LINEAR INTEGRATED CIRCUITS

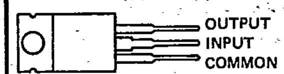
TYPE SERIES LM320 3-TERMINAL NEGATIVE-VOLTAGE REGULATORS

D2334, APRIL 1983

- 3-Terminal Regulators
- Internal Thermal Overload Protection
- Internal Short-Circuit Current Limiting
- Easily Adjustable to Higher Output Voltage
- Interchangeable with National Semiconductor LM320 Series

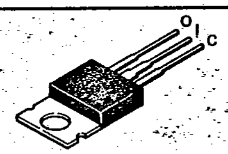
NOMINAL OUTPUT VOLTAGE	MAXIMUM OUTPUT CURRENT	REGULATOR
−5 V	1.5 A	LM320-5
−12 V	1 A	LM320-12
−15 V	1A	LM320-15

KC PACKAGE (TOP VIEW)



THE INPUT TERMINAL IS IN ELECTRICAL CONTACT WITH THE MOUNTING BASE

TO-220AB

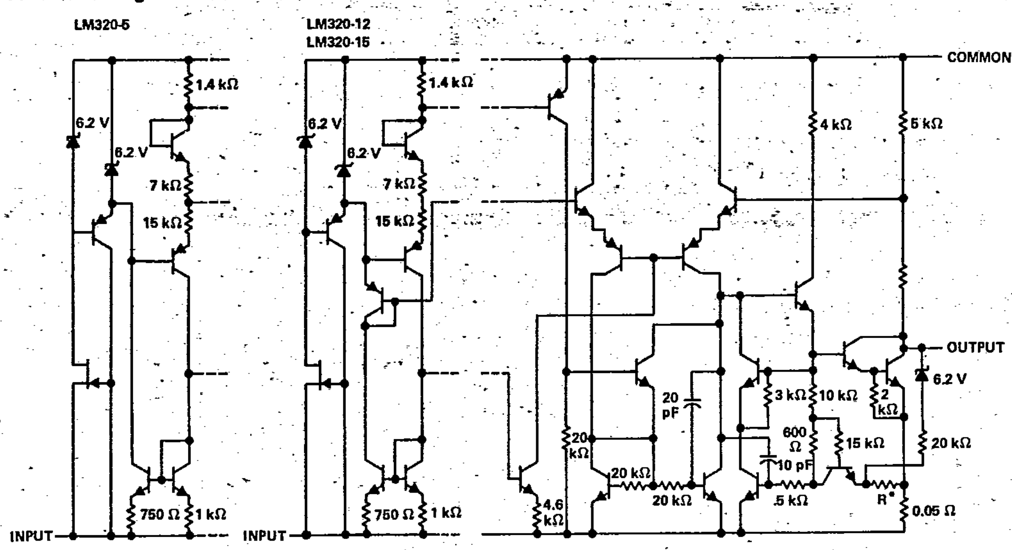


description

The LM320 series of three-terminal, fixed-negative-voltage monolithic integrated circuit voltage regulators are designed to provide a fixed output voltage of −5 volts, −12 volts, and −15 volts with up to 1.5 amperes of output current. Each is designed for a wide range of applications which includes on-card regulation for elimination of noise and distribution problems associated with single-point regulation.

The internal current limiting and thermal shutdown features of these regulators make them essentially immune to overload. The LM320, when used as a fixed-voltage regulator, needs only one external component: a compensation capacitor at the output terminal. In addition, these devices can be used with external components to obtain adjustable output voltages and currents or as the power-pass element in precision regulators.

schematic diagram



For LM320-5, R* = 50 Ω. For LM320-12 and LM320-15, R* = 150 Ω
All component values are nominal.

TYPE SERIES LM320
3-TERMINAL NEGATIVE-VOLTAGE REGULATORS

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

Input voltage: LM320-5	−25 V
LM320-12	−35 V
LM320-15	−35 V
Input-output voltage differential	25 V
Continuous total dissipation at 25°C free-air temperature (see Note 1)	2 W
Continuous total dissipation at (or below) 25°C case temperature (see Note 1)	15 W
Operating free-air, case, or virtual junction temperature range	−55°C to 150°C
Storage temperature range	−65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

NOTE 1: For operation above 25°C free-air or case temperature, refer to Figures 1 and 2. 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.

FREE-AIR TEMPERATURE DISSIPATION DERATING CURVE

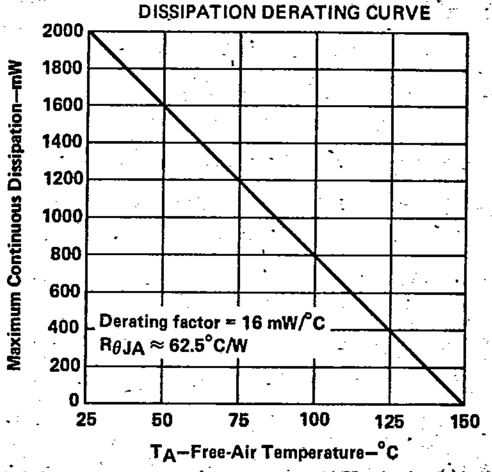


FIGURE 1

CASE TEMPERATURE DISSIPATION DERATING CURVE

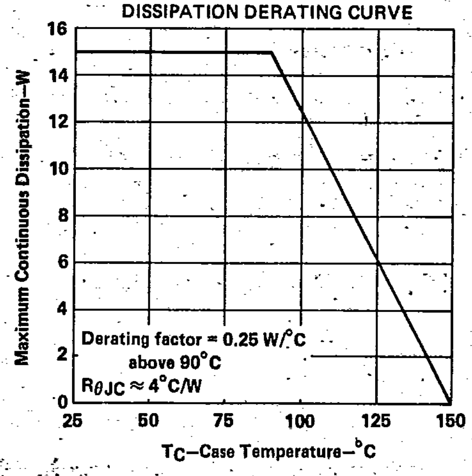


FIGURE 2

Voltage Regulators

6

recommended operating conditions

		MIN	MAX	UNIT
Input voltage, V_I	LM320-5	−7.5	−25	V
	LM320-12	−14.5	−32	
	LM320-15	−17.5	−35	
Output current, I_O	LM320-5		1.5	A
	LM320-12		1	
	LM320-15		1	
Operating virtual junction temperature, T_J		0	125	°C

LM320-5 electrical characteristics at specified virtual junction temperature, I_O = 5 mA, V_I = −10 V, (unless otherwise noted)

PARAMETER	TEST CONDITIONS†		MIN	TYP	MAX	UNIT
Output voltage		T_J = 25°C	−4.8		−5.2	V
	V_I = −7.5 V to −25 V, P ≤ 15 W,	I_O = 5 mA to 1.5 A, T_J = 0°C to 125°C	−4.75		−5.25	
Input regulation	V_I = −7.5 V to −25 V,	T_J = 25°C		10	40	mV
Ripple rejection	f = 120 Hz,	T_J = 0°C to 125°C	54	64		dB
Output regulation	I_O = 5 mA to 1.5 A,	T_J = 25°C		50	100	mV
Output noise voltage	C_L = 1 μF, f = 10 Hz to 100 kHz,	T_J = 25°C		150		μV
Output voltage long-term drift (see Note 2)	After 1000 h at T_J = 125°,	T_J = 25°C		10		mV
Bias current	V_I = −7.5 V to −25 V,	T_J = 0°C to 125°C		1	2	mA
Bias current change	V_I = −7.5 V to −25 V	T_J = 25°C		0.1	0.4	mA
	I_O = 5 mA to 1.5 A			0.1	0.4	

LM320-12 electrical characteristics at specified virtual junction temperature, I_O = 5 mA, V_I = −17 V, (unless otherwise noted)

PARAMETER	TEST CONDITIONS†		MIN	TYP	MAX	UNIT
Output voltage		T_J = 25°C	−11.6	−12	−12.4	V
	V_I = −14.5 V to −32 V, P ≤ 15 W,	I_O = 5 mA to 1 A, T_J = 0°C to 125°C	−11.4		−12.6	
Input regulation	V_I = −14.5 V to −32 V,	T_J = 25°C		4	20	mV
Ripple rejection	f = 120 Hz,	T_J = 0°C to 125°C	56	80		dB
Output regulation	I_O = 5 mA to 1 A,	T_J = 25°C		30	80	mV
Output noise voltage	C_L = 1 μF, f = 10 Hz to 100 kHz,	T_J = 25°C		400		μV
Output voltage long-term drift (see Note 2)	After 1000 h at T_J = 125°C,	T_J = 25°C		24		mV
Bias current	V_I = −14.5 V to −32 V,	T_J = 0°C to 125°C		2	4	mA
Bias current change	V_I = −14.5 V to −32 V	T_J = 25°C		0.1	0.4	mA
	I_O = 5 mA to 1 A			0.1	0.4	

LM320-15 electrical characteristics at specified virtual junction temperature, I_O = 5 mA, V_I = −20 V, (unless otherwise noted)

PARAMETER	TEST CONDITIONS†		MIN	TYP	MAX	UNIT
Output voltage		T_J = 25°C	−14.5	−15	−15.5	V
	V_I = −17.5 V to −35 V, P ≤ 15 W,	I_O = 5 mA to 1 A, T_J = 0°C to 125°C	−14.3		−15.7	
Input regulation	V_I = −17.5 V to −35 V,	T_J = 25°C		5	20	mV
Ripple rejection	f = 120 Hz,	T_J = 0°C to 125°C	56	80		dB
Output regulation	I_O = 5 mA to 1 A	T_J = 25°C		30	80	mV
Output noise voltage	C_L = 1 μF, f = 10 Hz to 100 kHz,	T_J = 25°C		400		μV
Output voltage long-term drift (see Note 2)	After 1000 h at T_J = 125°C,	T_J = 25°C		30		mV
Bias current	V_I = −17.5 V to −35 V,	T_J = 0°C to 125°C		2	4	mA
Bias current change	V_I = −17.5 V to −35 V,	T_J = 25°C		0.1	0.4	mA
	I_O = 5 mA to 1 A			0.1	0.4	

†All characteristics are measured with a 1-μF capacitor across the input and a 2-μF solid-tantalum capacitor across the output. All characteristics except ripple rejection and output noise voltage are measured using pulse techniques (t_w ≤ 10 ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

NOTE 2: 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.

TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

TYPE SERIES LM320
3-TERMINAL NEGATIVE-VOLTAGE REGULATORS

TYPICAL CHARACTERISTICS

NORMALIZED OUTPUT VOLTAGE
vs
VIRTUAL JUNCTION TEMPERATURE

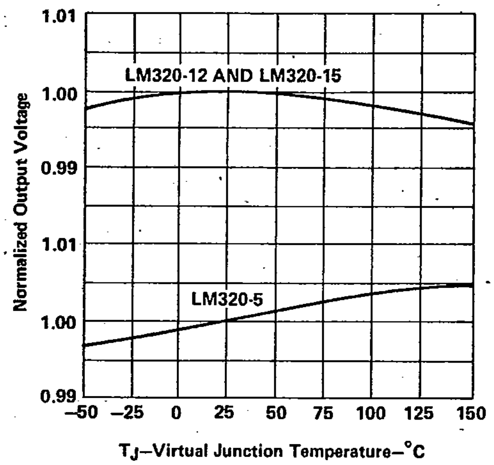


FIGURE 3

RIPPLE REJECTION
vs
FREQUENCY

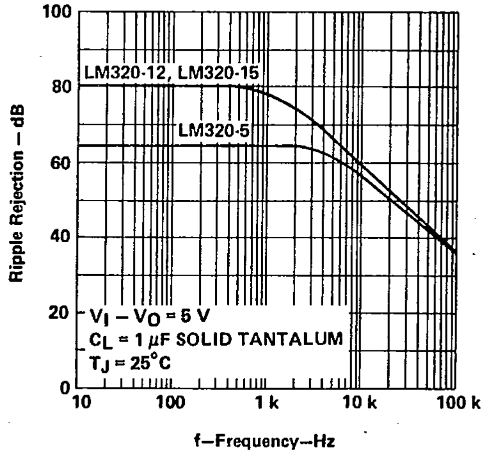


FIGURE 4

BIAS CURRENT
vs
INPUT VOLTAGE

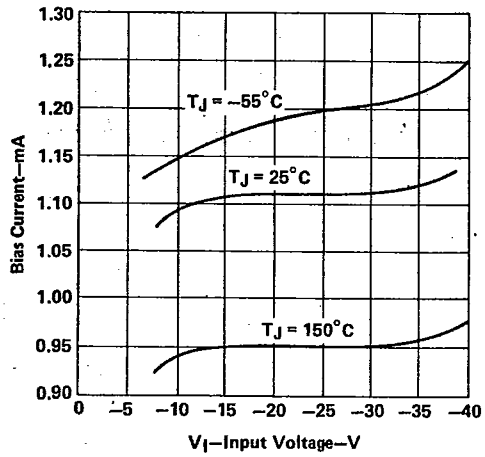


FIGURE 5

BIAS CURRENT
vs
OUTPUT CURRENT

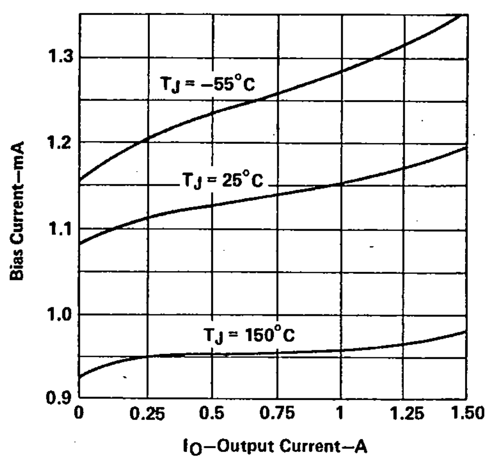


FIGURE 6

TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

TYPICAL CHARACTERISTICS

SHORT-CIRCUIT OUTPUT CURRENT vs INPUT-OUTPUT VOLTAGE DIFFERENTIAL

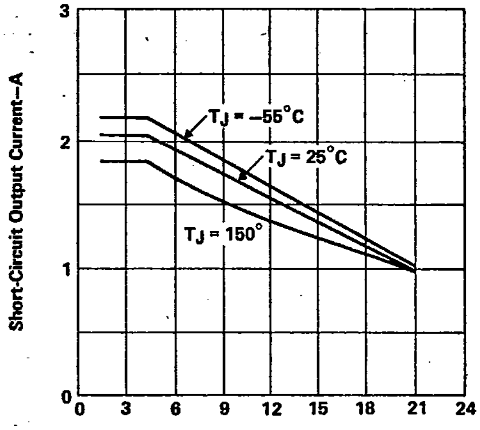


FIGURE 7

DROPOUT VOLTAGE vs OUTPUT CURRENT

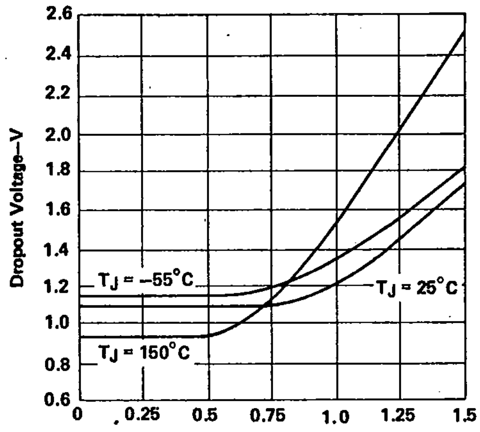


FIGURE 8

OUTPUT IMPEDANCE vs FREQUENCY

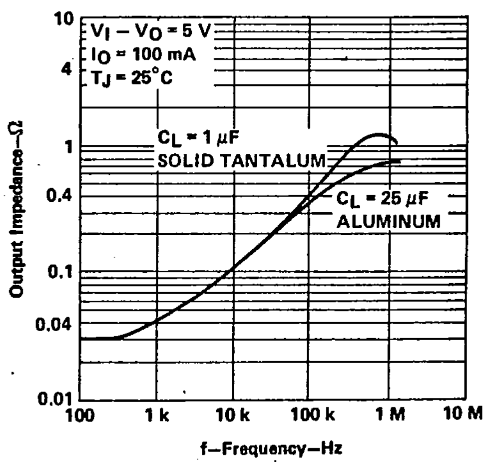


FIGURE 9

Voltage Regulators

6

TYPE SERIES LM320
3-TERMINAL NEGATIVE-VOLTAGE REGULATORS

TYPICAL APPLICATION INFORMATION

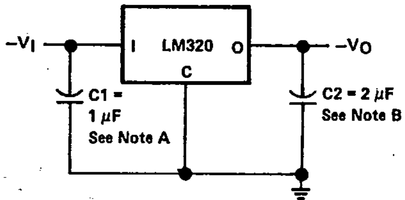


FIGURE 10 — FIXED-VOLTAGE REGULATOR

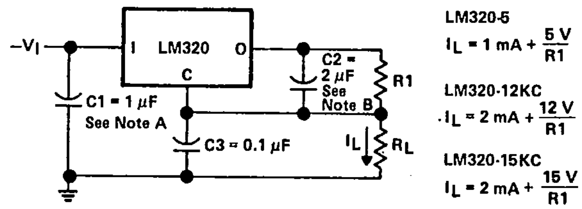


FIGURE 11 — CURRENT SOURCE REGULATOR

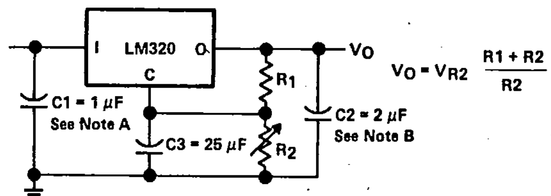


FIGURE 12 — ADJUSTABLE OUTPUT REGULATOR

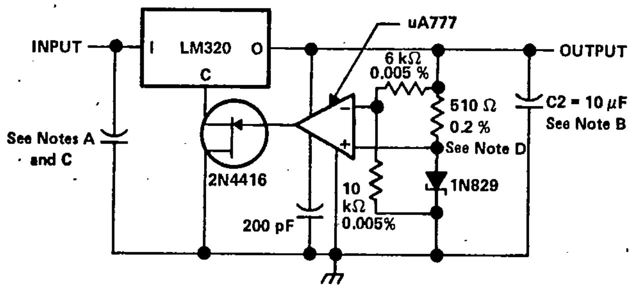


FIGURE 13 — HIGH-STABILITY REGULATOR

NOTES:
- A. Capacitor C1 is required if the regulator is not located within 75 mm (3 inches) of the power supply filter.
- B. Capacitor C2 is required for stability. For the value given, the capacitor must be solid tantalum but a 25-μF aluminum electrolytic may be substituted. Values given may be increased without limit.
- C. In Figure 13 capacitor C1 is solid tantalum.
- D. This resistor determines zener current. Adjust to minimize thermal drift.

TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265