National Semiconductor

LM320L/LM320ML Series 3-Terminal Negative Regulators

General Description

The LM320L/LM320ML 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, for the LM320L series, and 250 mA for the LM320ML series. These devices were designed using the latest computer techniques for optimizing the packaged IC thermal/electrical performance. The LM320L/LM320ML 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/LM320ML 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, and the LM320ML series is available in the 3-lead TO-202 package.

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

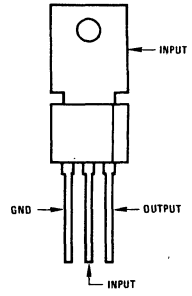
Features

- Preset output voltage error is less than ±5% over load, line and temperature
- LM320L is specified at an output current of 100 mA
- LM320ML is specified at an output current of 250 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
LM320ML	TO-202	7.5W	0.25A
LM320L	TO-92	0.6W	0.1A

Connection Diagrams

TO-202 Power Package (P)



FRONT VIEW

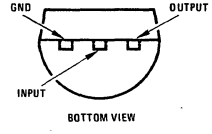
Order Numbers:

LM320MLP-5.0
LM320MLP-12
LM320MLP-15

See Package P03A

For Tab Bend TO-202 Order Numbers:
LM320MLP-5.0 TB
LM320MLP-12 TB
LM320MLP-15 TB
See Package P03E

TO-92 Plastic Package (Z)



BOTTOM VIEW

Order Numbers:

LM320LZ-5.0
LM320LZ-12
LM320LZ-15

See Package Z03A

Absolute Maximum Ratings

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
Molded TO-202	−65°C to +150°C
Lead	Temperature
(Soldering, 10 seconds)	300°C

Electrical Characteristics LM320ML

(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			
	PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_O	Output Voltage	T_j = 25°C, I_O = 250 mA	−5.2	−5	−4.8	−12.5	−12	−11.5	−15.6	−15	−14.4	
		1 mA ≤ I_O ≤ 250 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
ΔV_O	Line Regulation	T_j = 25°C, I_O = 250 mA (V_{MIN} ≤ V_{IN} ≤ V_{MAX})	(−25 ≤ V_{IN} ≤ −7.3)		50	(−30 ≤ V_{IN} ≤ −14.6)		40	(−30 ≤ V_{IN} ≤ 17.7)		40	mV V
ΔV_O	Load Regulation	T_j = 25°C 1 mA ≤ I_O ≤ 250 mA			50			120			150	mV
ΔV_O	Long Term Stability	I_O = 250 mA		20			48			60		mV/khr
I_Q	Quiescent Current	I_O = 250 mA		2	6		2	6		2	6	mA
ΔI_Q	Quiescent Current Change	1 mA ≤ I_O ≤ 250 mA			0.3		0.3		0.3			mA
		I_O = 250 mA (V_{MIN} ≤ V_{IN} ≤ V_{MAX})	(−20 ≤ V_{IN} ≤ −7.5)		0.25	(−27 ≤ V_{IN} ≤ −14.8)		0.25	(−30 ≤ V_{IN} ≤ −18)		0.25	V
V_n	Output Noise Voltage	T_j = 25°C, I_O = 250 mA f = 10 Hz-10 kHz		40			100			120		μV
$\frac{\Delta V_{IN}}{\Delta V_O}$	Ripple Rejection	T_j = 25°C, I_O = 250 mA f = 120 Hz	54			56			54			dB
	Input Voltage Required to Maintain Line Regulation	T_j = 25°C I_O = 250 mA			−7.3			−14.6			−17.7	V

Note 1: Thermal resistance of the TO-202 Package (P) without a heat sink is 12°C/W junction to case and 70°C/W case to ambient.

Note 2: To ensure constant junction temperature, low duty cycle pulse testing is used.

Note 3: Thermal resistance, junction to ambient, of the TO-92 (Z) Package is 180°C/W when mounted with 0.40 inch leads on a PC board, and 160°C/W when mounted with 0.25 inch leads on a PC board.

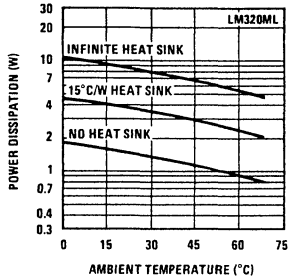
Electrical Characteristics LM320L (Note 4) $T_A = 0°C$ to $+70°C$ unless otherwise noted.

OUTPUT VOLTAGE			−5V			−12V			−15V			UNITS
INPUT VOLTAGE (unless otherwise noted)			−10V			−17V			−20V			
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	
		1mA ≤ I_O ≤ 100 mA $V_{MIN} \le V_{IN} \le V_{MAX}$	−5.25		−4.75 (−20 ≤ V_{IN} ≤ −7.5)	−12.6		−11.4 (−27 ≤ V_{IN} ≤ −14.8)	−15.75		−14.25 (−30 ≤ V_{IN} ≤ −18)	V
		1 mA ≤ I_O ≤ 40 mA $V_{MIN} \le V_{IN} \le V_{MAX}$	−5.25		−4.75 (−20 ≤ V_{IN} ≤ −7)	−12.6		−11.4 (−27 ≤ −14.5)	−15.75		−14.25 (−30 ≤ V_{IN} ≤ −17.5)	
ΔV_O	Line Regulation	$T_j = 25°C$, $I_O = 100$ mA $V_{MIN} \le V_{IN} \le V_{MAX}$			60 (−20 ≤ V_{IN} ≤ −7.3)			45 (−27 ≤ V_{IN} ≤ −14.6)			45 (−30 ≤ V_{IN} ≤ −17.7)	mV V
		$T_j = 25°C$, $I_O = 40$ mA $V_{MIN} \le V_{IN} \le V_{MAX}$			60 (−20 ≤ V_{IN} ≤ −7)			45 (−27 ≤ V_{IN} ≤ −14.5)			45 (−30 ≤ V_{IN} ≤ −17.5)	mV 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 $V_{MIN} \le V_{IN} \le V_{MAX}$			0.25 (−20 ≤ V_{IN} ≤ −7.5)			0.25 (−27 ≤ V_{IN} ≤ −14.8)			0.25 (−30 ≤ V_{IN} ≤ −18)	mA V
V_n	Output Noise Voltage	$T_j = 25°$, $I_O = 100$ 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	$T_j = 25°$ $I_O = 100$ mA $I_O = 40$ mA			−7.3 −7.0			−14.6 −14.5			−17.7 −17.5	V

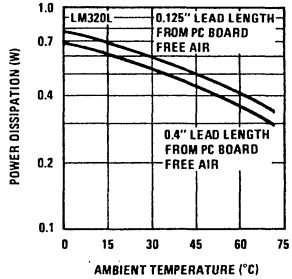
Note 4: To ensure constant junction temperature, low duty cycle pulse testing is used.

Typical Performance Characteristics

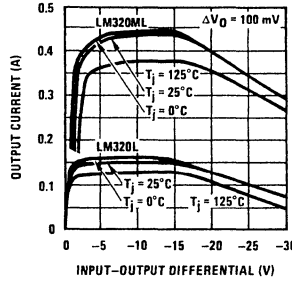
Maximum Average Power Dissipation (TO-202)



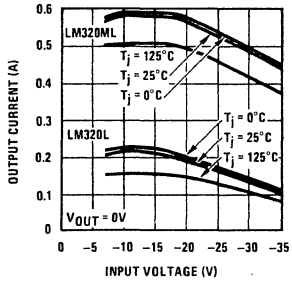
Maximum Average Power Dissipation (TO-92)



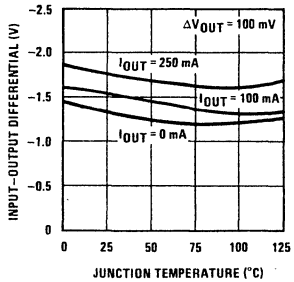
Peak Output Current



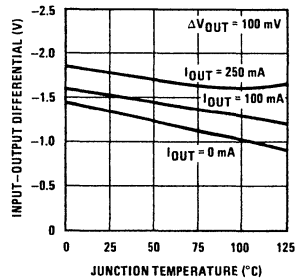
Short-Circuit Output Current



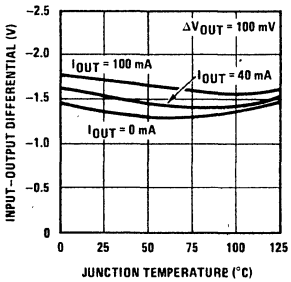
Dropout Voltage, LM320ML, –5V



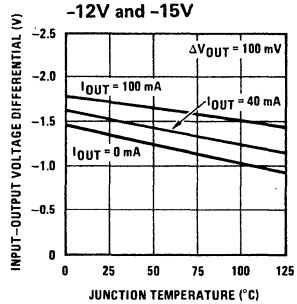
Dropout Voltage, LM320ML, –12V and –15V



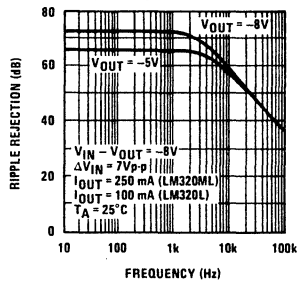
Dropout Voltage, LM320L –5V



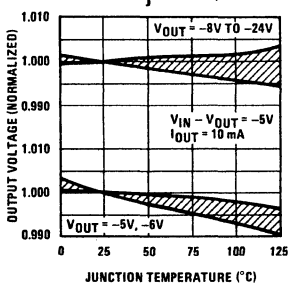
Dropout Voltage, LM320L -12V and -15V



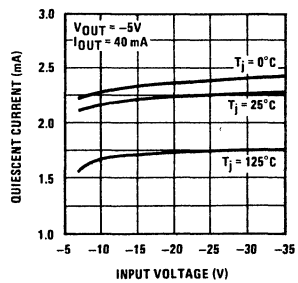
Ripple Rejection



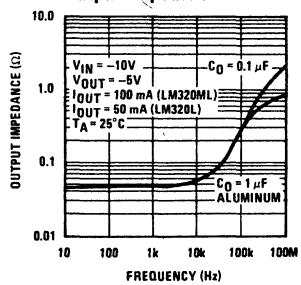
Output Voltage vs. Temperature (Normalized to 1V at $T_j = 25°C$)



Quiescent Current

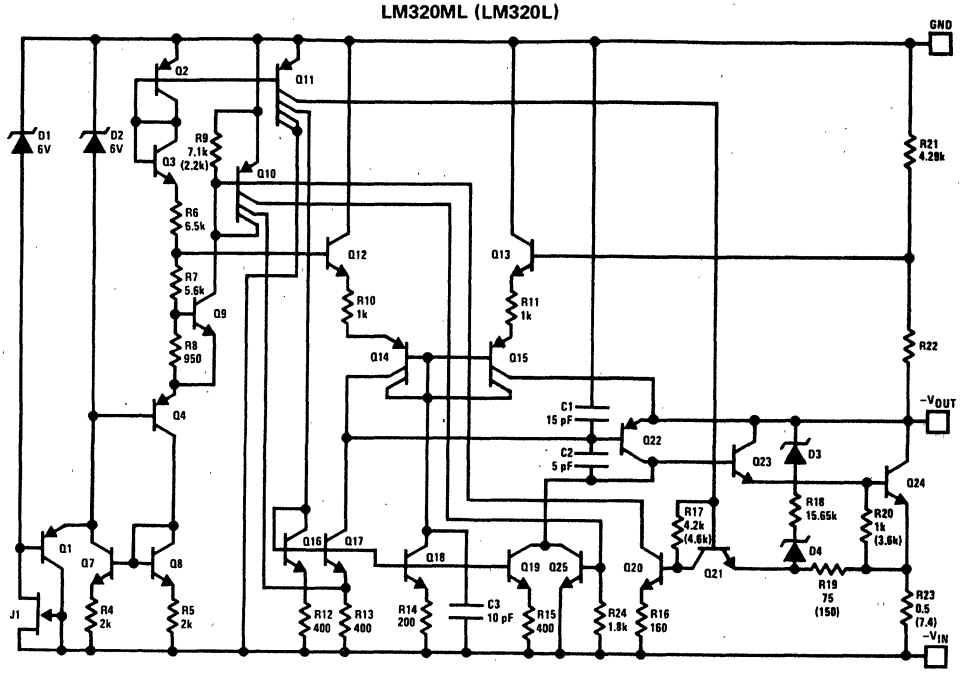


Output Impedance

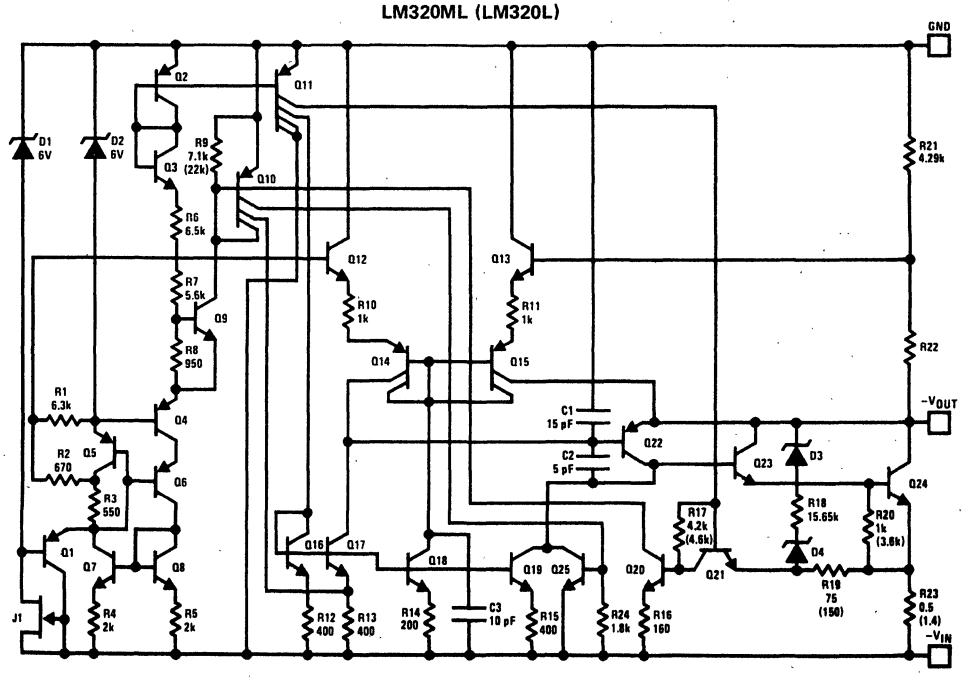


Schematic Diagrams

-5V
LM320ML (LM320L)

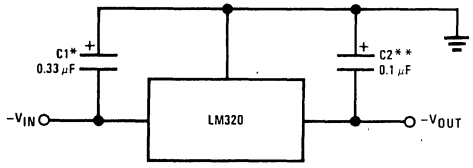


-12V and -15V
LM320ML (LM320L)



Typical Applications

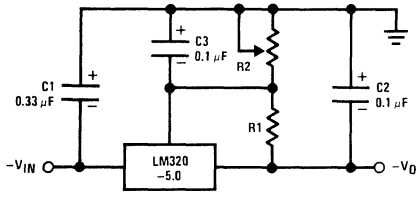
Fixed Output Regulator



*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.

Adjustable Output Regulator



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

±15V, 250 mA Dual Power Supply