National Semiconductor

March 1989

LM320L 3-Terminal Negative Regulators

General Description

The LM320L series of 3-terminal negative voltage regulators features fixed output voltages of −5V, −12V, and −15V, with output current capabilities in excess of 100 mA. These devices were designed using the latest computer techniques for optimizing the packaged IC thermal/electrical performance. The LM320L series, even when combined with a minimum output compensation capacitor of 0.1 μF, exhibits an excellent transient response, a maximum line regulation of 0.07% V_O/V, and a maximum load regulation of 0.01% V_O/mA.

The LM320L series also includes, as self-protection circuitry: safe operating area circuitry for output transistor power dissipation limiting, a temperature independent short circuit current limit for peak output current limiting, and a thermal shutdown circuit to prevent excessive junction temperature. Although designed primarily as fixed voltage regulators, these devices may be combined with simple external circuitry for boosted and/or adjustable voltages and currents. The LM320L series is available in the 3-lead TO-92 package.

For output voltages other than −5V, −12V and −15V, the LM137 and LM137HV series provide an output voltage range from −1.2V to −47V.

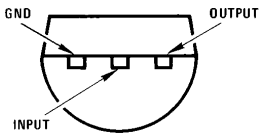
Features

- Preset output voltage error is less than ±5% over load, line and temperature
- LM320L is specified at an output current of 100 mA
- Internal short-circuit, thermal and safe operating area protection
- Easily adjustable to higher output voltages
- Maximum line regulation less than 0.07% V_{OUT}/V
- Maximum load regulation less than 0.01% V_{OUT}/mA
- Easily compensated with a small 0.1 μF output capacitor

Device	Package	Rated Power Dissipation	Design Output Current
LM320L	TO-92 (Z)	0.6W	0.1A

Connection Diagram

TO-92 Plastic Package (Z)



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Order Number LM320LZ-5.0, LM320LZ-12 or LM320LZ-15
See NS Package Number Z03A

RRD-B30M115/Printed in U. S. A.

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Input Voltage

V_{OUT} = −5V 12V and 15V −35V

Internal Power Dissipation (Notes 1 and 3) Internally Limited

Operating Temperature Range 0°C to +70°C

Maximum Junction Temperature +125°C

Storage Temperature Range

Molded TO-92 −55°C to +150°C

Lead Temperature (Soldering, 10 sec.) 260°C

Electrical Characteristics (Note 2) T_A = 0°C to +70°C unless otherwise noted.

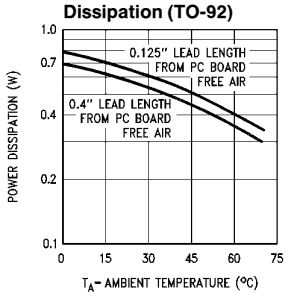
Output Voltage			**−5V**			**−12V**			**−15V**			**Units**
Input Voltage (unless otherwise noted)			**−10V**			**−17V**			**−20V**			
Symbol	**Parameter**	**Conditions**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	
V_O	Output Voltage	T_j = 25°C, I_O = 100 mA	−5.2	−5	−4.8	−12.5	−12	−11.5	−15.6	−15	−14.4	
		1 mA ≤ I_O ≤ 100 mA V_{MIN} ≤ V_{IN} ≤ V_{MAX}	−5.25 (−20 ≤ V_{IN} ≤ −7.5)		−4.75	−12.6 (−27 ≤ V_{IN} ≤ −14.8)		−11.4	−15.75 (−30 ≤ V_{IN} ≤ −18)		−14.25	V
		1 mA ≤ I_O ≤ 40 mA V_{MIN} ≤ V_{IN} ≤ V_{MAX}	−5.25 (−20 ≤ V_{IN} ≤ −7)		−4.75	−12.6 (−27 ≤ V_{IN} ≤ −14.5)		−11.4	−15.75 (−30 ≤ V_{IN} ≤ −17.5)		−14.25	
ΔV_O	Line Regulation	T_j = 25°C, I_O = 100 mA			60			45			45	mV
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}	(−20 ≤ V_{IN} ≤ −7.3)			(−27 ≤ V_{IN} ≤ −14.6)			(−30 ≤ V_{IN} ≤ −17.7)			V
		T_j = 25°C, I_O = 40 mA			60			45			45	mV
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}	(−20 ≤ V_{IN} ≤ −7)			(−27 ≤ V_{IN} ≤ −14.5)			(−30 ≤ V_{IN} ≤ −17.5)			V
ΔV_O	Load Regulation	T_j = 25°C 1 mA ≤ I_O ≤ 100 mA			50			100			125	mV
ΔV_O	Long Term Stability	I_O = 100 mA		20			48			60		mV/khr
I_Q	Quiescent Current	I_O = 100 mA		2	6		2	6		2	6	mA
ΔI_Q	Quiescent Current Change	1 mA ≤ I_O ≤ 100 mA			0.3			0.3			0.3	mA
		1 mA ≤ I_O ≤ 40 mA			0.1			0.1			0.1	
		I_O = 100 mA			0.25			0.25			0.25	mA
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}	(−20 ≤ V_{IN} ≤ −7.5)			(−27 ≤ V_{IN} ≤ −14.8)			(−30 ≤ V_{IN} ≤ −18)			V
V_n	Output Noise Voltage	T_j = 25°C, I_O = 100 mA f = 10 Hz–10 kHz		40			96			120		μV
$\frac{\Delta V_{IN}}{\Delta V_O}$	Ripple Rejection	T_j = 25°C, I_O = 100 mA f = 120 Hz	50			52			50			dB
	Input Voltage Required to Maintain Line Regulation	T_j = 25°C I_O = 100 mA			−7.3			−14.6			−17.7	V
		I_O = 40 mA			−7.0			−14.5			−17.5	

Note 1: Thermal resistance of Z package is typically 60°C/W θ_{JC}, 232°C/W θ_{jA} at still air, and 88°C/W at 400 ft/min of air. The maximum junction temperature shall not exceed 125°C on electrical parameters.

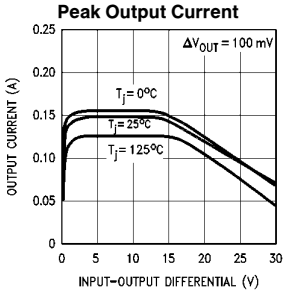
Note 2: To ensure constant junction temperature pulse testing is used.

Typical Performance Characteristics

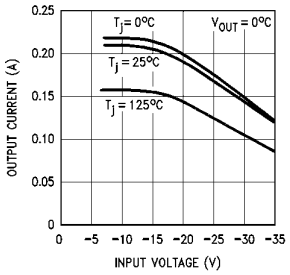
Maximum Average Power Dissipation (TO-92)



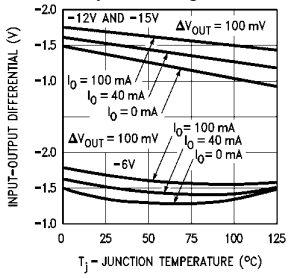
Peak Output Current



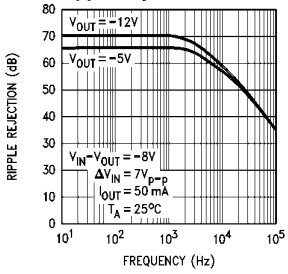
Short Circuit Output Current



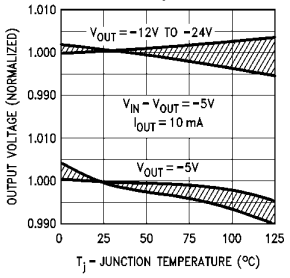
Dropout Voltage



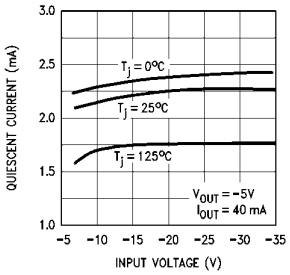
Ripple Rejection



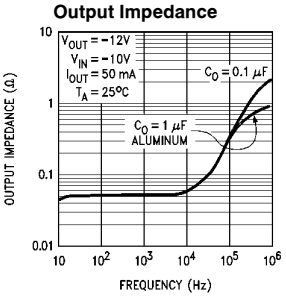
Output Voltage vs Temperature (Normalized to 1V @ 25°C)



Quiescent Current



Output Impedance



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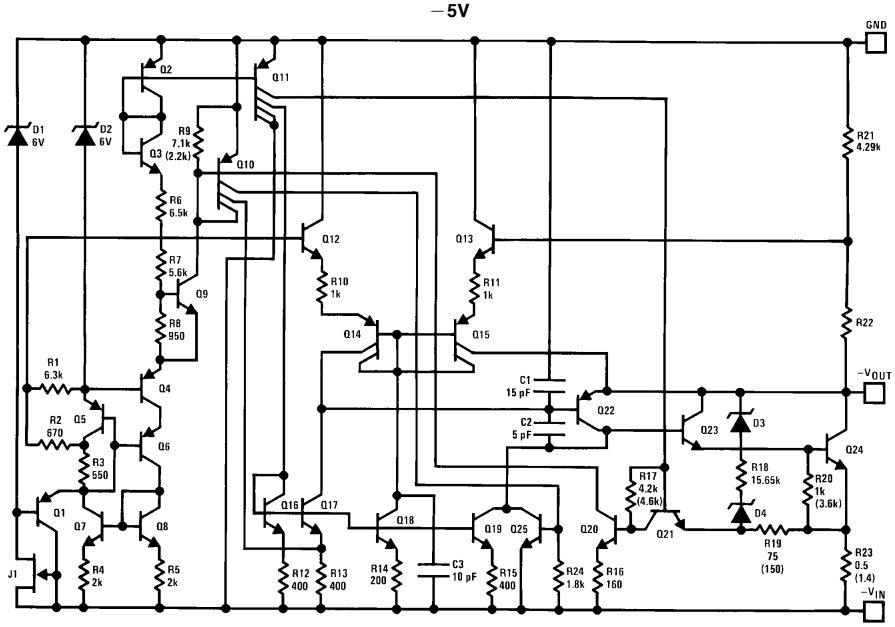
Schematic Diagrams

−5V



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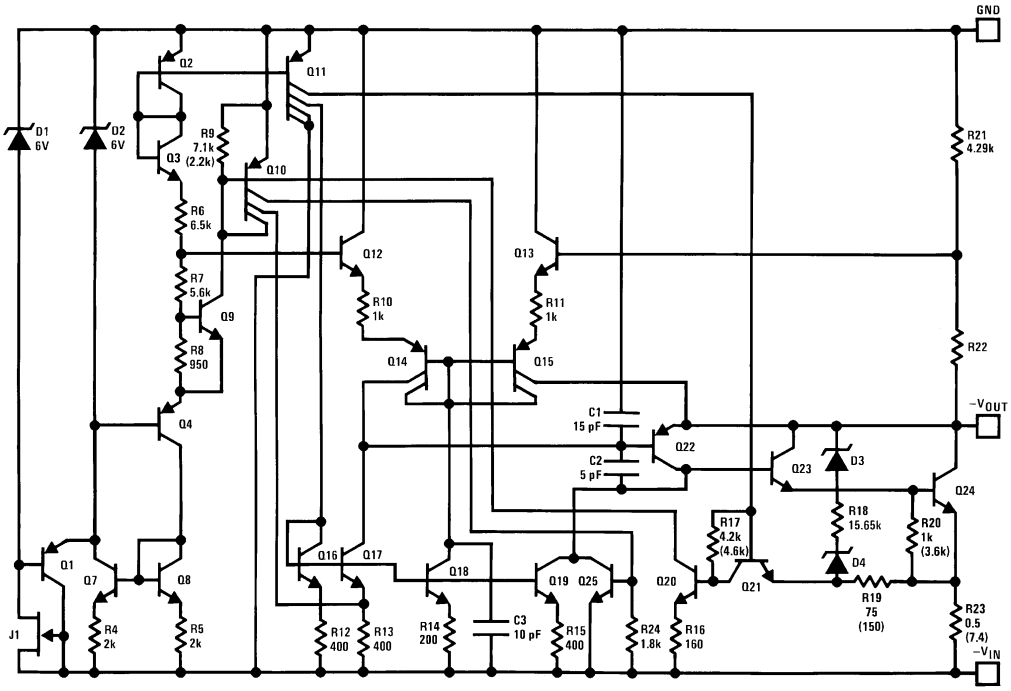
−12V and −15V



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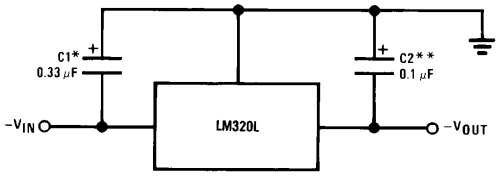
Typical Applications

Fixed Output Regulator



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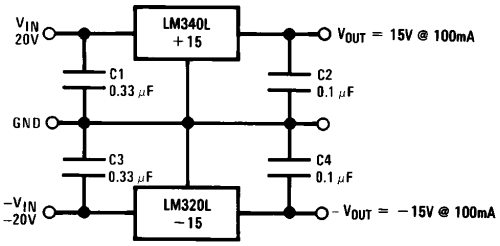
*Required if the regulator is located far from the power supply filter. A 1 µF aluminum electrolytic may be substituted.

**Required for stability. A 1 µF aluminum electrolytic may be substituted.

± 15V, 100 mA Dual Power Supply



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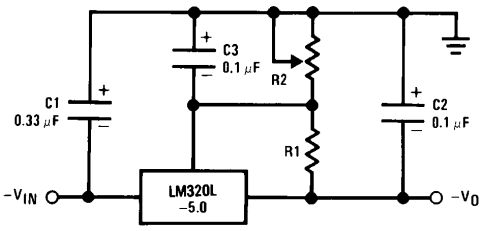
Adjustable Output Regulator



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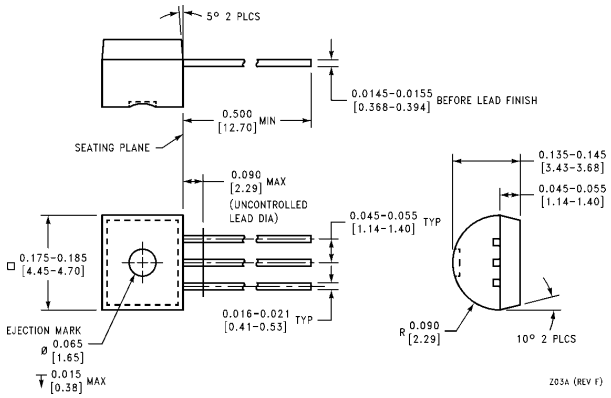
$$-V_O = -5V - (5V/R1 + I_Q) \bullet R2,$$
$$5V/R1 > 3\,I_Q$$

Physical Dimensions inches (millimeters)



TO-92 Plastic Package (Z)
Order Number LM320LZ-5.0, LM320LZ-12 or LM320LZ-15
NS Package Number Z03A

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