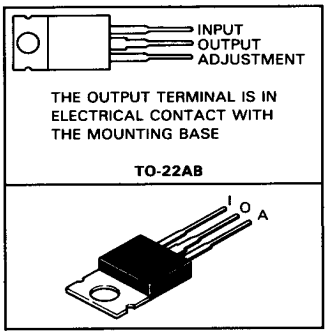
D2212, SEPTEMBER 1977—REVISED FEBRUARY 1988

- Output Voltage Range Adjustable from 1.2 V to 37 V
- Output Current Capability of 1.5 A Max
- Input Regulation Typically 0.01% Per Input-Volt Change
- Output Regulation Typically 0.1%
- Peak Output Current Constant Over Temperature Range of Regulator
- Popular 3-Lead TO-220AB Package
- Ripple Rejection Typically 80 dB
- Direct Replacement for National LM217 and LM317

terminal assignments

KC PACKAGE
(TOP VIEW)



description

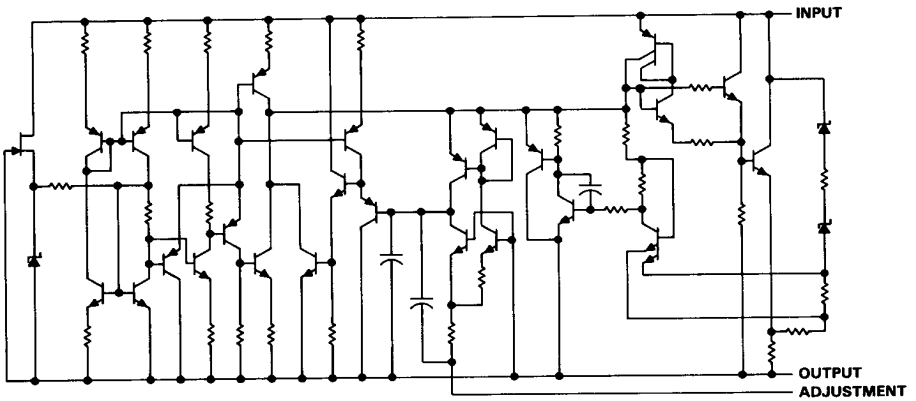
The LM217 and LM317 are adjustable 3-terminal positive-voltage regulators capable of supplying 1.5 A over a differential voltage range of 3 V to 40 V. They are exceptionally easy to use and require only two external resistors to set the output voltage. Both input and output regulation are better than standard fixed regulators. The devices are packaged in a standard transistor package that is easily mounted and handled.

In addition to higher performance than fixed regulators, these regulators offer full overload protection available only in integrated circuits. Included on the chip are current limit, thermal overload protection, and safe-area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected. Normally, no capacitors are needed unless the device is situated far from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejection, which is difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators, these regulators are useful in a wide variety of other applications. The primary applications of each of these regulators is that of a programmable output regulator, but by connecting a fixed resistor between the adjustment terminal and the output terminal, each device can be used as a precision current regulator. Even though the regulator is floating and sees only the input-to-output differential voltage, use of these devices to regulate output voltages that would cause the maximum-rated differential voltage to be exceeded if the output became shorted to ground is not recommended. The TL783 is recommended for output voltages exceeding 37 V. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground, which programs the output to 1.2 V where most loads draw little current.

The LM217 and LM317 are characterized for operation from −25°C to 150°C and from 0°C to 125°C, respectively.

schematic



absolute maximum ratings over operating temperature range (unless otherwise noted)

	LM217	LM317	UNIT
Input-to-output differential voltage, $V_I - V_O$	40	40	V
Continuous total dissipation at 25°C free-air temperature (see Note 1)	2000	2000	mW
Continuous total dissipation at (or below) 25°C case temperature (see Note 1)	20	15	W
Operating free-air, case, or virtual junction temperature range	−25 to 150	0 to 125	°C
Storage temperature range	−65 to 150	−65 to 150	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260	260	°C

NOTE 1: For operation above 25°C free-air or case temperature, refer to Figures 15 and 16. To avoid exceeding the design maximum virtual junction temperature, these ratings should not be exceeded. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

recommended operating conditions

	LM217		LM317		UNIT
	MIN	MAX	MIN	MAX	
Output current, I_O	5	1500	10	1500	mA
Operating virtual junction temperature, T_J	−25	150	0	125	°C

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electrical characteristics over recommended ranges of operating virtual junction temperature (unless otherwise noted) (see Note 2)

PARAMETER	TEST CONDITIONS†		LM217			LM317			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Input regulation (See Note 3)	$V_I - V_O$ = 3 V to 40 V, See Note 4	T_J = MIN to MAX, I_O = 10 mA to 1.5 A		0.01 0.02	0.02 0.05		0.01 0.02	0.04 0.07	%/V
Ripple rejection	V_O = 10 V,	f = 120 Hz		65			65		dB
	V_O = 10 V, 10-μF capacitor between ADJ and ground	f = 120 Hz,	66	80		66	80		
Output regulation	I_O = 10 mA to 1.5 A, T_J = 25°C, See Note 4	$V_O \le 5$ V		5	15		5	25	mV
		$V_O > 5$ V		0.1	0.3		0.1	0.5	%
	I_O = 10 mA to 1.5 A, See Note 4	$V_O \le 5$ V		20	50		20	70	mV
		$V_O > 5$ V		0.3	1		0.3	1.5	%
Output voltage change with temperature	T_J = MIN to MAX			1			1		%
Output voltage long-term drift (see Note 5)	After 1000 h at T_J = MAX and $V_I - V_O$ = 40 V			0.3	1		0.3	1	%
Output noise voltage	f = 10 Hz to 10 kHz, T_J = 25°C			0.003			0.003		%
Minimum output current to maintain regulation	$V_I - V_O$ = 40 V			3.5	5		3.5	10	mA
Peak output current	$V_I - V_O \le 15$ V		1.5	2.2		1.5	2.2		A
	$V_I - V_O \le 40$ V, T_J = 25°C			0.4		0.15	0.4		
Adjustment-terminal current				50	100		50	100	μA
Change in adjustment-terminal current	$V_I - V_O$ = 2.5 V to 40 V, I_O = 10 mA to 1.5 A			0.2	5		0.2	5	μA
Reference voltage (output to ADJ)	$V_I - V_O$ = 3 V to 40 V, I_O = 10 mA to 1.5 A, P ≤ 15 W		1.2	1.25	1.3	1.2	1.25	1.3	V

†Unless otherwise noted, these specifications apply for the following test conditions; $V_I - V_O$ = 5 V and I_O = 0.5 A. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

NOTES: 2. All characteristics are measured with a 0.1-μF capacitor across the input and a 1-μF capacitor across the output.
3. Input regulation is expressed here as the percentage change in output voltage per 1-V change at the input.
4. Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.
5. Since long-term drift cannot be measured on the individual devices prior to shipment, this specification is not intended to be a guarantee or warranty. It is an engineering estimate of the average drift to be expected from lot to lot.

TYPICAL APPLICATION DATA

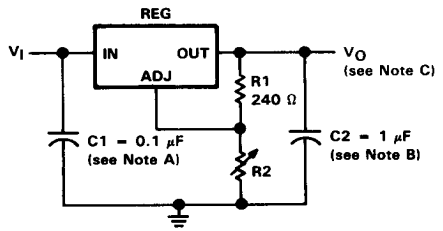


FIGURE 1. ADJUSTABLE VOLTAGE REGULATOR

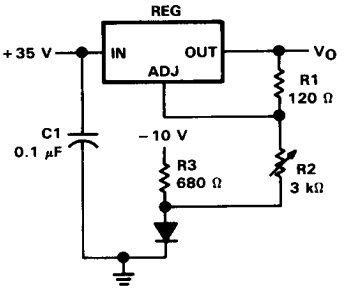
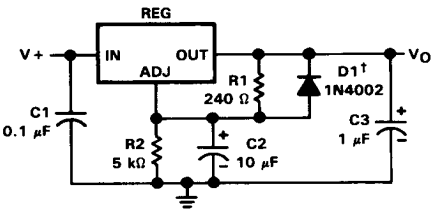


FIGURE 2. 0-V to 30-V REGULATOR CIRCUIT



†D1 discharges C2 if output is shorted to ground.

FIGURE 3. ADJUSTABLE REGULATOR CIRCUIT WITH IMPROVED RIPPLE REJECTION

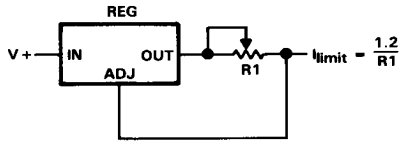


FIGURE 4. PRECISION CURRENT LIMITER CIRCUIT

NOTES: A. Use of an input bypass capacitor is recommended if regulator is far from filter capacitors.
B. Use of an output capacitor improves transient response but is optional.
C. Output voltage is calculated from the equation: $V_O = V_{ref}\left(1 + \frac{R2}{R1}\right)$
V_{ref} equals the difference between the output and adjustment terminal voltages.

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TYPICAL APPLICATIONS

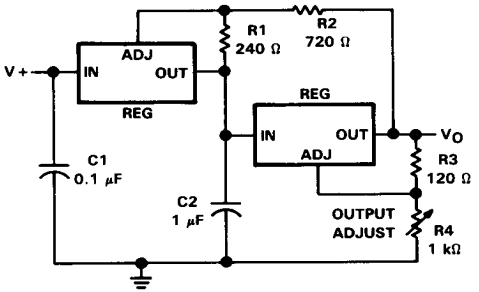


FIGURE 5. TRACKING PREREGULATOR CIRCUIT

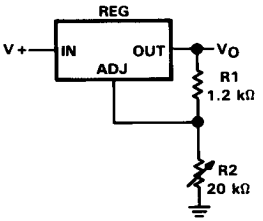


FIGURE 6. 1.2 to 20-V REGULATOR CIRCUIT WITH MINIMUM PROGRAM CURRENT

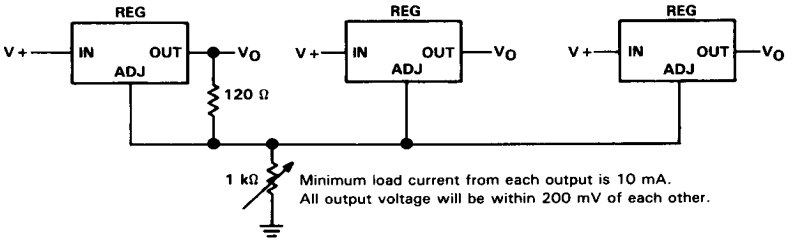
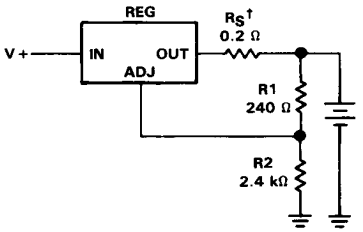


FIGURE 7. ADJUSTING MULTIPLE ON-CARD REGULATORS WITH A SINGLE CONTROL



†R_S controls output impedance of charger

$$Z_{OUT} = R_S \left(1 + \frac{R2}{R1}\right)$$

The use of R_S allows low charging rates with a fully-charged battery.

FIGURE 8. BATTERY CHARGER CIRCUIT

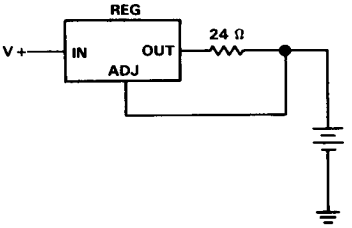


FIGURE 9. 50-mA CONSTANT-CURRENT BATTERY CHARGER CIRCUIT

TYPICAL APPLICATIONS

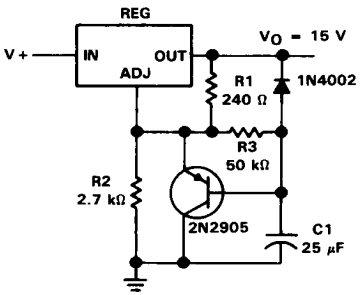


FIGURE 10. SLOW-TURN-ON 15-V REGULATOR CIRCUIT

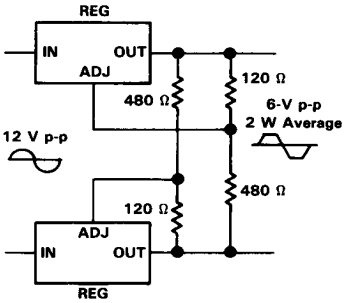
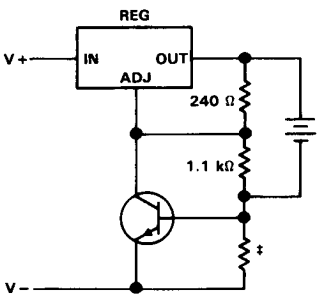


FIGURE 11. A-C VOLTAGE REGULATOR CIRCUIT



‡This resistor sets peak current (0.6 A for 1 Ω)

FIGURE 12. CURRENT-LIMITED 6-V CHARGER

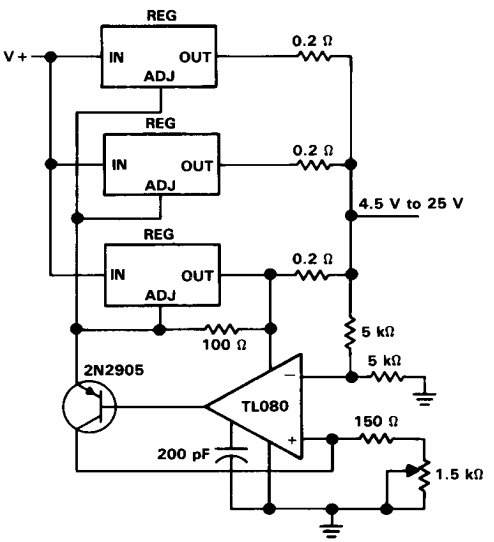


FIGURE 13. ADJUSTABLE 4-A REGULATOR

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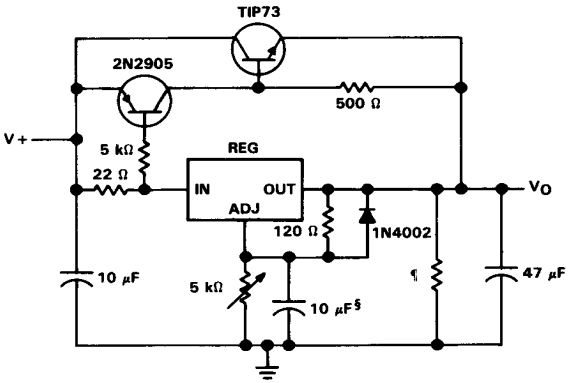

¶Minimum load current is 30 mA.
§Optional capacitor improves ripple rejection

FIGURE 14. HIGH-CURRENT ADJUSTABLE REGULATOR

THERMAL INFORMATION

FREE-AIR TEMPERATURE DISSIPATION DERATING CURVE

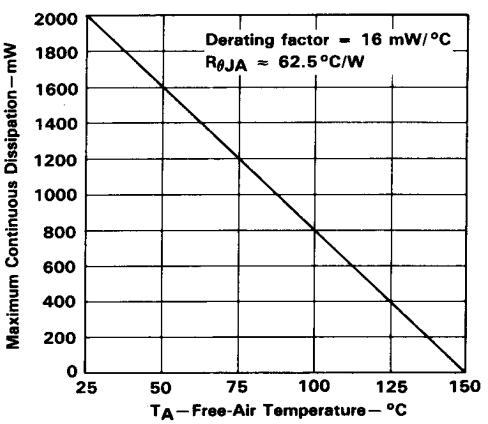

FIGURE 15

CASE TEMPERATURE DISSIPATION DERATING CURVE

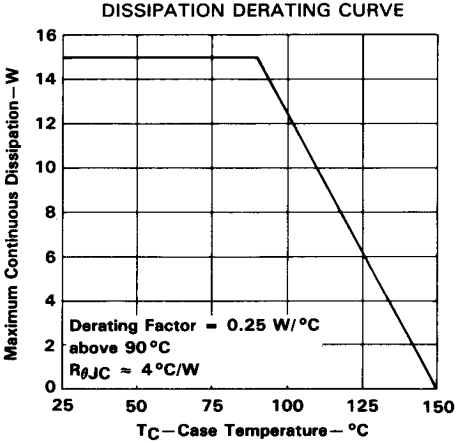

FIGURE 16