M5236L, ML

GENERAL PURPOSE 3-TERMINAL VARIABLE VOLTAGE OUTPUT REGULATOR (FOR DRIVER)

DESCRIPTION

The M5236 is a semiconductor integrated circuit designed for general-purpose output voltage regulator.

A high-performance variable output voltage regulator with small input-output voltage differences can be made in combination with externally connected PNP transistors.

It is housed in a small 3-pin package, including a reference voltage circuit, error amplifier, and driver, and the output voltage can be set freely by externally connected resistors, and a small, compact power supply circuit can be achieved, making the device suitable for use in small electronic equipment, such as car stereo, radio cassette recorder and portable stereo equipment.

FEATURES

- Wide operating voltage range ······························ V_{IN}=3.5V~36V, V_O=1.5V~33V
- Capable of operating at low input-output voltage for driver by externally connected power transistors 〔$V_{CE(sat)}$ state of TR〕 ······················· $V_{I-O(min)}$≒0.2V
- Output voltage can be set freely by externally connected resistors
- Built-in ASO protection and thermal cutoff circuits
- Capable of taping (automated insertion) and lead forming

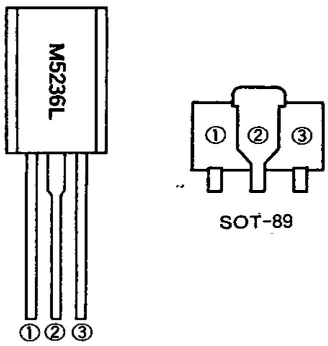
APPLICATION

For car stereo equipment, radio casette recorder, portable stereo and other general electronic equipment.

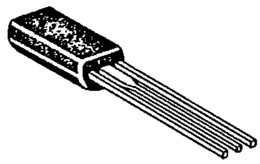
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ························ V_{IN}=3.5V~30V
Rated supply voltage ························ V_O=1.5V~25V

PIN CONFIGURATION



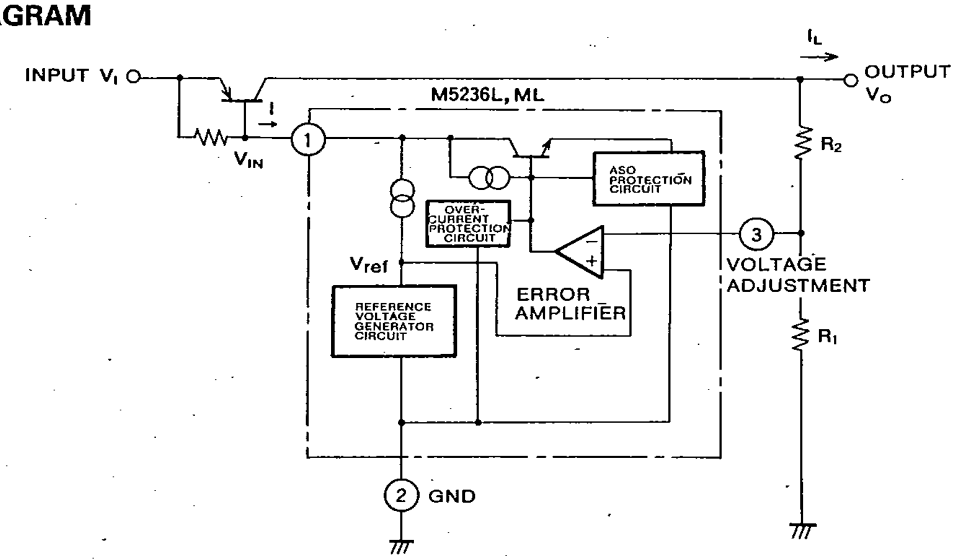
PIN CONNECTION
① INPUT
② GND
③ VOLTAGE ADJUSTMENT



TO-92L package

SOT-89 package

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (T_a=25℃)

Symbol	Parameter	Ratings	Unit
V_{IN}	Input voltage	36	V
I_D	Drive current	30	mA
V_I-V_O	Input-output voltage difference	30	V
P_d	Power dissipation	900(SIP)/500(ML)	mW
T_{opr}	Operating temperature	−20～+75	℃
T_{stg}	Storage temperature	−55～+150	℃

ELECTRICAL CHARACTERISTICS (measurement circuit (a) is used with, T_a=25℃, V_I=15V, V_O=12V, I_L=200mA, C_{REF}=1μF, R_1=4.3kΩ, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{IN}	Input voltage	(between pin ① and pin ②)	3.5		36	V
V_O	Output voltage	R_2≒0.82kΩ～108kΩ	1.5		33	V
V_I-V_O	Minimum input-output voltage difference			0.2		V
V_{REF}	Reference voltage	(between pin ③ and pin ②)	1.20	1.26	1.32	V
$R_{eg\text{-}in}$	Input regulation	V_I=15～20V		0.02	0.1	%/V
$R_{eg\text{-}L}$	Load regulation	I_L=10～200mA		0.02	0.1	%
I_B	Bias current	I_L=0(disregarding the current in resistors R_1, R_2)		1.7	3.0	mA
TC_{VO}	Temperature coefficient of output voltage	T_a=0～75℃		0.02		%/℃
RR	Ripple rejection ratio	f=120Hz(measured with circuit (b))		68		dB
V_{NO}	Output noise voltage	f=20Hz～100kHz		33		μVrms

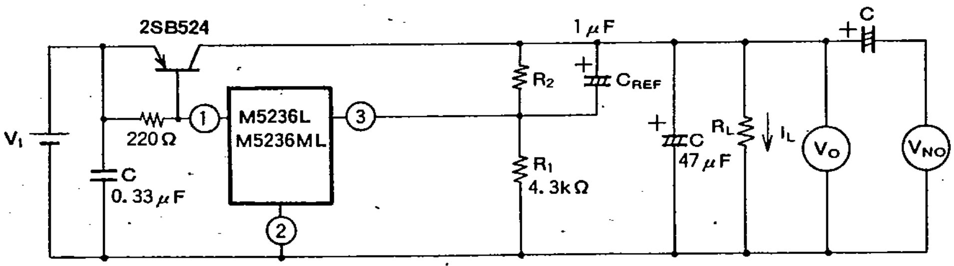
TEST CIRCUITS

(a) Standard test circuit

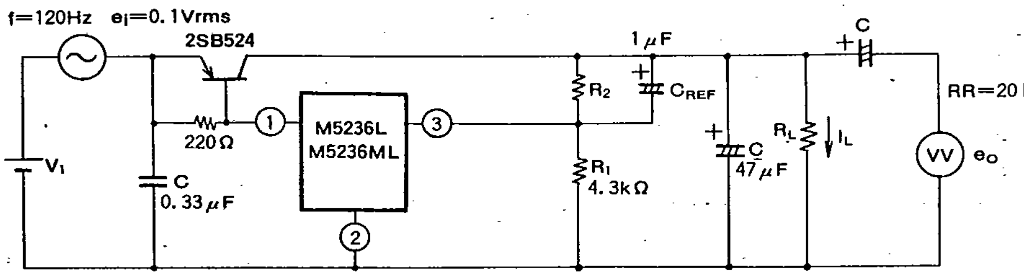
$$V_O=V_{REF}(1+\frac{R_2}{R_1})≒1.26\times(1+\frac{R_2}{4.3})\ (V)$$

$$R_2=R_1(\frac{V_O}{V_{REF}}-1)≒4.3\times(\frac{V_O}{1.26}-1)\ (k\Omega)$$

(R_1=4.3kΩ, V_{REF}≒1.26V)



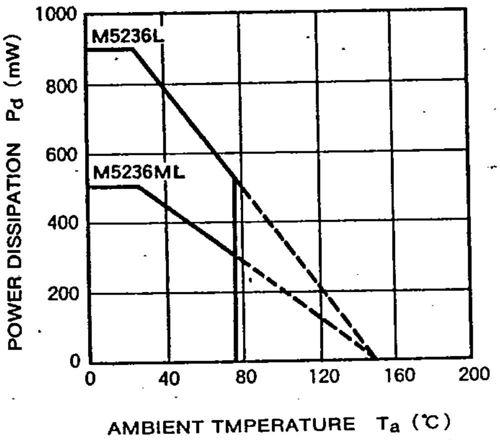
(b) Ripple rejection test circuit



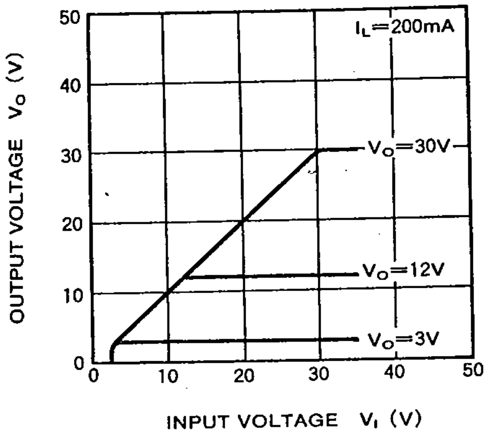
$$RR=20\log\ (\frac{e_I}{e_O})\ (dB)$$

TYPICAL CHARACTERISTICS

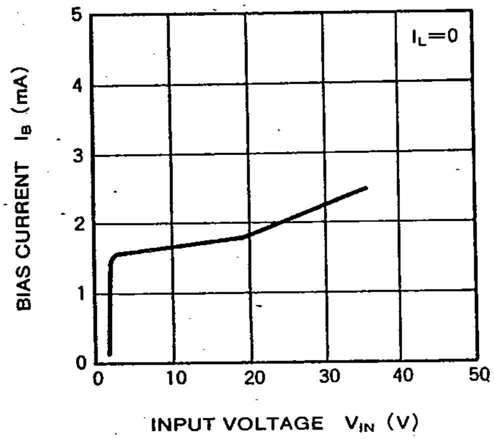
THERMAL DERATING (MAXIMUM RATINGS)



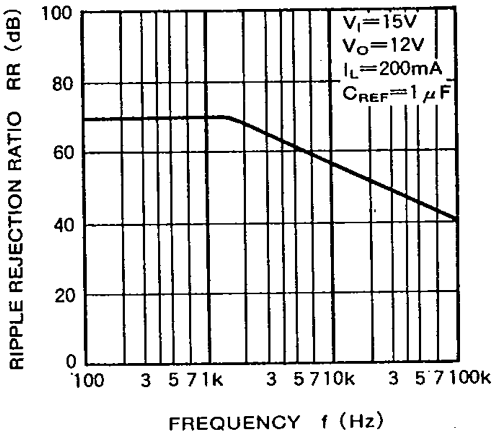
OUTPUT VOLTAGE CHARACTERISTICS



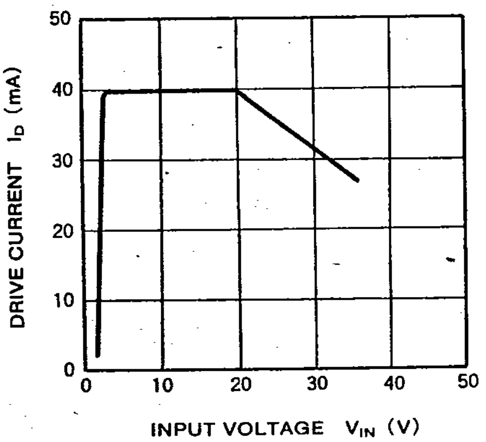
BIAS CURRENT VS. INPUT VOLTAGE



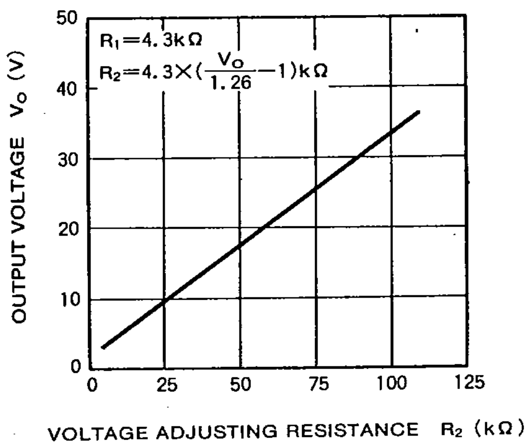
RIPPLE REJECTION



DRIVE CURRINT VS. INPUT VOLTAGE

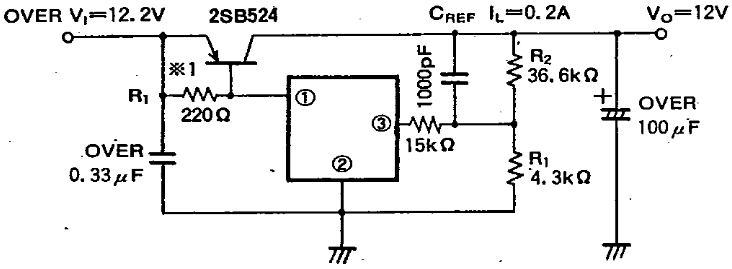


OUPUT VOLTAGE VS. VOLTAGE ADJUSTING RESISTANCE



APPLICATION EXAMPLES

1. Standard application circuit



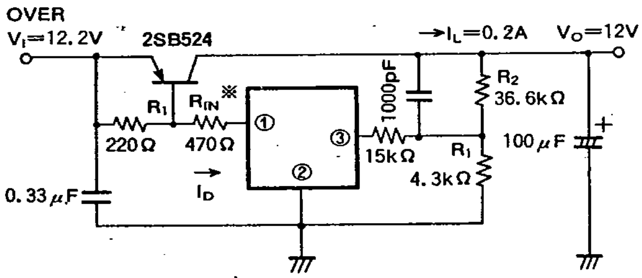
$$V_O = V_{REF} \times \left(1+\frac{R_2}{R_1}\right) V$$

V_{REF}=1.26V(typ.)

※1. R_1 of 180～220Ω should be used.

Note) Capacitors displaying small capacity change with temperature should be used.

2. Control circuit for maximum drive current (I_{DM})



When the input voltage (V_I) is lower than the set output voltage (V_O), drive current of approximately 30mA to 45mA runs in Pin ① of the integrated circuit. (Refer to TYPICAL CHARACTERISTICS DRIVE CURRENT VS INPUT VOLTAGE. For example, when the input voltage V_I of 20V is higher than the fixed output voltage of 20V or above, and input and output are inverted, power dissipation in the circuit is P_d=20V×45mA=900mW, and reaches the maximum rating, making it necessary to control the drive current.) When the input power supply is supplied by batteries and the current needs to be controlled, a resistor R_{IN} can be inserted to control the drive current. (Fig. 1 shows input voltage dependency of the control current and input resistor R_{IN}.)

When the input voltage reaches 12V (=V_O), the current at Pin ① is limited to approximately to 20mA.

Fig. 2 shows I_D-V_I characteristics of the circuit.

Fig. 1 MAXIMUM DRIVE CURRENT CONTROL CHARACTERISTICS (I_{DM})

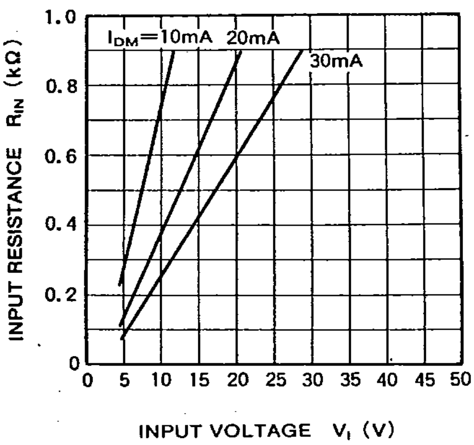
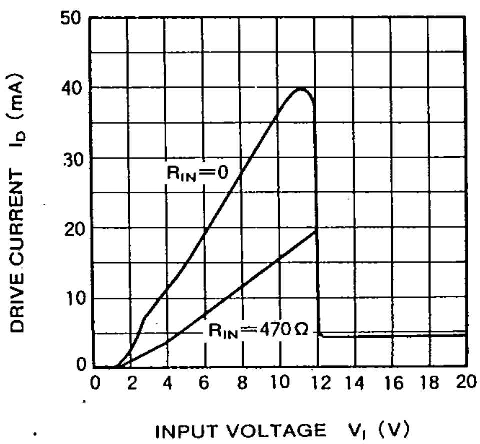
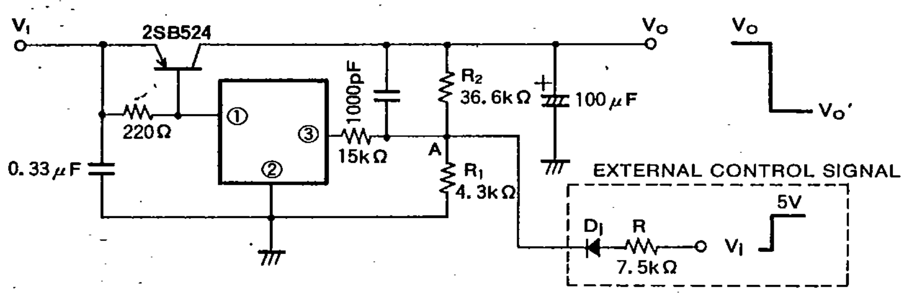


Fig. 2 I_D—V_I CHARACTERISTICS IN APPLICATION EXAMPLE 2



3. ON/OFF control of output voltage circuit



Resistor R in the control circuit is determined by the following equation.

$$R=\frac{V_i-V_F-V_{REF}'}{\frac{V_{REF}'}{R_1}+\frac{V_{REF}'-V_O'}{R_2}}$$

where, V_i: External control voltage
V_F: Forward voltage of diode (D_i)
V_{REF}: 1.4V Pin ③ voltage when V_{REF}' is $V_{O(OFF)}$
V_O': 0V output voltage when V_O' is $V_{O(OFF)}$