



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 $0.1 \mu F$, 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 $-47V$.

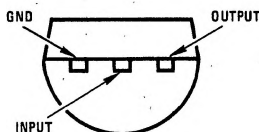
Features

- Preset output voltage error is less than $\pm 5\%$ 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 $0.1 \mu F$ 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)



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

TL/H/7621-1

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) $T_A = 0^\circ\text{C}$ to +70°C unless otherwise noted.

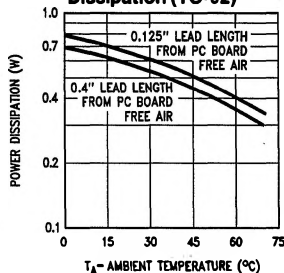
Output Voltage			-5V			-12V			-15V			Units
Input Voltage (unless otherwise noted)			-10V			-17V			-20V			
Symbol	Parameter	Conditions	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V _O	Output Voltage	T _J = 25°C, I _O = 100 mA	-5.2	-5	-4.8	-12.5	-12	-11.5	-15.6	-15	-14.4	V
		1 mA ≤ I _O ≤ 100 mA	-5.25		-4.75	-12.6		-11.4	-15.75		-14.25	
		V _{MIN} ≤ V _{IN} ≤ V _{MAX}	(-20 ≤ V _{IN} ≤ -7.5)			(-27 ≤ V _{IN} ≤ -14.8)			(-30 ≤ V _{IN} ≤ -18)			
		1 mA ≤ I _O ≤ 40 mA	-5.25		-4.75	-12.6		-11.4	-15.75		-14.25	
		V _{MIN} ≤ V _{IN} ≤ V _{MAX}	(-20 ≤ V _{IN} ≤ -7)			(-27 ≤ V _{IN} ≤ -14.5)			(-30 ≤ V _{IN} ≤ -17.5)			
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 _O	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 _n	Output Noise Voltage	T _J = 25°C, I _O = 100 mA f = 10 Hz–10 kHz	40			96			120			μV
ΔV _{IN} ΔV _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 I _O = 40 mA	-7.3 -7.0			-14.6 -14.5			-17.7 -17.5			V

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.

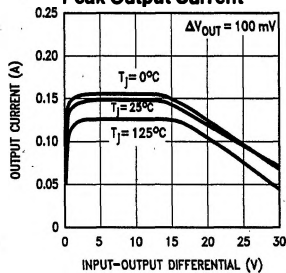
Note 2: To ensure constant junction temperature pulse testing is used.

Typical Performance Characteristics

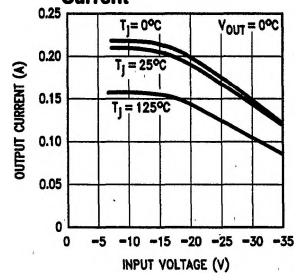
Maximum Average Power Dissipation (TO-92)



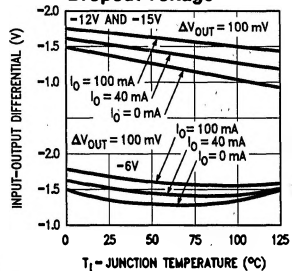
Peak Output Current



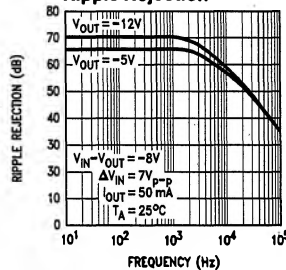
Short Circuit Output Current



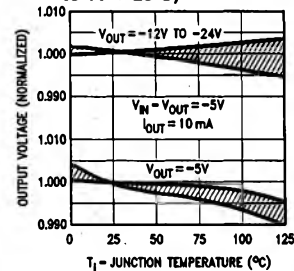
Dropout Voltage



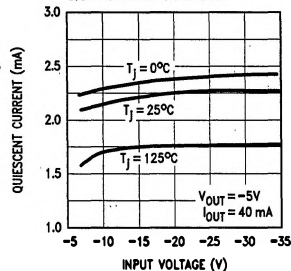
Ripple Rejection



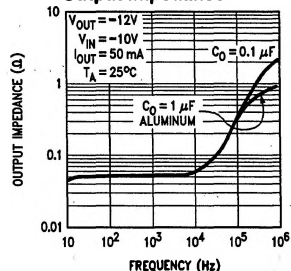
Output Voltage vs Temperature (Normalized to 1V @ 25 $^{\circ}\text{C}$)



Quiescent Current

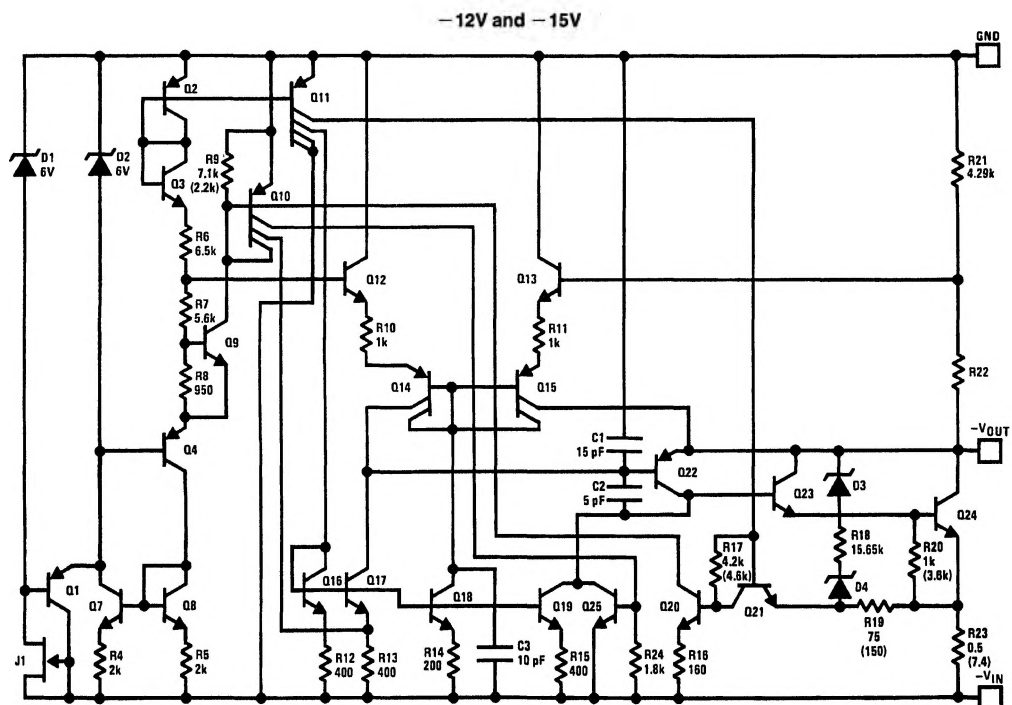
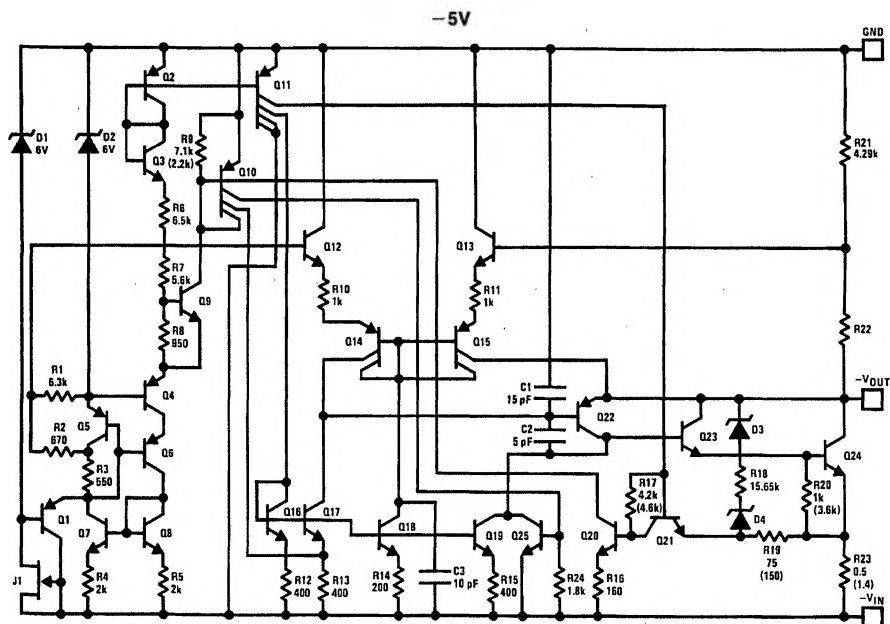


Output Impedance



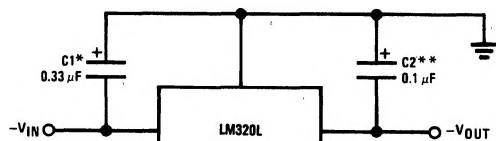
TL/H/7821-2

Schematic Diagrams



Typical Applications

Fixed Output Regulator

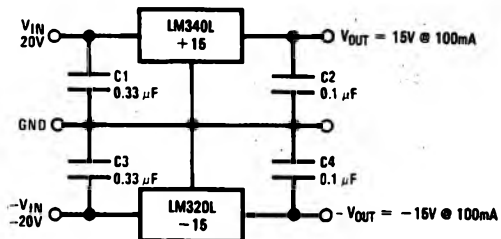


TL/H/7821-5

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

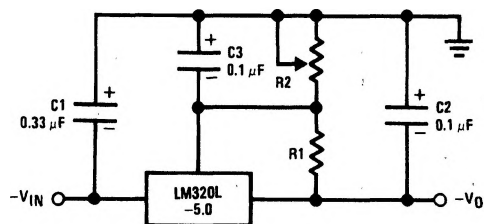
**Required for stability. A 1 μ F aluminum electrolytic may be substituted.

$\pm 15V$, 100 mA Dual Power Supply



TL/H/7821-7

Adjustable Output Regulator



TL/H/7821-6

$$-V_O = -5V - (5V/R_1 + I_O) \cdot R_2$$

$$5V/R_1 > 3I_O$$