LM340, LM340A and LM7805 Family Wide V_{IN} 1.5-A Fixed Voltage Regulators

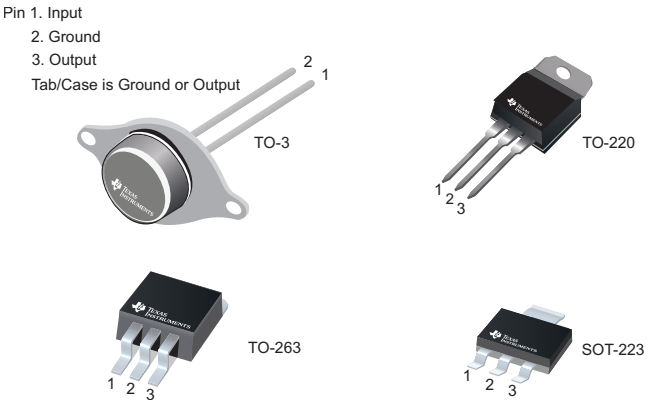
1 Features

- Output Current up to 1.5 A
- Available in Fixed 5-V, 12-V, and 15-V Options
- Output Voltage Tolerances of ±2% at T_J = 25°C (LM340A)
- Line Regulation of 0.01% / V of at 1-A Load (LM340A)
- Load Regulation of 0.3% / A (LM340A)
- Internal Thermal Overload, Short-Circuit and SOA Protection
- Available in Space-Saving SOT-223 Package
- Output Capacitance Not Required for Stability

2 Applications

- Industrial Power Supplies
- SMPS Post Regulation
- HVAC Systems
- AC Inventors
- Test and Measurement Equipment
- Brushed and Brushless DC Motor Drivers
- Solar Energy String Invertors

Available Packages



3 Description

The LM340 and LM7805 Family monolithic 3-terminal positive voltage regulators employ internal current-limiting, thermal shutdown and safe-area compensation, making them essentially indestructible. If adequate heat sinking is provided, they can deliver over 1.5-A output current. They are intended as fixed voltage regulators in a wide range of applications including local (on-card) regulation for elimination of noise and distribution problems associated with single-point regulation. In addition to use as fixed voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents.

Considerable effort was expended to make the entire series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply.

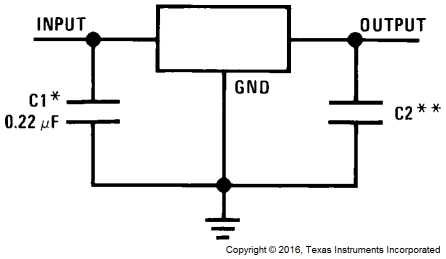
LM7805 is also available in a higher accuracy and better performance version (LM340A). Refer to LM340A specifications in the *LM340A Electrical Characterisitcs* table.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM340x LM7805 Family	DDPAK/TO-263 (3)	10.18 mm × 8.41 mm
	SOT-223 (4)	6.50 mm × 3.50 mm
	TO-220 (3)	14.986 mm × 10.16 mm
	TO-3 (2)	38.94 mm x 25.40 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Fixed Output Voltage Regulator



*Required if the regulator is located far from the power supply filter.
**Although no output capacitor is needed for stability, it does help transient response. (If needed, use 0.1-μF, ceramic disc).

Table of Contents

4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision K (November 2015) to Revision L — **Page**

- Changed pinout number order for the TO-220 and SOT-223 packages from: 2, 3, 1 to: 1, 2, 3 ... 1

Changes from Revision J (December 2013) to Revision K — **Page**

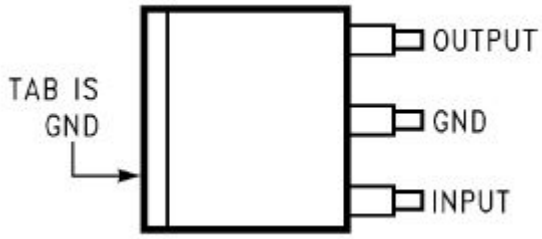
- Added *ESD Ratings* table, *Thermal Information* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1
- Deleted obsolete LM140 and LM7808C devices from the data sheet ... 1
- Changed Figure 13 caption from *Line Regulation 140AK-5.0* to *Line Regulation LM340,* ... 11
- Changed Figure 14 caption from *Line Regulation 140AK-5.0* to *Line Regulation LM340,* ... 11

Changes from Revision I (March 2013) to Revision J — **Page**

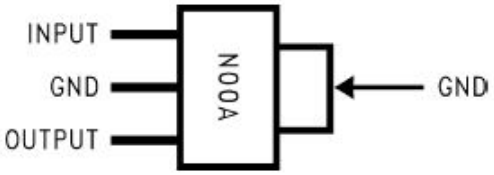
- Changed 0.5 from typ to max ... 5

5 Pin Configuration and Functions

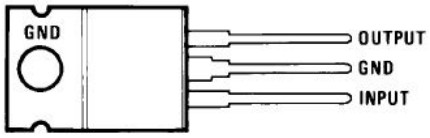
LM7805 and LM7812 KTT Package
3-Pin DDPAK/TO-263
Top View



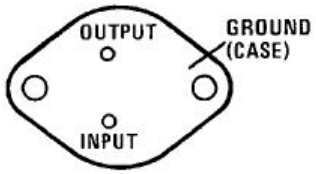
LM7805 DCY Package
4-Pin SOT-223
Side View



LM7805, LM7812, and LM7815 NDE Package
3-Pin TO-220
Top View



LM340K-5.0 NDS Package
2-Pin TO-3
Top View



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
INPUT	1	I	Input voltage pin
GND	2	I/O	Ground pin
OUTPUT	3	O	Output voltage pin

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)(2)

		MIN	MAX	UNIT
DC input voltage			35	V
Internal power dissipation(3)		Internally Limited		
Maximum junction temperature			150	°C
Lead temperature (soldering, 10 sec.)	TO-3 package (NDS)		300	°C
	Lead temperature 1,6 mm (1/16 in) from case for 10 s		230	°C
Storage temperature		−65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3) The maximum allowable power dissipation at any ambient temperature is a function of the maximum junction temperature for operation (T_{JMAX} = 125°C or 150°C), the junction-to-ambient thermal resistance (θ_{JA}), and the ambient temperature (T_A). $P_{DMAX} = (T_{JMAX} - T_A)/\theta_{JA}$. If this dissipation is exceeded, the die temperature rises above T_{JMAX} and the electrical specifications do not apply. If the die temperature rises above 150°C, the device goes into thermal shutdown. For the TO-3 package (NDS), the junction-to-ambient thermal resistance (θ_{JA}) is 39°C/W. When using a heat sink, θ_{JA} is the sum of the 4°C/W junction-to-case thermal resistance (θ_{JC}) of the TO-3 package and the case-to-ambient thermal resistance of the heat sink. For the TO-220 package (NDE), θ_{JA} is 54°C/W and θ_{JC} is 4°C/W. If SOT-223 is used, the junction-to-ambient thermal resistance is 174°C/W and can be reduced by a heat sink (see Applications Hints on heat sinking).If the DDPAK\TO-263 package is used, the thermal resistance can be reduced by increasing the PCB copper area thermally connected to the package: Using 0.5 square inches of copper area, θ_{JA} is 50°C/W; with 1 square inch of copper area, θ_{JA} is 37°C/W; and with 1.6 or more inches of copper area, θ_{JA} is 32°C/W.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM)(1)	±2000	V

(1) ESD rating is based on the human-body model, 100 pF discharged through 1.5 kΩ.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
Temperature (T_A)	LM340A, LM340	0	125	°C

6.4 Thermal Information

THERMAL METRIC(1)		LM340, LM7805 Family				UNIT
		NDE (TO-220)	KTT (DDPAK/TO-263)	DCY (SOT-223)	NDS (TO-3)	
		3 PINS	3 PINS	4 PINS	2 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	23.9	44.8	62.1	39	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	16.7	45.6	44	2	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	5.3	24.4	10.7	—	°C/W
ψ_{JT}	Junction-to-top characterization parameter	3.2	11.2	2.7	—	°C/W
ψ_{JB}	Junction-to-board characterization parameter	5.3	23.4	10.6	—	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	1.7	1.5	—	—	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report.

6.5 LM340A Electrical Characteristics, V_O = 5 V, V_I = 10 V

I_{OUT} = 1 A, 0°C ≤ T_J ≤ 125°C (LM340A) unless otherwise specified(1)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O	Output voltage	T_J = 25°C		4.9	5	5.1	V
		P_D ≤ 15 W, 5 mA ≤ I_O ≤ 1 A 7.5 V ≤ V_{IN} ≤ 20 V		4.8		5.2	V
ΔV_O	Line regulation	7.5 V ≤ V_{IN} ≤ 20 V	T_J = 25°C		3	10	mV
			Over temperature, I_O = 500 mA			10	mV
		8 V ≤ V_{IN} ≤ 12 V	T_J = 25°C			4	mV
			Over temperature			12	mV
ΔV_O	Load regulation	T_J = 25°C	5 mA ≤ I_O ≤ 1.5 A		10	25	mV
			250 mA ≤ I_O ≤ 750 mA			15	mV
		Over temperature, 5 mA ≤ I_O ≤ 1 A				25	mV
I_Q	Quiescent current	T_J = 25°C				6	mA
		Over temperature				6.5	mA
ΔI_Q	Quiescent current change	T_J = 25°C, I_O = 1 A 7.5 V ≤ V_{IN} ≤ 20 V				0.8	mA
		Over temperature, 5 mA ≤ I_O ≤ 1 A				0.5	mA
		Over temperature, I_O = 500 mA 8 V ≤ V_{IN} ≤ 25 V				0.8	mA
V_N	Output noise voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 kHz			40		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple rejection	f = 120 Hz 8 V ≤ V_{IN} ≤ 18 V	T_J = 25°C, , I_O = 1 A	68	80		dB
			Over temperature, I_O = 500 mA	68			dB
R_O	Dropout voltage	T_J = 25°C, I_O = 1 A			2		V
	Output resistance	f = 1 kHz			8		mΩ
	Short-circuit current	T_J = 25°C			2.1		A
	Peak output current	T_J = 25°C			2.4		A
	Average TC of V_O	Min, T_J = 0°C, I_O = 5 mA			−0.6		mV/°C
V_{IN}	Input voltage required to maintain line regulation	T_J = 25°C		7.5			V

(1) All characteristics are measured with a 0.22-μF capacitor from input to ground and a 0.1-μF capacitor from output to ground. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques (t_w ≤ 10 ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.