National Semiconductor

Voltage Regulators

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 ±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 shutdown circuit takes over, preventing the IC from overheating.

For applications requiring other voltages, see LM117 Data Sheet.

Features

- Line regulation of 0.04%/V
- Load regulation of 0.01%/mA
- Output voltage tolerances of ±2% at $T_J = 25°C$ and ±4% over the temperature range (LM140LA) ±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)
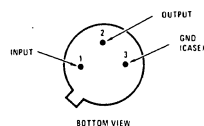
Output Voltage Options

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

Equivalent Circuit
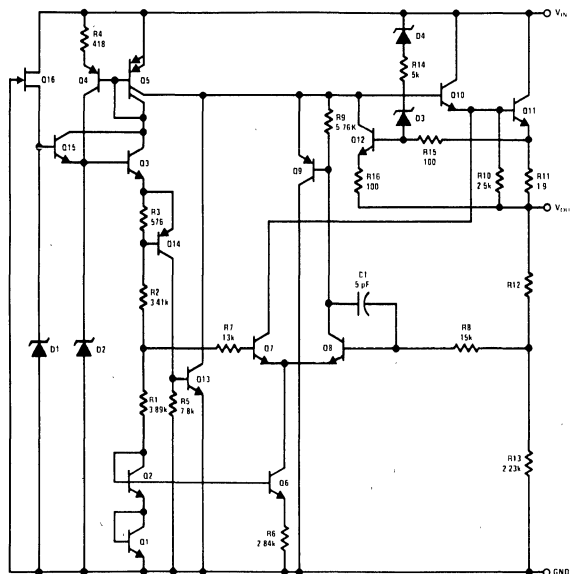
Connection Diagrams

TO-39 Metal Can Package (H)

OUTPUT
GND (CASE)
INPUT

BOTTOM VIEW

Order Number:

LM140LAH-5.0	LM340LAH-5.0
LM140LAH-12	LM340LAH-12
LM140LAH-15	LM340LAH-15

See Package H03A

TO-92 Plastic Package (Z)

OUTPUT   INPUT
GND

BOTTOM VIEW
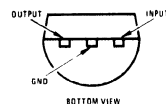
Order Number:
LM340LAZ-5.0
LM340LAZ-12
LM340LAZ-15
See Package Z03A

Absolute Maximum Ratings

Input Voltage
        5.0V, 12V, 15V Output Voltage Options   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° to +150°C
Lead Temperature (Soldering, 10 seconds)   +300°C

Electrical Characteristics (Note 2)

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

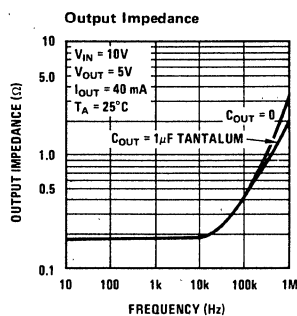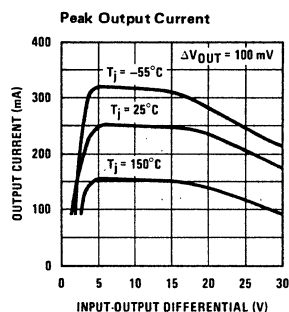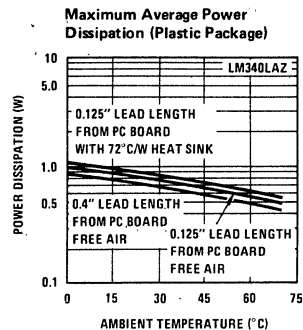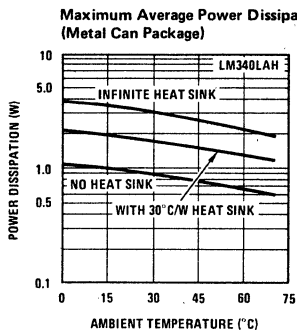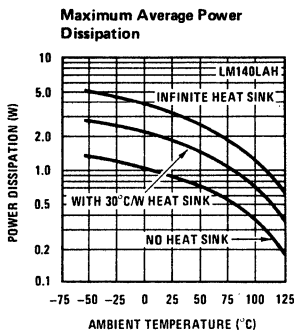| OUTPUT VOLTAGE OPTION			5.0V			12V			15V			
INPUT VOLTAGE (unless otherwise noted)			10V			19V			23V			UNITS
PARAMETER		CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_O	Output Voltage	$T_j = 25°C$	4.9	5	5.1	11.75	12	12.25	14.7	15	15.3	
	Output Voltage Over Temp. (Note 4)	LM140LA LM240LA $I_O = 1$-100 mA $I_O = 1$-40 mA and $V_{IN} = (\ )V$	4.8		5.2	11.5		12.5	14.4		15.6	V
			(7.2-20)			(14.5-27)			(17.6-30)			
		LM340LA $I_O = 1$-100 mA or $I_O = 1$-40 mA and $V_{IN} = (\ )V$	4.85		5.15	11.65		12.35	14.55		15.45	
			(7-20)			(14.3-27)			(17.5-30)			
ΔV_O	Line Regulation	$I_O = 40$ mA		18	30		30	65		37	70	
		$T_j = 25°C$ $V_{IN} = (\ )$ V	(7-25)			(14.2-30)			(17.3-30)			mV
		$I_O = 100$ mA		18	30		30	65		37	70	
		$V_{IN} = (\ )V$	(7.5-25)			(14.5-30)			(17.5-30)			
	Load Regulation	$T_j = 25°C$ $I_O = 1$-40 mA		5	20		10	40		12	50	
		$I_O = 1$-100 mA		20	40		30	80		35	100	
	Long Term Stability			12			24			30		mV 1000 hrs
I_O	Quiescent Current	$T_j = 25°C$		3	4.5		3	4.5		3.1	4.5	mA
		$T_j = 125°C$			4.2			4.2			4.2	
ΔI_Q	Quiescent Current Change	$T_j = 25°C$ ΔLoad $I_O = 1$-40mA			0.1			0.1			0.1	
		ΔLine			0.5			0.5			0.5	mA
		$V_{IN} = (\ )$ V	(7.5-25)			(14.3-30)			(17.5-30)			
V_N	Output Noise Voltage	$T_j = 25°C$ (Note 3) $f = 10$ Hz-10 kHz		40			80			90		μV
$\dfrac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	$f = 120$ Hz, $V_{IN} = (\ )$ 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	$T_j = 25°C$, $I_O = 40$ mA	7			14.2			17.3			V

Note 1: Thermal resistance of the Metal Can Package (H) without a heat sink is 40°C/W junction to case and 140°C/W junction to ambient. Thermal resistance of the TO-92 package is 180°C/W junction to ambient with 0.4 inch leads from PC board and 160°C/W junction to ambient with 0.125 inch lead length to a PC board.

Note 2: The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of tests.
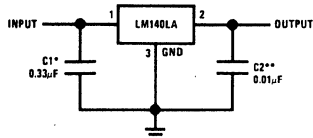
Note 3: It is recommended that a minimum load capacitor of 0.01μF be used to limit the high frequency noise bandwidth.

Note 4: The temperature coefficient of V_{OUT} is typically within 0.01%V_O/°C.

Typical Performance Characteristics

Maximum Average Power Dissipation

Maximum Average Power Dissipation (Metal Can Package)

Maximum Average Power Dissipation (Plastic Package)

Peak Output Current

Dropout Voltage

Output Impedance

Ripple Rejection

Quiescent Current

Quiescent Current
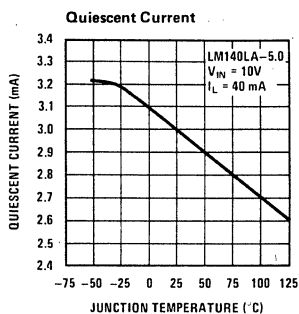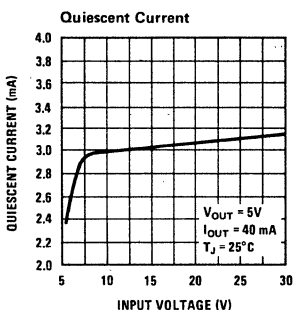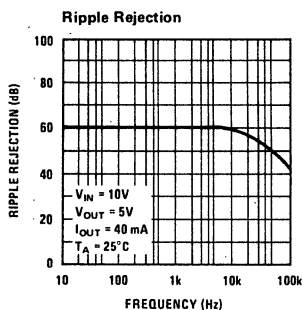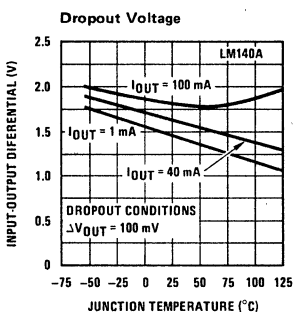
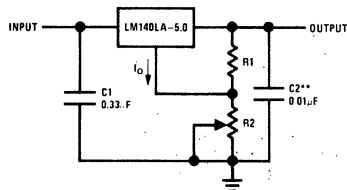# Typical Applications

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

**See note 3 in the electrical characteristics table.

Fixed Output Regulator

$V_{OUT} = 5V + (5V/R1 + I_O) R2$

5V/R1 · 3 I_O load regulation (L,) · [(R1 + R2)/R1] (L, of LM140LA-5 0)

Adjustable Output Regulator