



NATL SEMICON (LINEAR)

T-58-11-13

## LM140L/LM340L Series 3-Terminal Positive Regulators

### General Description

The LM140L series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. The LM140LA is an improved version of the LM78LXX series with a tighter output voltage tolerance (specified over the full military temperature range), higher ripple rejection, better regulation and lower quiescent current. The LM140LA regulators have  $\pm 2\%$   $V_{OUT}$  specification,  $0.04\%/V$  line regulation, and  $0.01\%/mA$  load regulation. When used as a zener diode/resistor combination replacement, the LM140LA usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM140LA to be used in logic systems, instrumentation, Hi-Fi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

The LM140LA/LM340LA are available in the low profile metal three lead TO-39 (H) and the LM340LA are also available in the plastic TO-92 (Z). With adequate heat sinking the regulator can deliver 100 mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation. If internal power dissipation

becomes too high for the heat sinking provided, the thermal shut-down circuit takes over, preventing the IC from overheating.

For applications requiring other voltages, see LM117L Data Sheet.

### Features

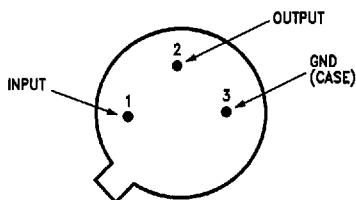
- Line regulation of  $0.04\%/V$
- Load regulation of  $0.01\%/mA$
- Output voltage tolerances of  $\pm 2\%$  at  $T_j = 25^\circ C$  and  $\pm 4\%$  over the temperature range (LM140LA)  $\pm 3\%$  over the temperature range (LM340LA)
- Output current of 100 mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limit
- Available in metal TO-39 low profile package (LM140LA/LM340LA) and plastic TO-92 (LM340LA)

### Output Voltage Options

|             |     |             |     |
|-------------|-----|-------------|-----|
| LM140LA-5.0 | 5V  | LM340LA-5.0 | 5V  |
| LM140LA-12  | 12V | LM340LA-12  | 12V |
| LM140LA-15  | 15V | LM340LA-15  | 15V |

### Connection Diagrams

TO-39 Metal Can Package (H)

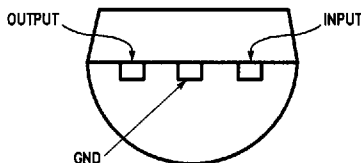


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Bottom View

Order Number LM140LAH-5.0, LM140LAH-5.0/883, LM140LAH-12, LM140LAH-12/883, LM140LAH-15, LM140LAH-15/883, LM340LAH-5.0, LM340LAH-12 or LM340LAH-15  
See NS Package Number H03A

TO-92 Plastic Package (Z)



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Bottom View

Order Number LM340LAZ-5.0, LM340LAZ-12 or LM340LAZ-15  
See NS Package Number Z03A

## NATL SEMICOND (LINEAR)

## Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 4)

Input Voltage 35V  
Internal Power Dissipation (Note 1) Internally Limited

Operating Temperature Range

LM140LA -55°C to +125°C  
LM340LA 0°C to +70°C

Maximum Junction Temperature +150°C

Storage Temperature Range

Metal Can (H package) -65°C to +150°C  
Molded TO-92 -55°C to +150°C

Lead Temperature (Soldering, 10 sec.)

Metal Can +300°C  
Plastic TO-92 +230°C

## Electrical Characteristics

Test conditions unless otherwise specified.  $T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$  (LM140LA),  $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$  (LM340LA),  $I_O = 40\text{ mA}$ ,  $C_{IN} = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.01\text{ }\mu\text{F}$ .

| Output Voltage Option                  |                                                    |                                                    |                                                                                            | 5.0V     |     |           | 12V       |     |           | 15V         |     |       | Units          |
|----------------------------------------|----------------------------------------------------|----------------------------------------------------|--------------------------------------------------------------------------------------------|----------|-----|-----------|-----------|-----|-----------|-------------|-----|-------|----------------|
| Input Voltage (unless otherwise noted) |                                                    |                                                    |                                                                                            | 10V      |     |           | 19V       |     |           | 23V         |     |       |                |
| Symbol                                 | Parameter                                          | Conditions                                         |                                                                                            | Min      | Typ | Max       | Min       | Typ | Max       | Min         | Typ | Max   |                |
| V <sub>O</sub>                         | Output Voltage                                     | T <sub>J</sub> = 25°C                              |                                                                                            | 4.9      | 5   | 5.1       | 11.75     | 12  | 12.25     | 14.7        | 15  | 15.3  | V              |
|                                        | Output Voltage Over Temp. (Note 3)                 | LM140LA                                            | I <sub>O</sub> = 1 – 100 mA                                                                | 4.8      |     | 5.2       | 11.5      |     | 12.5      | 14.4        |     | 15.6  |                |
|                                        |                                                    |                                                    |                                                                                            | (7.2–20) |     |           | (14.5–27) |     |           | (17.6–30)   |     |       |                |
|                                        |                                                    | LM340LA                                            | I <sub>O</sub> = 1 – 100 mA or<br>I <sub>O</sub> = 1 – 40 mA and<br>V <sub>IN</sub> = ( )V | 4.85     |     | 5.15      | 11.65     |     | 12.35     | 14.55       |     | 15.45 |                |
|                                        |                                                    |                                                    |                                                                                            | (7–20)   |     |           | (14.3–27) |     |           | (17.5–30)   |     |       |                |
| ΔV <sub>O</sub>                        | Line Regulation                                    | T <sub>J</sub> = 25°C                              | I <sub>O</sub> = 40 mA<br>V <sub>IN</sub> = ( )V                                           | 18 30    |     |           | 30 65     |     |           | 37 70       |     |       | mV             |
|                                        |                                                    |                                                    |                                                                                            | (7–25)   |     |           | (14.2–30) |     |           | (17.3–30)   |     |       |                |
|                                        |                                                    |                                                    | I <sub>O</sub> = 100 mA<br>V <sub>IN</sub> = ( )V                                          | 18 30    |     |           | 30 65     |     |           | 37 70       |     |       |                |
|                                        |                                                    |                                                    |                                                                                            | (7.5–25) |     |           | (14.5–30) |     |           | (17.5–30)   |     |       |                |
|                                        | Load Regulation                                    | T <sub>J</sub> = 25°C                              | I <sub>O</sub> = 1 – 40 mA<br>I <sub>O</sub> = 1 – 100 mA                                  | 5 20     |     |           | 10 40     |     |           | 12 50       |     |       |                |
|                                        |                                                    |                                                    |                                                                                            | 20 40    |     |           | 30 80     |     |           | 35 100      |     |       |                |
|                                        | Long Term Stability                                |                                                    |                                                                                            | 12       |     |           | 24        |     |           | 30          |     |       | mV<br>1000 hrs |
| I <sub>O</sub>                         | Quiescent Current                                  | T <sub>J</sub> = 25°C                              |                                                                                            | 3 4.5    |     |           | 3 4.5     |     |           | 3.1 4.5     |     |       | mA             |
|                                        |                                                    | T <sub>J</sub> = 125°C                             |                                                                                            | 4.2      |     |           | 4.2       |     |           | 4.2         |     |       |                |
| ΔI <sub>O</sub>                        | Quiescent Current Change                           | T <sub>J</sub> = 25°C                              | ΔLoad I <sub>O</sub> = 1 – 40 mA                                                           | 0.1      |     |           | 0.1       |     |           | 0.1         |     |       | mA             |
|                                        |                                                    |                                                    | ΔLine<br>V <sub>IN</sub> = ( )V                                                            | 0.5      |     |           | 0.5       |     |           | 0.5         |     |       |                |
|                                        |                                                    |                                                    | (7.5–25)                                                                                   |          |     | (14.3–30) |           |     | (17.5–30) |             |     |       |                |
| V <sub>N</sub>                         | Output Noise Voltage                               | T <sub>J</sub> = 25°C (Note 2)<br>f = 10 Hz–10 kHz |                                                                                            | 40       |     |           | 80        |     |           | 90          |     |       | μV             |
| $\frac{\Delta V_{IN}}{\Delta V_{OUT}}$ | Ripple Rejection                                   | f = 120 Hz, V <sub>IN</sub> = ( )V                 |                                                                                            | 55 62    |     |           | 47 54     |     |           | 45 52       |     |       | dB             |
|                                        |                                                    |                                                    |                                                                                            | (7.5–18) |     |           | (14.5–25) |     |           | (17.5–28.5) |     |       |                |
|                                        | Input Voltage Required to Maintain Line Regulation | T <sub>J</sub> = 25°C, I <sub>O</sub> = 40 mA      |                                                                                            | 7        |     |           | 14.2      |     |           | 17.3        |     |       | V              |

**Note 1:** Thermal resistance of H-package is typically  $26^\circ\text{C/W}$   $\theta_{JC}$ ,  $250^\circ\text{C/W}$   $\theta_{JA}$  still air, and  $94^\circ\text{C/W}$   $\theta_{JA}$  400 l/min of air. For the Z-package is  $60^\circ\text{C/W}$   $\theta_{JC}$ ,  $232^\circ\text{C/W}$   $\theta_{JA}$  still air, and  $88^\circ\text{C/W}$   $\theta_{JA}$  at 400 l/min of air. The maximum junction temperature shall not exceed  $125^\circ\text{C}$  on electrical parameters.

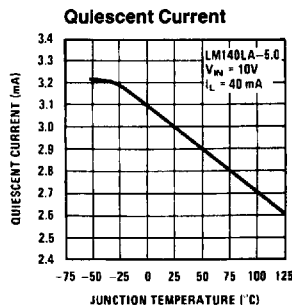
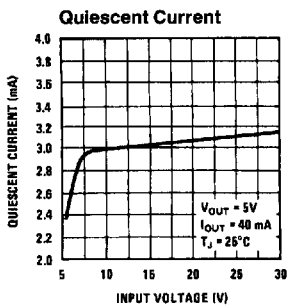
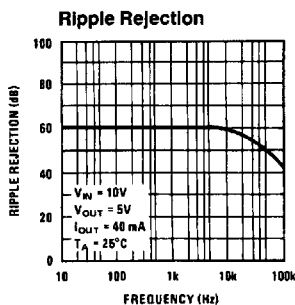
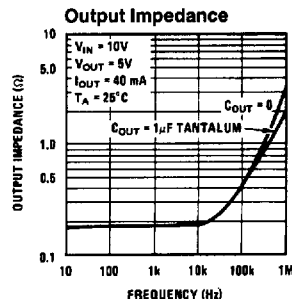
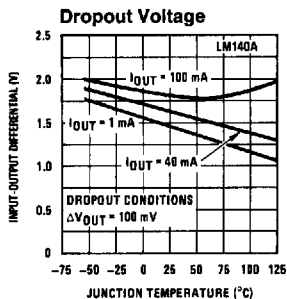
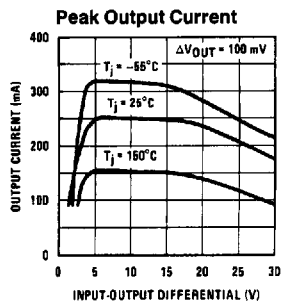
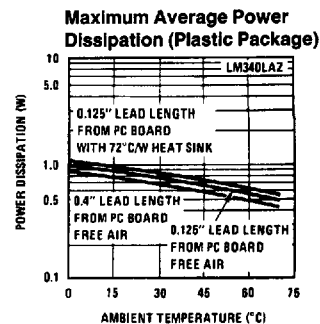
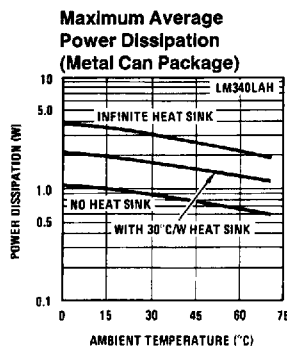
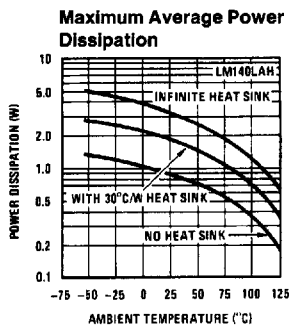
**Note 2:** It is recommended that a minimum load capacitor of  $0.01\text{ }\mu\text{F}$  be used to limit the high frequency noise bandwidth.

**Note 3:** The temperature coefficient of  $V_{OUT}$  is typically within  $0.01\%$   $V_O/^\circ\text{C}$ .

**Note 4:** A military RETS specification is available upon request. At the time of printing, the LM140LA-5.0, -12, and -15 RETS specifications complied with the Min and Max limits in this table. The LM140LAH-5.0, LM140LAH-12, and LM140LAH-15 may also be procured as Standard Military Drawings.

## Typical Performance Characteristics

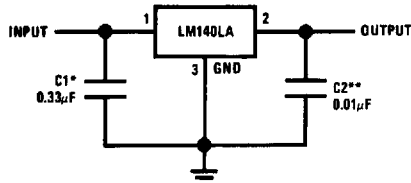
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TL/H/7782-4

## Typical Applications

## Fixed Output Regulator

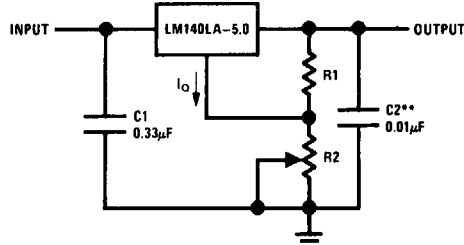


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\*Required if the regulator is located far from the power supply filter.

\*\*See note 3 in the electrical characteristics table.

## Adjustable Output Regulator



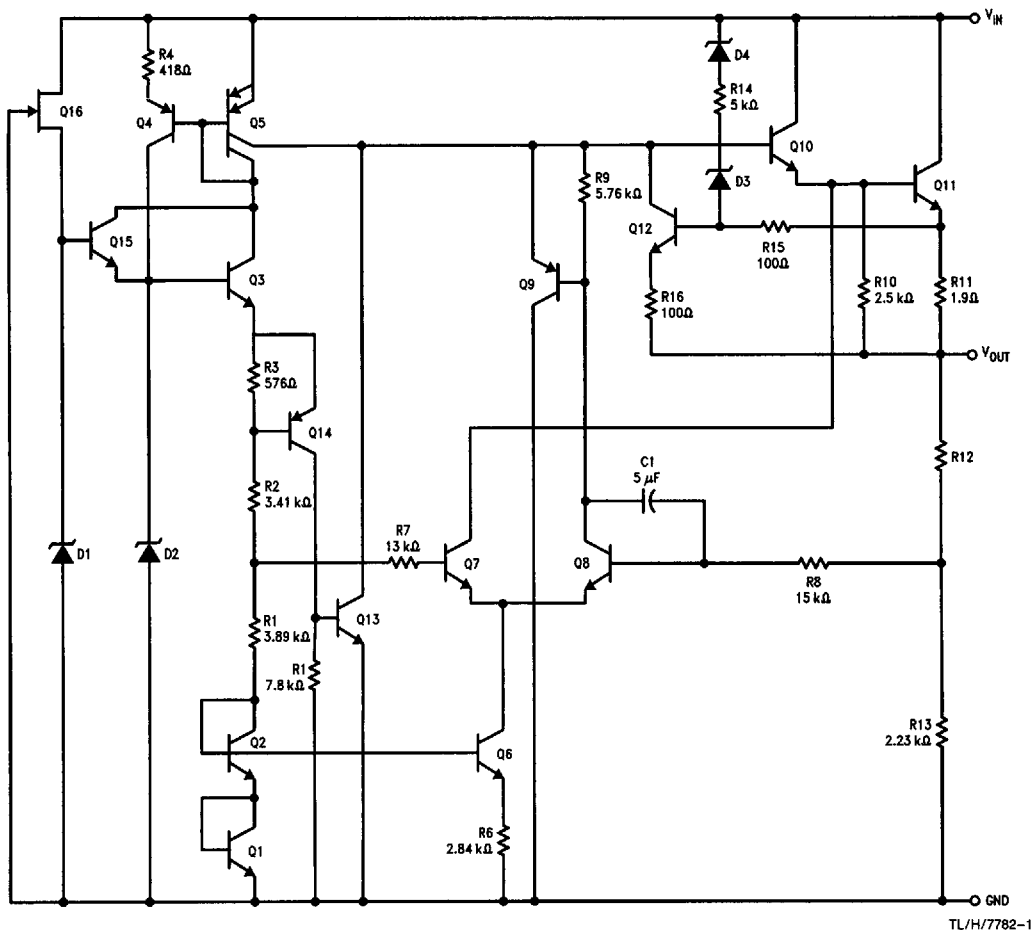
$$V_{OUT} = 5\text{ V} + (5\text{ V}/R1 + I_0) R2$$

$$5\text{ V}/R1 = 3 I_0 \text{ load regulation (L)} [(R1 + R2)/R1] (L, \text{ of LM140LA-5.0})$$

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## Equivalent Circuit

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TL/H/7782-1