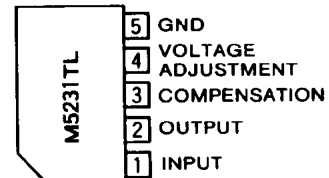
- High input voltage $V_i=70V$
- Wide range of output voltages $V_o=3V\sim 50V$
- Low output noise voltage $V_{NO}=6\mu V_{rms}(typ.)$
- Built-in current limiting and thermal shutdown circuits
- Capability of adjusting the output voltage rise time constant of the coefficients by the external capacitor
- Capability of the operating control by the external signal

APPLICATION

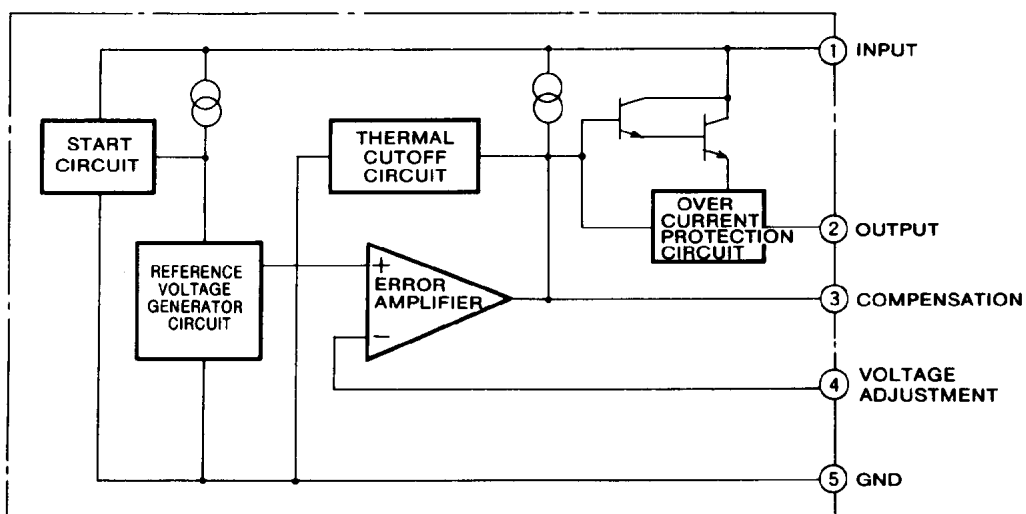
Audio, VTR equipment, and a variety of electronic musical instruments.

RECOMMENDED OPERATING CONDITIONS

- Supply voltage range 8~70V
 Rated supply voltage 35V

PIN CONFIGURATION (TOP VIEW)

Outline 5P5T

BLOCK DIAGRAM

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

Symbol	Parameter	Ratings	Unit
V_i	Input voltage	70	V
I_L	Load current	30	mA
V_i-V_o	Input-output voltage difference	67	V
P_d	Power dissipation	450	mW
T_{opr}	Operating temperature	$-20\sim+75$	$^\circ\text{C}$
T_{stg}	Storage temperature	$-55\sim+125$	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS (measurement circuit (a) is used with, $T_a=25^\circ\text{C}$, $V_i=40\text{V}$, $V_o=35\text{V}$, $I_L=10\text{mA}$, $C=10\mu\text{F}$, $C_{REF}=1\mu\text{F}$, $R_1=3.3\text{k}\Omega$, unless otherwise noted)

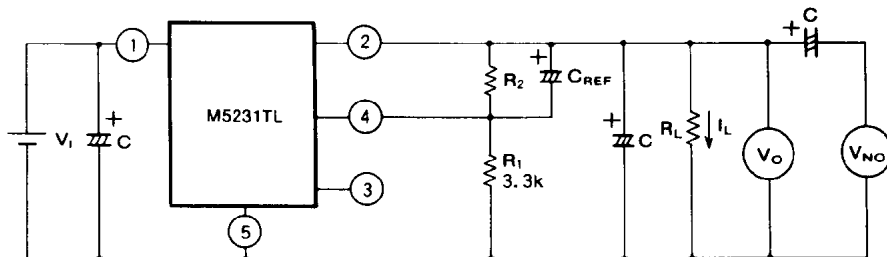
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_i	Input voltage		8		70	V
V_o	Output voltage	$R_2 \approx 1.5\sim 88\text{k}\Omega$	3		50	V
V_i-V_o	Minimum input-output voltage differential			2.5	3.0	V
V_{REF}	Reference voltage	(between pin ④ and pin ⑤)	(1.66)	1.8	(1.90)	V
Reg_{in}	Input regulation	$V_i=38\sim 60\text{V}$		0.04	0.1	%/V
Reg_{L}	Load regulation	$I_L=0\sim 20\text{mA}$		0.03	0.1	%
I_B	Bias current	$I_L=0$ (disregarding the current in resistors R_1, R_2)		1.2	2.5	mA
TC_{V_o}	Temperature coefficient of output voltage	$T_a=0\sim 75^\circ\text{C}$, $V_o=3\sim 50\text{V}$		0.02		%/ $^\circ\text{C}$
RR	Ripple rejection	$f=120\text{Hz}$ (measured with circuit (b))		62		dB
V_{NO}	Output noise voltage	$f=20\text{Hz}\sim 100\text{kHz}$		6		μVrms

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

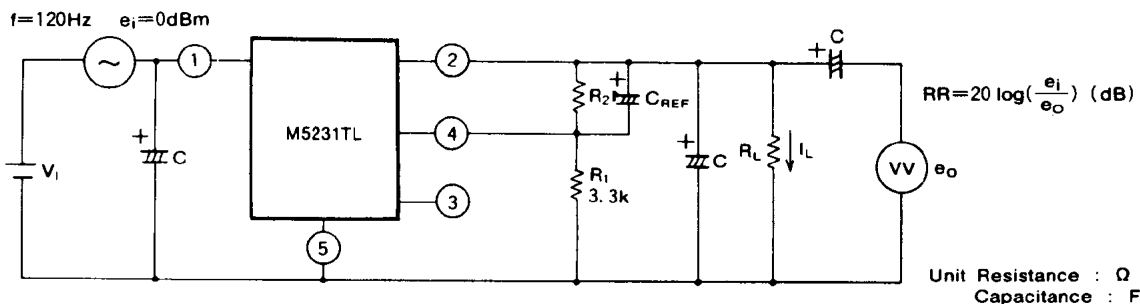
$$V_o = V_{REF} \left(1 + \frac{R_2}{R_1}\right) \approx 1.8 \times \left(1 + \frac{R_2}{3.3}\right) \text{ (V)}$$

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

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



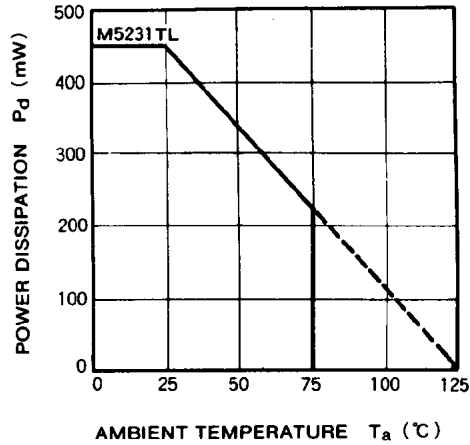
Unit Resistance : Ω
Capacitance : F

(b) Ripple rejection test circuit

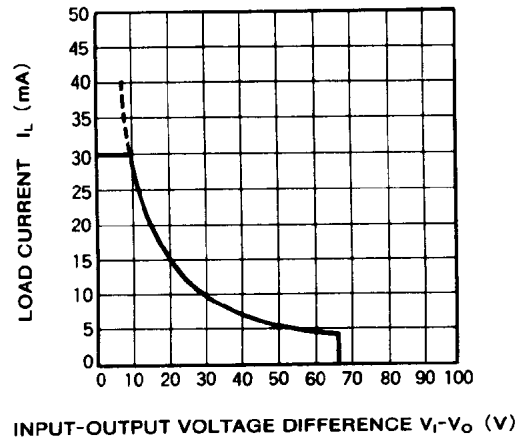
VARIABLE OUTPUT VOLTAGE REGULATOR

TYPICAL CHARACTERISTICS ($T_a=25^\circ\text{C}$, unless otherwise noted)

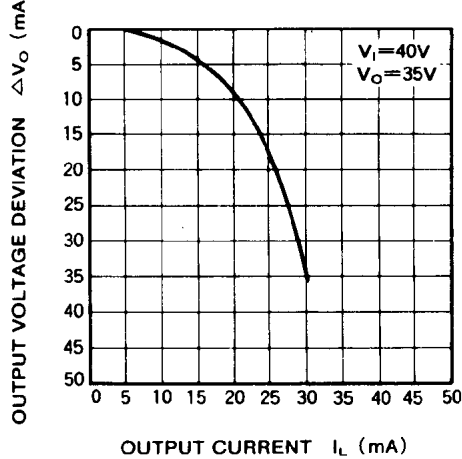
THERMAL DERATING (MAXIMUM RATINGS)



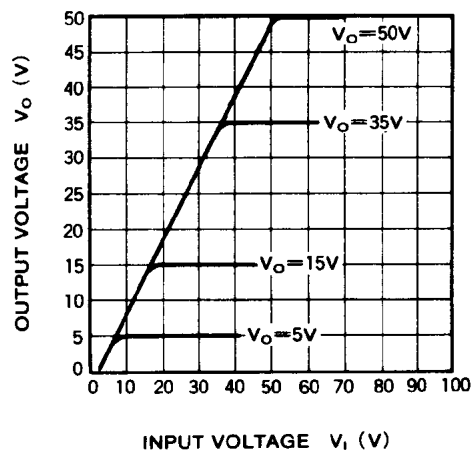
LOAD CURRENT VS. INPUT-OUTPUT VOLTAGE DIFFERENCE



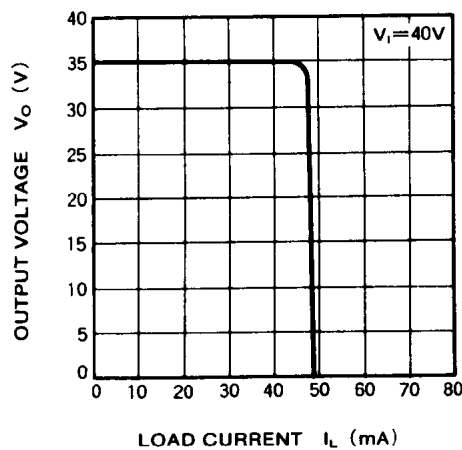
OUTPUT VOLTAGE REGULATION



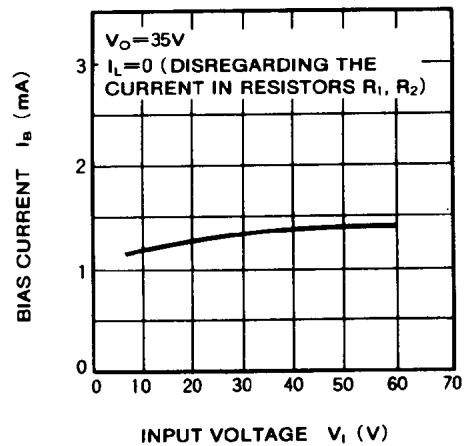
OUTPUT VOLTAGE CHARACTERISTICS



LOAD CHARACTERISTICS

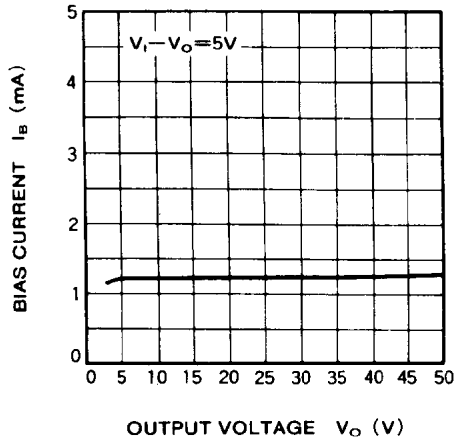


BIAS CURRENT VS. INPUT VOLTAGE

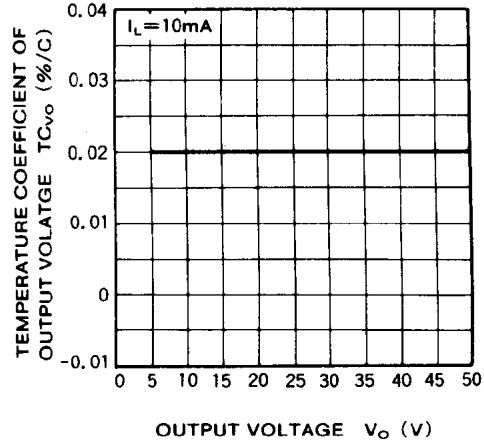


VARIABLE OUTPUT VOLTAGE REGULATOR

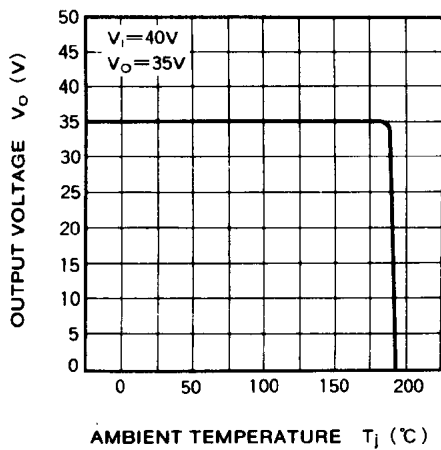
BIAS CURRENT VS. OUTPUT VOLTAGE



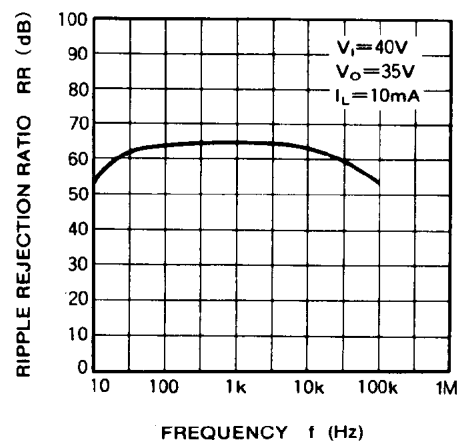
TEMPERATURE COEFFICIENT OF OUTPUT VOLTAGE VS. OUTPUT VOLTAGE CHARACTERISTICS



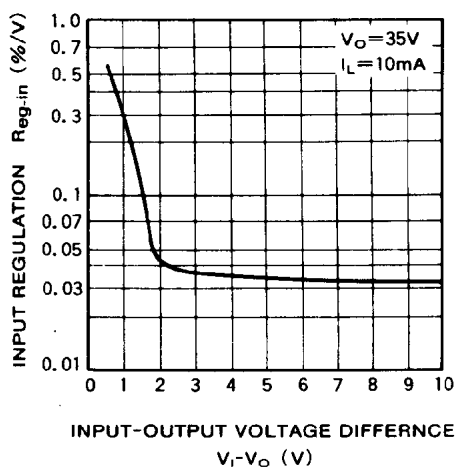
THERMAL CUTOFF



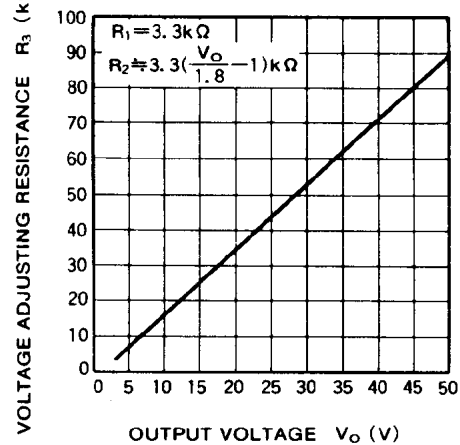
RIPPLE REJECTION



INPUT REGULATION VS. INPUT-OUTPUT VOLTAGE DIFFERENCE



VOLTAGE ADJUSTING RESISTANCE VS. OUTPUT VOLTAGE

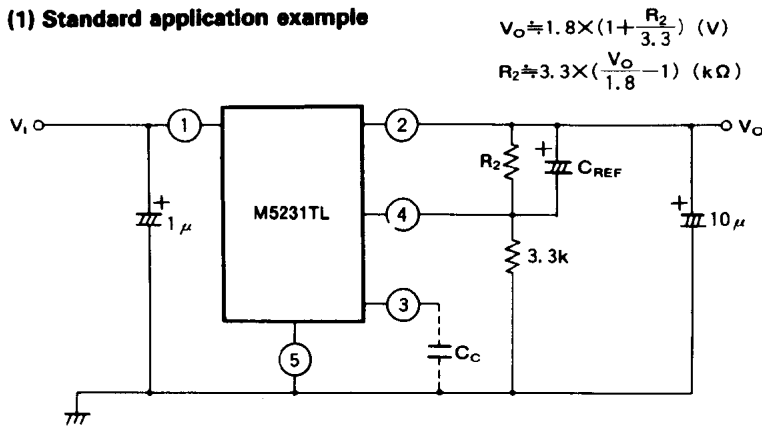


M5231TL

VARIABLE OUTPUT VOLTAGE REGULATOR

APPLICATION EXAMPLES

(1) Standard application example



$$V_O \approx 1.8 \times \left(1 + \frac{R_2}{3.3}\right) \text{ (V)}$$

$$R_2 \approx 3.3 \times \left(\frac{V_O}{1.8} - 1\right) \text{ (k}\Omega\text{)}$$

C_{REF}

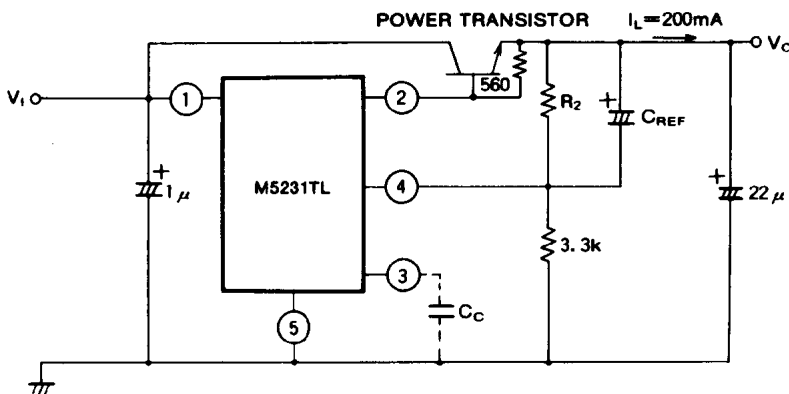
Connection of this capacitor gives the following characteristics.

- 1) The rise time of the output voltage can be adjusted (slowed).
- 2) The ripple rejection ratio is improved.
- 3) Output noise voltage is reduced down to 1/10 of three terminal regulator IC.

C_C

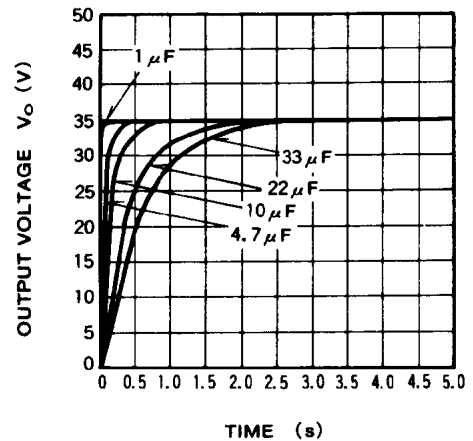
Compensation capability by connection of a capacitor.

(2) Current boost circuit with NPN external power TR

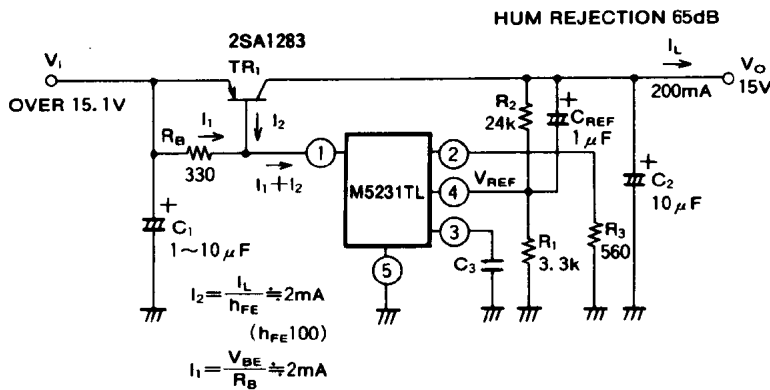


EXAMPLE 1 OF CHARACTERISTIC ACHIEVED

OUTPUT VOLTAGE CHARACTERISTICS FOR EXTERNAL CAPACITORS (C_{REF})

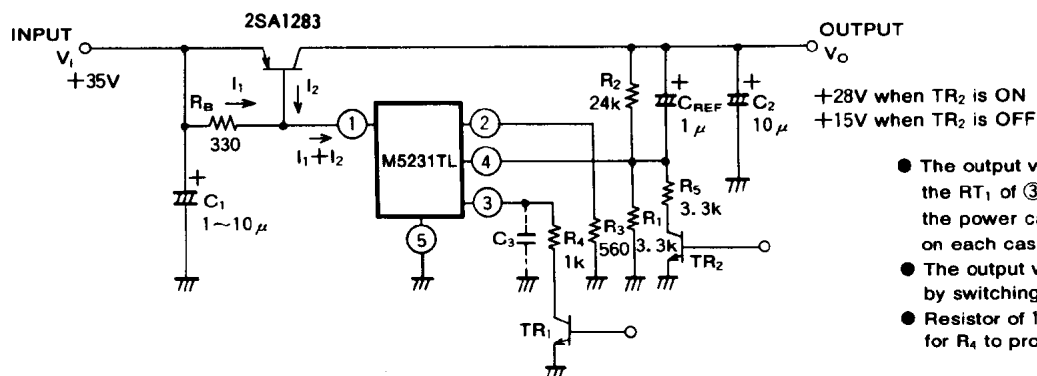


(3) Supper low dropout regulator circuits (V_{IO}=100mW)



- Stable operation is expected even if the input-output voltage differences are as low as 0.1V. The heat sink of power TR can become small in size owing to low dissipation. The R₃ is a load current limit resistor and the input-output voltage differences between ① and ② pins must be over 3V. $V_I - V_{RE} - (I_1 + I_2 - I_B)R_3 > 3V$

(4) Output voltage ON/OFF controller, Step UP/DOWN controller



- The output voltage V_O is 0V when the RT_1 of ③ pin is ON. Therefore, the power can be on/off depending on each case.
- The output voltage is changeable by switching the RT_2 .
- Resistor of $1k\Omega$ must be connected for R_4 to protect the integrated circuit.

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