National Semiconductor

# LM320L, LM79LXXAC Series 3-Terminal Negative Regulators

## General Description

The LM320L/LM79LXXAC 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 LM79LXXAC 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/LM79LXXAC 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 LM79LXXAC series is available in the 3-lead TO-92 package, and SO-8; 8 lead package. The LM320L series is available in the 3-lead TO-92 package.

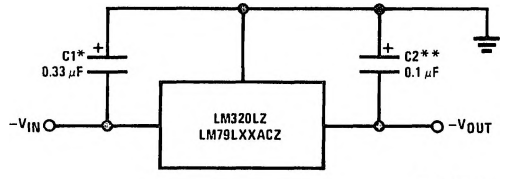
For output voltage other than −5V, −12V and −15V the LM137L series provides an output voltage range from 1.2V to 47V.

## Features

- Preset output voltage error is less than ±5% overload, line and temperature
- Specified at an output current of 100 mA
- Easily compensated with a small 0.1 μF output capacitor
- 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

## Typical Applications

**Fixed Output Regulator**

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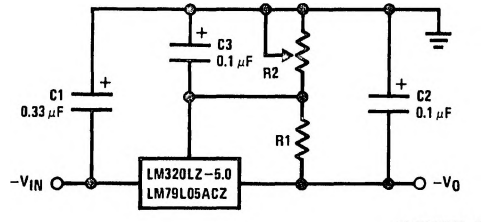
*Required if the regulator is located far from the power supply filter. A 1 μF aluminum electrolytic may be substituted.

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

**Adjustable Output Regulator**

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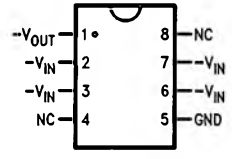
$-V_O = -5V - (5V/R1 + I_Q) \bullet R2$,
$5V/R1 > 3\,I_Q$

## Connection Diagrams

**SO-8 Plastic (Narrow Body)**

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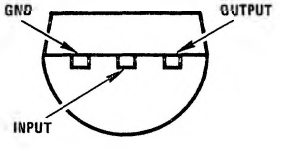
**Top View**

**Order Number LM79L05ACM, LM79L12ACM or LM79L15ACM**
**See NS Package Number M08A**

**TO-92 Plastic Package (Z)**

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**Bottom View**

**Order Number LM320LZ-5.0, LM79L05ACZ, LM320LZ-12, LM79L12ACZ, LM320LZ-15 or LM79L15ACZ**
**See NS Package Number Z03A**

## Absolute Maximum Ratings

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

Input Voltage
$V_O$ = −5V, −12V, −15V −35V
Internal Power Dissipation (Note 1) Internally Limited

Operating Temperature Range 0°C to +70°C
Maximum Junction Temperature +125°C
Storage Temperature Range −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.

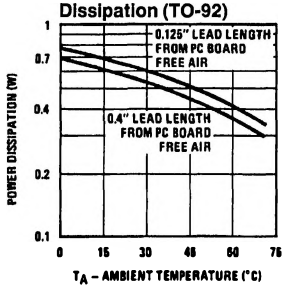
| Output Voltage | | | −5V | | | −12V | | | −15V | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Input Voltage (unless otherwise noted) | | | −10V | | | −17V | | | −20V | | | |
| Symbol | Parameter | Conditions | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| $V_O$ | Output Voltage | Tj = 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<br>$V_{MIN}$ ≤ $V_{IN}$ ≤ $V_{MAX}$ | −5.25<br>(−20 ≤ $V_{IN}$ ≤ −7.5) | | −4.75 | −12.6<br>(−27 ≤ $V_{IN}$ ≤ −14.8) | | −11.4 | −15.75<br>(−30 ≤ $V_{IN}$ ≤ −18) | | −14.25 | V |
| | | 1 mA ≤ $I_O$ ≤ 40 mA<br>$V_{MIN}$ ≤ $V_{IN}$ ≤ $V_{MAX}$ | −5.25<br>(−20 ≤ $V_{IN}$ ≤ −7) | | −4.75 | −12.6<br>(−27 ≤ $V_{IN}$ ≤ −14.5) | | −11.4 | −15.75<br>(−30 ≤ $V_{IN}$ ≤ −17.5) | | −14.25 | |
| $\Delta V_O$ | Line Regulation | Tj = 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 |
| | | Tj = 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 |
| $\Delta V_O$ | Load Regulation | Tj = 25°C<br>1 mA ≤ $I_O$ ≤ 100 mA | | | 50 | | | 100 | | | 125 | mV |
| $\Delta V_O$ | Long Term Stability | $I_O$ = 100 mA | | 20 | | | 48 | | | 60 | | mV/khrs |
| $I_Q$ | Quiescent Current | $I_O$ = 100 mA | | 2 | 6 | | 2 | 6 | | 2 | 6 | mA |
| $\Delta I_Q$ | 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 | Tj = 25°C, $I_O$ = 100 mA<br>f = 10 Hz − 10 kHz | | 40 | | | 96 | | | 120 | | μV |
| $\frac{\Delta V_{IN}}{\Delta V_O}$ | Ripple Rejection | Tj = 25°C, $I_O$ = 100 mA<br>f = 120 Hz | 50 | | | 52 | | | 50 | | | dB |
| | Input Voltage Required to Maintain Line Regulation | Tj = 25°C, $I_O$ = 100 mA | | | −7.3 | | | −14.6 | | | −17.7 | V |
| | | $I_O$ = 40 mA | | | −7.0 | | | −14.5 | | | −17.5 | V |

**Note 1:** Thermal resistance of Z package is 60°C/W $\theta_{jc}$, 232°C/W $\theta_{ja}$ at still air, and 88°C/W at 400 ft/min of air. The M package $\theta_{ja}$ is 180°C/W in still air. The maximum junction temperature shall not exceed 125°C on electrical parameters.

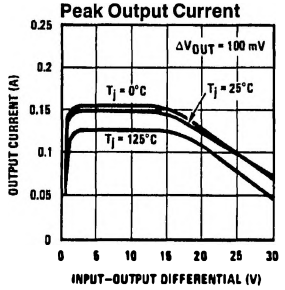
**Note 2:** To ensure constant junction temperature, low duty cycle pulse testing is used.

## Typical Performance Characteristics

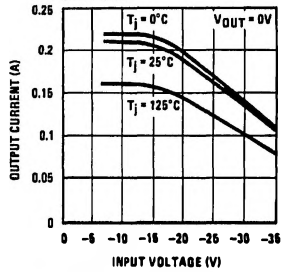
**Maximum Average Power Dissipation (TO-92)**



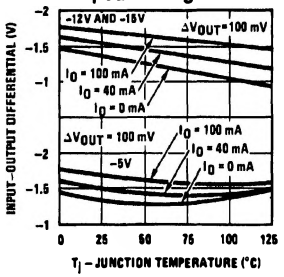

**Peak Output Current**



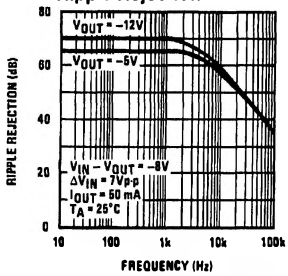

**Short Circuit Output Current**



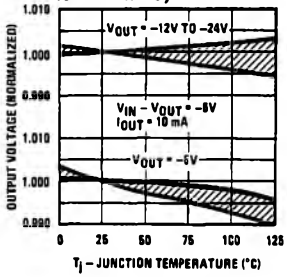

**Dropout Voltage**



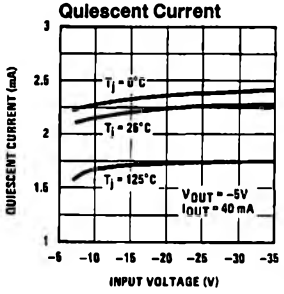

**Ripple Rejection**



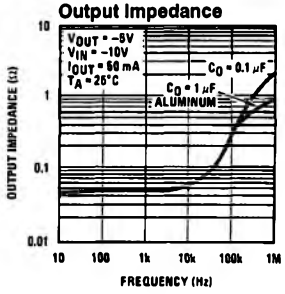

**Output Voltage vs. Temperature (Normalized to 1V @ 25°C)**




**Quiescent Current**




**Output Impedance**

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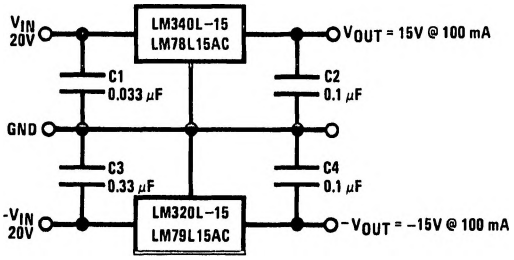
## Typical Applications (Continued)

**±15V, 100 mA Dual Power Supply**

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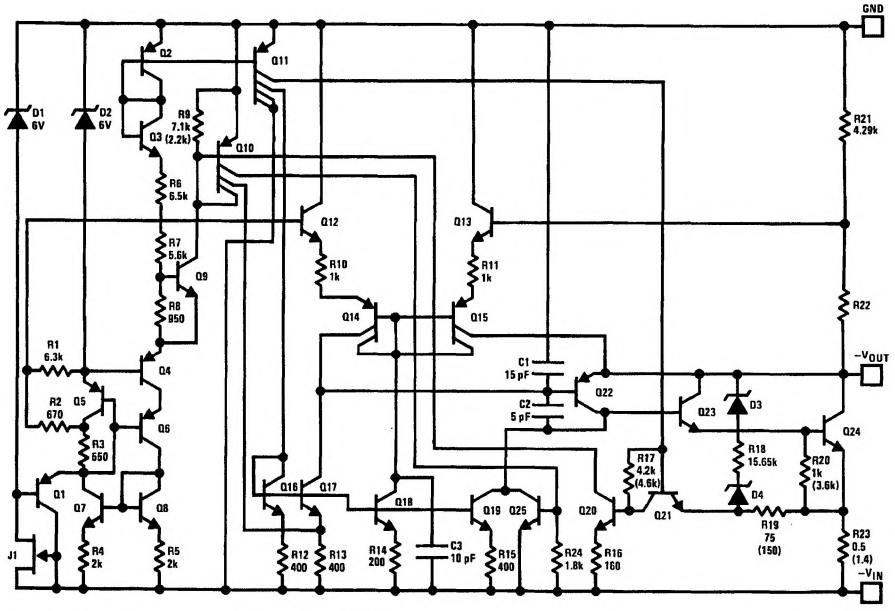
## Schematic Diagrams

−5V

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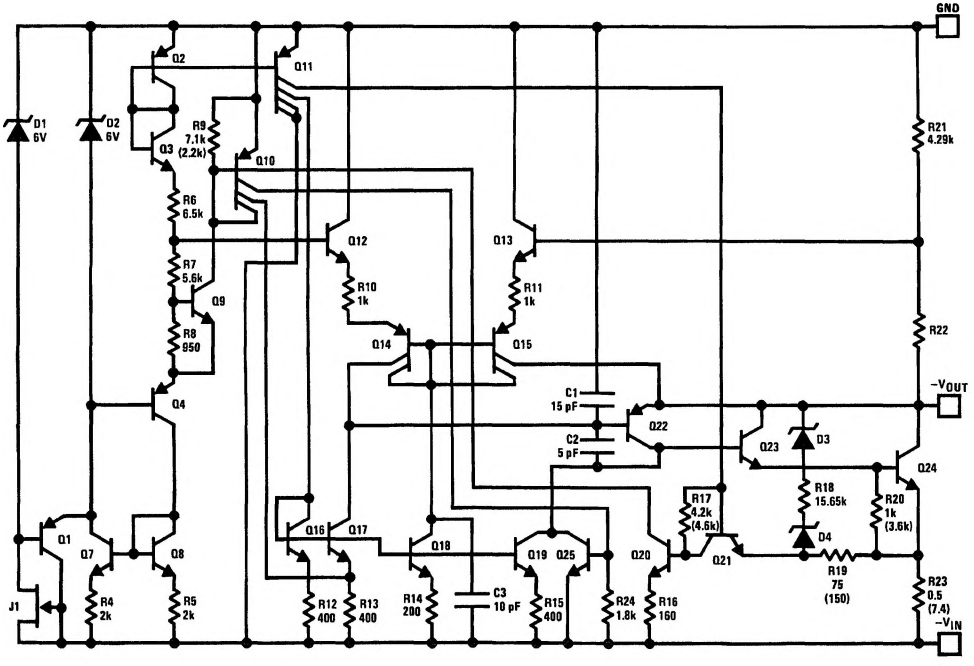
−12V and −15V

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