M5231L

VARIABLE OUTPUT VOLTAGE REGULATOR

DESCRIPTION

The M5231L is a semiconductor integrated circuit which is designed for variable output voltage regulator and is housed in a small 5-pin SIL package.

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 use 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~50V)
- Low output noise voltage (V_{NO}=6μVrms typ.)
- Built-in current limiting and thermal shutdown circuits
- Capability of adjusting the output voltage rise time constant of the coefficients by the value of the external capacitor
- Capability of the operating control by the external signal

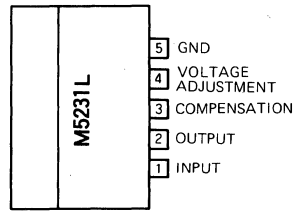
APPLICATIONS

- Audio, VTR
- General use

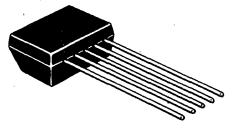
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ..... 8~70V
Rated supply voltage 40V

PIN CONFIGURATION (TOP VIEW)

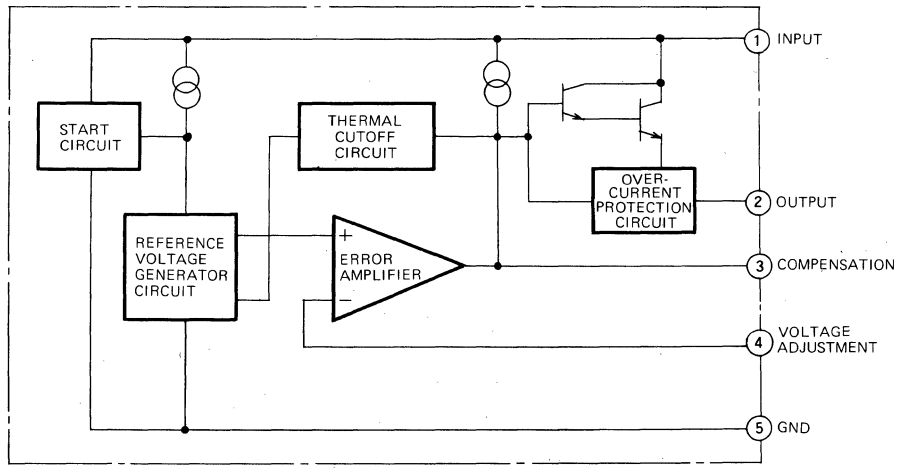


Outline 5P5



5 pin plastic SIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃)

Symbol	Parameter	Limits	Unit
V_I	Input voltage	70	V
I_L	Load current	30	mA
$V_I - V_O$	Input-output voltage difference	67	V
Pd	Power dissipation	300	mW
Topr	Operating temperature	−20 ~ +75	°C
Tstg	Storage temperature	−55 ~ +125	°C

ELECTRICAL CHARACTERISTICS

(measurement circuit (a) is used, with, T_a = 25℃, V_I = 40V, V_O = 35V, I_L = 10mA, C = 10 μF, C_{REF} = 1 μF, R_1 = 3.3kΩ, 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 ~ 88 kΩ	3		50	V
V_{REF}	Reference voltage	(between Pin ④ and Pin ⑤)	(1.62)	1.8	(1.98)	V
$V_I - V_O$	Minimum input-output voltage differential			2.0		V
Reg-in	Input regulation	V_I = 38 ~ 60V		0.04	0.1	%/V
Reg-L	Load regulation	I_L = 0 ~ 20 mA		0.03	0.1	%
I_B	Bias current	I_L = 0 (disregarding the current in resistors R_1, R_2)		1.2	3.0	mA
TC_{VO}	Temperature coefficient of output voltage	Ta = 0 ~ 75°C, V_O = 3 ~ 50 V		0.01		%/°C
RR	Ripple rejection	f = 120 Hz (measured with circuit (b))		62		dB
V_{NO}	Output noise voltage	f = 20Hz ~ 100 kHz (between the output terminal and ground)		6		μVrms

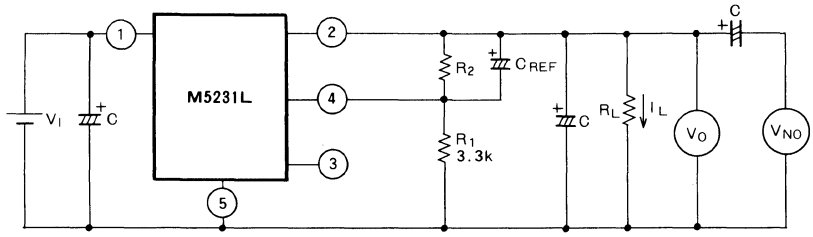
TEST CIRCUITS

(a) Standard test circuit

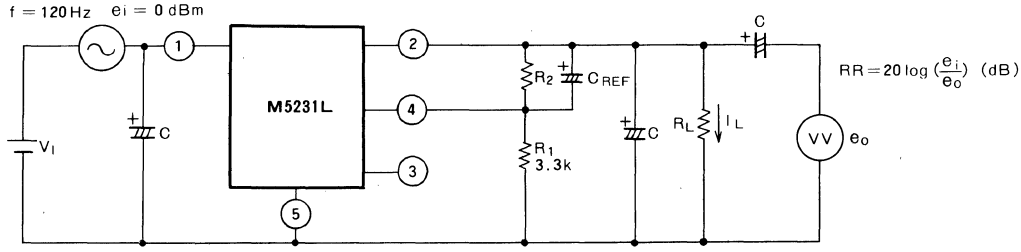
$$V_O = V_{REF}(1 + \frac{R_2}{R_1}) \fallingdotseq 1.8 \times (1 + \frac{R_2}{3.3}) \quad (V)$$

$$R_2 = R_1(\frac{V_O}{V_{REF}} - 1) \fallingdotseq 3.3 \times (\frac{V_O}{1.8} - 1) \quad (k\Omega)$$

R_1 = 3.3kΩ, $V_{REF} \fallingdotseq$ 1.8V

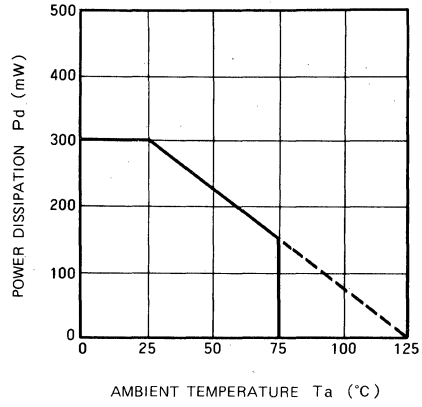


(b) Ripple rejection test circuit

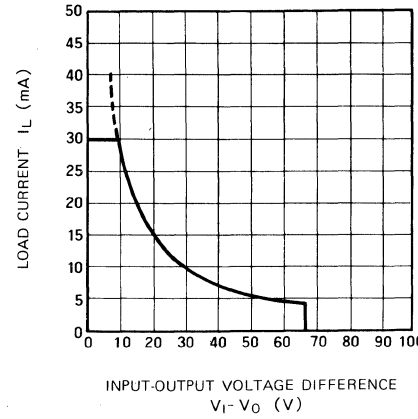


TYPICAL CHARACTERISTICS

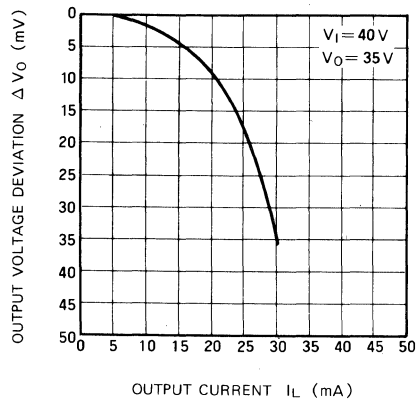
THERMAL DERATING



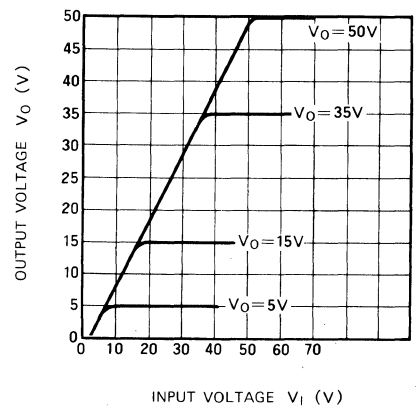
LOAD CURRENT VS INPUT-OUTPUT VOLTAGE DIFFERENCE



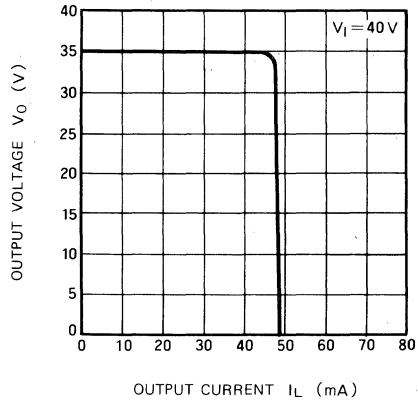
OUTPUT VOLTAGE REGULATION



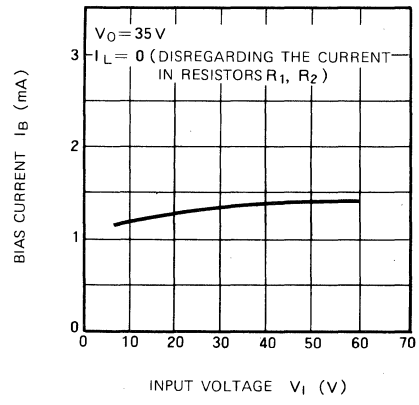
OUTPUT VOLTAGE CHARACTERISTICS



LOAD CHARACTERISTICS



BIAS CURRENT VS INPUT VOLTAGE



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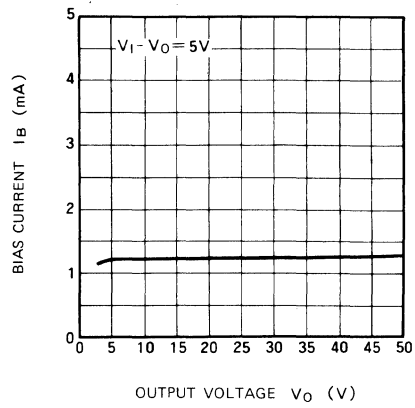
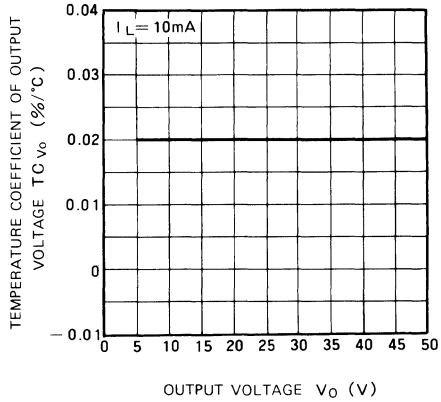
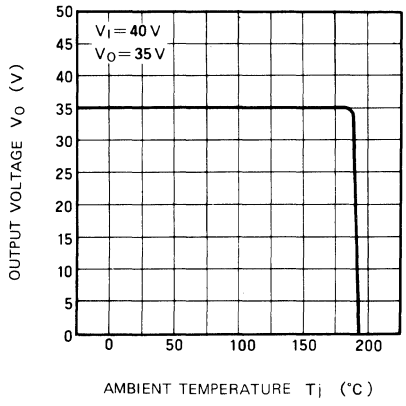
BIAS CURRENT VS OUTPUT VOLTAGE



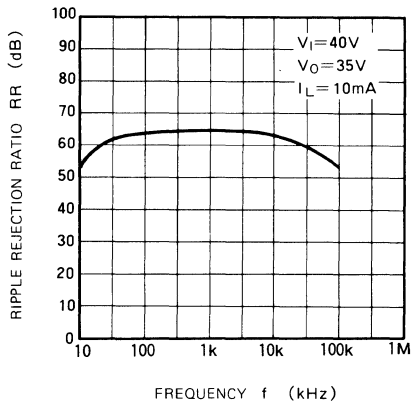
TEMPERATURE COEFFICIENT OF OUTPUT VOLTAGE VS OUTPUT VOLTAGE CHARACTERISTICS



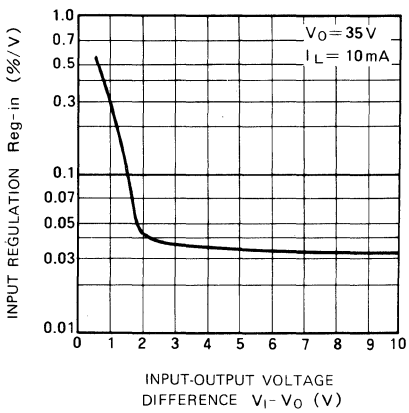
THERMAL CUTOFF



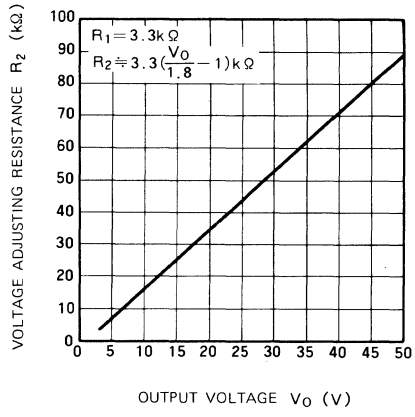
RIPPLE REJECTION



INPUT REGULATION VS INPUT-OUTPUT VOLTAGE DIFFERENCE

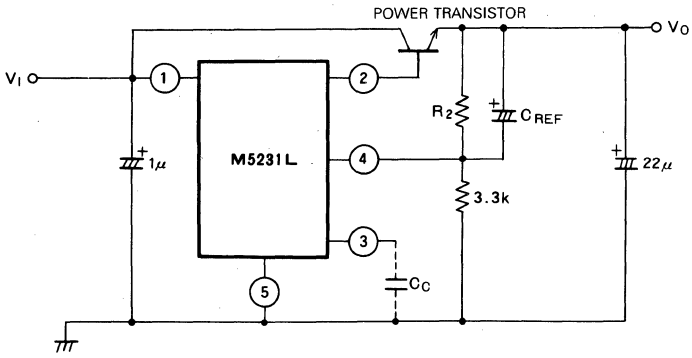


VOLTAGE ADJUSTING RESISTANCE VS OUTPUT VOLTAGE



APPLICATION EXAMPLES

1. Current boost circuit with NPN external power TR



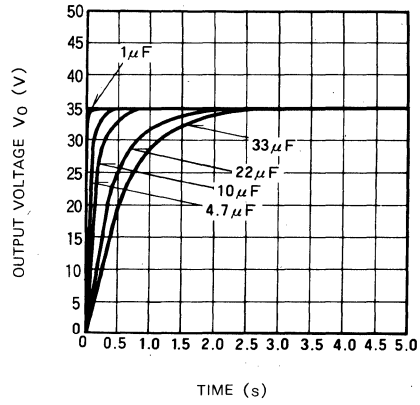
CREF

The connection of this capacitor gives the following characteristics.
1) The rise time constant 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 terminals regulator IC.

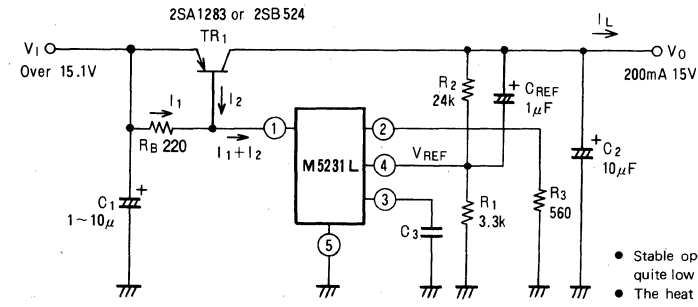
CC

Capability of the compensation by connecting the capacitor.

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



2. Low dropout regulator circuits (V_{IO}=0.1V) Ripple rejection 65dB



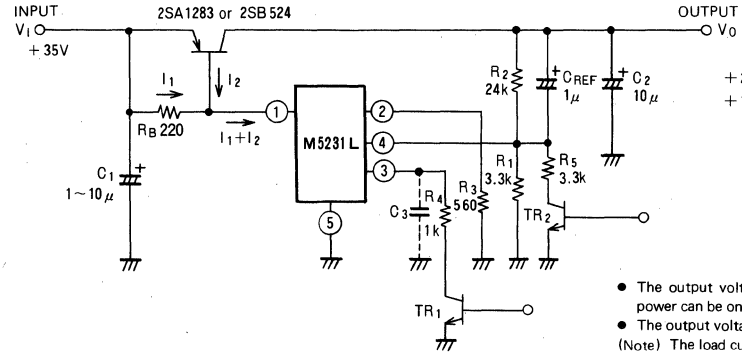
$I_2 = \frac{I_L}{h_{FE}} \fallingdotseq 2\,mA$ (h_{FE} 100)

$I_1 = \frac{V_{BE}}{R_B} \fallingdotseq 3\,mA$

- Stable operations are expected even if the input-output voltage differences are quite low as 0.1V.
- The heat sink of power TR can become small in size owing to the low dissipation.
- The R_3 is a load current limit resistor and the input-output voltage differencial between ① and ② pins must be over 3V.

$$V_I - V_{BE} - (I_1 + I_2 - I_B)R_3 > 3V$$

3. Output voltage ON/OFF controller, Step UP/DOWN controller



+28V when TR_2 is ON
+15V when TR_2 is OFF

- The output voltage V_O is 0V when the TR_1 of ③ pin is ON. Therefore, the power can be on/off depending on each case.
- The output voltage V_O is changeable by switching the TR_2.

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