

LM340-MIL 広 V_{IN} 、1.5A固定電圧レギュレータ

1 特長

- 最大1.5Aの出力電流
- 5V、12V、15Vの固定オプションで利用可能
- 内部的な熱過負荷、短絡、SOA保護
- 省スペースのSOT-223パッケージで供給
- 安定のために出力容量が不要

2 アプリケーション

- 産業用電源
- SMPSポスト・レギュレーション
- HVACシステム
- ACインバータ
- テストおよび計測機器
- ブラシ付きおよびブラシレスDCモータ・ドライバ
- ソーラー・エネルギー・ストリング・インバータ

3 概要

LM340-MILモノリシック3ピン、正電圧レギュレータは、内部的な電流制限、サーマル・シャットダウン、安全領域補償を採用し、非常に堅牢です。十分なヒートシンクを取り付けられれば、1.5Aを超える出力電流を供給できます。単一ポイント・レギュレーションに伴うノイズと分配の問題を除去するためのローカル(オンカード)レギュレーションなど、広範なアプリケーションにおける固定電圧レギュレータ用に設計されています。固定電圧レギュレータとしての使用に加えて、これらのデバイスを外付け部品とともに使用し、可変の出力電圧および電流を得ることもできます。

さまざまな設計上の工夫により、使いやすく、外付け部品が最小限で済むレギュレータとなっています。出力をバイパスする必要はありませんが、バイパスすれば過渡応答が向上します。入力バイパスは、レギュレータの位置が電源のフィルタ・コンデンサから遠く離れている場合のみ必要です。

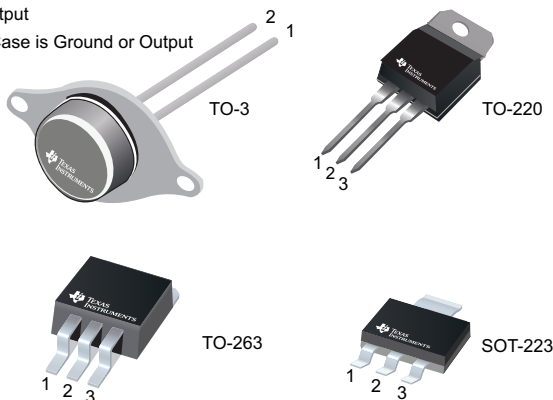
製品情報⁽¹⁾

型番	パッケージ	本体サイズ(公称)
LM340-MIL	TO-3 (2)	38.94mm×25.40mm
	TO-220 (3)	14.986mm×10.16mm
	DDPAK/TO-263 (3)	10.18mm×8.41mm
	SOT-23 (4)	6.50mm×3.50mm

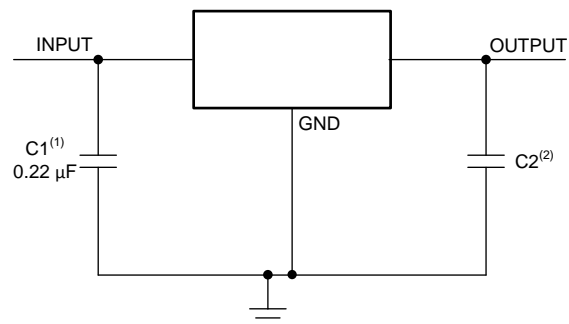
(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。

利用可能なパッケージ

Pin 1. Input
2. Ground
3. Output
Tab/Case is Ground or Output



固定出力電圧レギュレータ



- (1) レギュレータが電源フィルタから遠く離れた位置にある場合に必要です。
- (2) 安定性のためには出力コンデンサは必要ありませんが、過渡応答の向上に役立ちます(必要なら、0.1 μ Fのセラミック・ディスクを使用します)。

目次

1	特長	1	7.4	Device Functional Modes	11
2	アプリケーション	1	8	Application and Implementation	12
3	概要	1	8.1	Application Information	12
4	改訂履歴	2	8.2	Typical Application	13
5	Pin Configuration and Functions	3	8.3	System Examples	14
6	Specifications	4	9	Power Supply Recommendations	16
6.1	Absolute Maximum Ratings	4	10	Layout	16
6.2	ESD Ratings	4	10.1	Layout Guidelines	16
6.3	Recommended Operating Conditions	4	10.2	Layout Example	16
6.4	Thermal Information	4	10.3	Heat Sinking DDPACK/TO-263 and SOT-223 Package Parts	17
6.5	Electrical Characteristics: $V_O = 5\text{ V}$, $V_I = 10\text{ V}$	5	11	デバイスおよびドキュメントのサポート	18
6.6	Electrical Characteristics: $V_O = 12\text{ V}$, $V_I = 19\text{ V}$	6	11.1	ドキュメントのサポート	18
6.7	Electrical Characteristics: $V_O = 15\text{ V}$, $V_I = 23\text{ V}$	7	11.2	ドキュメントの更新通知を受け取る方法	18
6.8	Typical Characteristics	8	11.3	コミュニティ・リソース	18
7	Detailed Description	11	11.4	商標	18
7.1	Overview	11	11.5	静電気放電に関する注意事項	18
7.2	Functional Block Diagram	11	11.6	Glossary	18
7.3	Feature Description	11	12	メカニカル、パッケージ、および注文情報	18

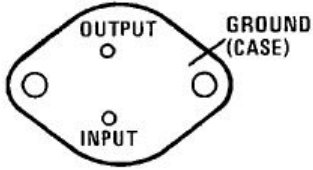
4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

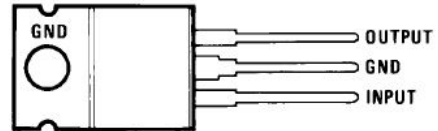
日付	改訂内容	注
2017年6月	*	初版

5 Pin Configuration and Functions

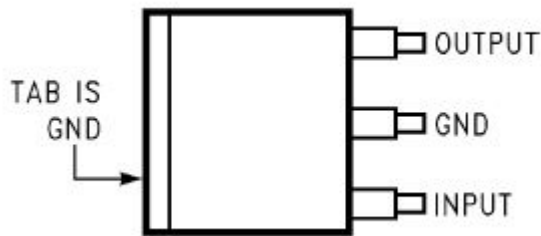
NDS Package
2-Pin TO-3
Top View



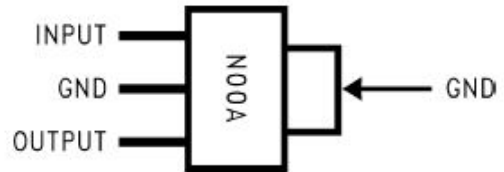
NDE Package
3-Pin TO-220
Top View



KTT Package
3-Pin DDPAK/TO-263
Top View



DCY Package
4-Pin SOT-223
Side 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
Storage temperature, T _{stg}	-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)/θ_{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)	0	125	°C

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾	LM340-MIL				UNIT
	NDE (TO-220)	KTT (DDPAK/TO-263)	DCY (SOT-223)	NDS (TO-3)	
	3 PINS	3 PINS	4 PINS	2 PINS	
R _{θJA} Junction-to-ambient thermal resistance	23.9	44.8	62.1	39	°C/W
R _{θJC(top)} Junction-to-case (top) thermal resistance	16.7	45.6	44	2	°C/W
R _{θJB} 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 _{θJC(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 Electrical Characteristics: $V_O = 5\text{ V}$, $V_I = 10\text{ V}$

 $0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ unless otherwise specified⁽¹⁾

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	
V_O	Output voltage	$T_J = 25^\circ\text{C}$, $5\text{ mA} \leq I_O \leq 1\text{ A}$	4.8	5	5.2	V	
		$P_D \leq 15\text{ W}$, $5\text{ mA} \leq I_O \leq 1\text{ A}$ $7.5\text{ V} \leq V_{IN} \leq 20\text{ V}$	4.75		5.25	V	
ΔV_O	Line regulation	$I_O = 500\text{ mA}$	$T_J = 25^\circ\text{C}$ $7\text{ V} \leq V_{IN} \leq 25\text{ V}$	3	50	mV	
			Over temperature $8\text{ V} \leq V_{IN} \leq 20\text{ V}$		50	mV	
		$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$ $7.5\text{ V} \leq V_{IN} \leq 20\text{ V}$		50	mV	
			Over temperature $8\text{ V} \leq V_{IN} \leq 12\text{ V}$		25	mV	
ΔV_O	Load regulation	$T_J = 25^\circ\text{C}$	$5\text{ mA} \leq I_O \leq 1.5\text{ A}$	10	50	mV	
			$250\text{ mA} \leq I_O \leq 750\text{ mA}$		25	mV	
		Over temperature, $5\text{ mA} \leq I_O \leq 1\text{ A}$		50	mV		
I_Q	Quiescent current	$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$		8	mA	
			Over temperature		8.5	mA	
ΔI_Q	Quiescent current change	$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$, $5\text{ mA} \leq I_O \leq 1\text{ A}$		0.5		mA	
			$7\text{ V} \leq V_{IN} \leq 20\text{ V}$	$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$		1	mA
				Over temperature, $I_O \leq 500\text{ mA}$		1	mA
V_N	Output noise voltage	$T_A = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		40		μV	
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple rejection	$f = 120\text{ Hz}$ $8\text{ V} \leq V_{IN} \leq 18\text{ V}$	$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$	62	80	dB	
			Over temperature, $I_O \leq 500\text{ mA}$	62		dB	
R_O	Dropout voltage	$T_J = 25^\circ\text{C}$, $I_O = 1\text{ A}$		2		V	
	Output resistance	$f = 1\text{ kHz}$		8		$\text{m}\Omega$	
	Short-circuit current	$T_J = 25^\circ\text{C}$		2.1		A	
	Peak output current	$T_J = 25^\circ\text{C}$		2.4		A	
	Average TC of V_{OUT}	Over temperature, $I_O = 5\text{ mA}$		-0.6		$\text{mV}/^\circ\text{C}$	
V_{IN}	Input voltage required to maintain line regulation	$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$	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 ($t_w \leq 10\text{ ms}$, duty cycle $\leq 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.

6.6 Electrical Characteristics: $V_O = 12\text{ V}$, $V_I = 19\text{ V}$

 $0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ unless otherwise specified⁽¹⁾

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_O	Output voltage	$T_J = 25^\circ\text{C}$, $5\text{ mA} \leq I_O \leq 1\text{ A}$	11.5	12	12.5	V
		$P_D \leq 15\text{ W}$, $5\text{ mA} \leq I_O \leq 1\text{ A}$ $14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$	11.4		12.6	V
ΔV_O	Line regulation	$I_O = 500\text{ mA}$	$T_J = 25^\circ\text{C}$ $14.5\text{ V} \leq V_{IN} \leq 30\text{ V}$	4	120	mV
			Over temperature $15\text{ V} \leq V_{IN} \leq 27\text{ V}$		120	mV
		$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$ $14.6\text{ V} \leq V_{IN} \leq 27\text{ V}$		120	mV
			Over temperature $16\text{ V} \leq V_{IN} \leq 22\text{ V}$		60	mV
ΔV_O	Load regulation	$T_J = 25^\circ\text{C}$	$5\text{ mA} \leq I_O \leq 1.5\text{ A}$	12	120	mV
			$250\text{ mA} \leq I_O \leq 750\text{ mA}$		60	mV
		Over temperature, $5\text{ mA} \leq I_O \leq 1\text{ A}$		120	mV	
I_Q	Quiescent current	$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$		8	mA
			Over temperature		8.5	mA
ΔI_Q	Quiescent current change	$5\text{ mA} \leq I_O \leq 1\text{ A}$		0.5		mA
		$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$ $14.8\text{ V} \leq V_{IN} \leq 27\text{ V}$			1	mA
		Over temperature, $I_O \leq 500\text{ mA}$ $14.5\text{ V} \leq V_{IN} \leq 30\text{ V}$			1	mA
V_N	Output noise voltage	$T_A = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		75		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple rejection	$f = 120\text{ Hz}$	$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$	55	72	dB
		$15\text{ V} \leq V_{IN} \leq 25\text{ V}$	Over temperature, $I_O \leq 500\text{ mA}$,	55		dB
R_O	Dropout voltage	$T_J = 25^\circ\text{C}$, $I_O = 1\text{ A}$		2		V
	Output resistance	$f = 1\text{ kHz}$		18		$\text{m}\Omega$
	Short-circuit current	$T_J = 25^\circ\text{C}$		1.5		A
	Peak output current	$T_J = 25^\circ\text{C}$		2.4		A
	Average TC of V_{OUT}	Over temperature, $I_O = 5\text{ mA}$		-1.5		$\text{mV}/^\circ\text{C}$
V_{IN}	Input voltage required to maintain line regulation	$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$	14.6			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 ($t_w \leq 10\text{ ms}$, duty cycle $\leq 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.

6.7 Electrical Characteristics: $V_O = 15\text{ V}$, $V_I = 23\text{ V}$

 $0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ unless otherwise specified⁽¹⁾

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_O	Output voltage	$T_J = 25^\circ\text{C}$, $5\text{ mA} \leq I_O \leq 1\text{ A}$	14.4	15	15.6	V
		$P_D \leq 15\text{ W}$, $5\text{ mA} \leq I_O \leq 1\text{ A}$ $17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$	14.25		15.75	V
ΔV_O	Line regulation	$I_O = 500\text{ mA}$	$T_J = 25^\circ\text{C}$ $17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$	4	150	mV
			Over temperature $18.5\text{ V} \leq V_{IN} \leq 30\text{ V}$		150	mV
		$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$ $17.7\text{ V} \leq V_{IN} \leq 30\text{ V}$		150	mV
			Over temperature $20\text{ V} \leq V_{IN} \leq 26\text{ V}$		75	mV
ΔV_O	Load regulation	$T_J = 25^\circ\text{C}$	$5\text{ mA} \leq I_O \leq 1.5\text{ A}$	12	150	mV
			$250\text{ mA} \leq I_O \leq 750\text{ mA}$		75	mV
		Over temperature, $5\text{ mA} \leq I_O \leq 1\text{ A}$,		150	mV	
I_Q	Quiescent current	$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$		8	mA
			Over temperature		8.5	mA
ΔI_Q	Quiescent current change	$5\text{ mA} \leq I_O \leq 1\text{ A}$		0.5		mA
		$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$ $17.9\text{ V} \leq V_{IN} \leq 30\text{ V}$			1	mA
		Over temperature, $I_O \leq 500\text{ mA}$ $17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$			1	mA
V_N	Output noise voltage	$T_A = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		90		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple rejection	$f = 120\text{ Hz}$	$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$	54	70	dB
		$18.5\text{ V} \leq V_{IN} \leq 28.5\text{ V}$	Over temperature, $I_O \leq 500\text{ mA}$,	54		dB
R_O	Dropout voltage	$T_J = 25^\circ\text{C}$, $I_O = 1\text{ A}$		2		V
	Output resistance	$f = 1\text{ kHz}$		19		$\text{m}\Omega$
	Short-circuit current	$T_J = 25^\circ\text{C}$		1.2		A
	Peak output current	$T_J = 25^\circ\text{C}$		2.4		A
	Average TC of V_{OUT}	Over temperature, $I_O = 5\text{ mA}$		-1.8		$\text{mV}/^\circ\text{C}$
V_{IN}	Input voltage required to maintain line regulation	$T_J = 25^\circ\text{C}$, $I_O \leq 1\text{ A}$	17.7			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 ($t_w \leq 10\text{ ms}$, duty cycle $\leq 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.

6.8 Typical Characteristics

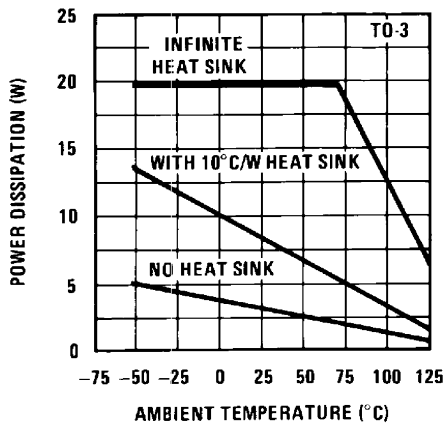


Figure 1. Maximum Average Power Dissipation

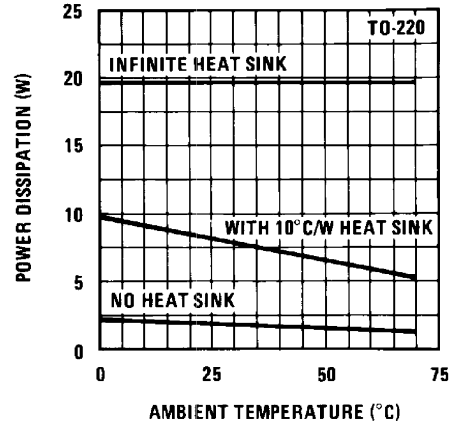


Figure 2. Maximum Average Power Dissipation

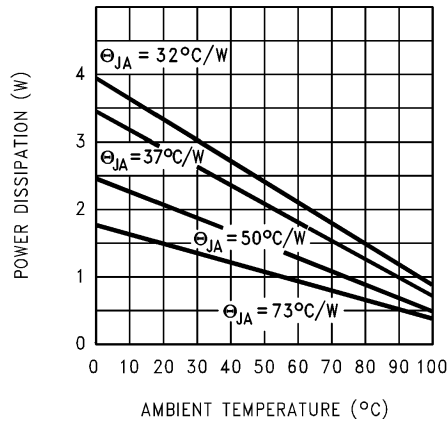


Figure 3. Maximum Power Dissipation (DDPAK/TO-263)

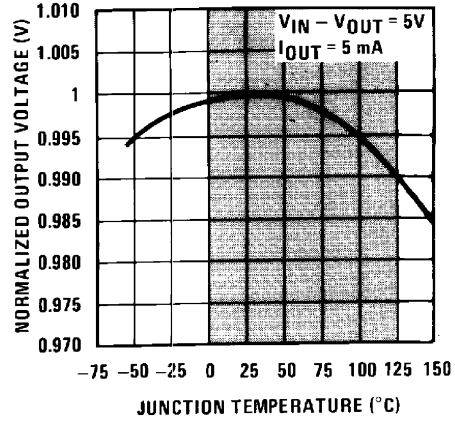


Figure 4. Output Voltage (Normalized to 1 V at $T_J = 25^\circ\text{C}$)

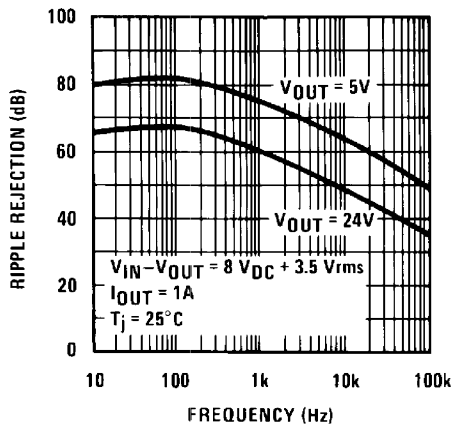


Figure 5. Ripple Rejection

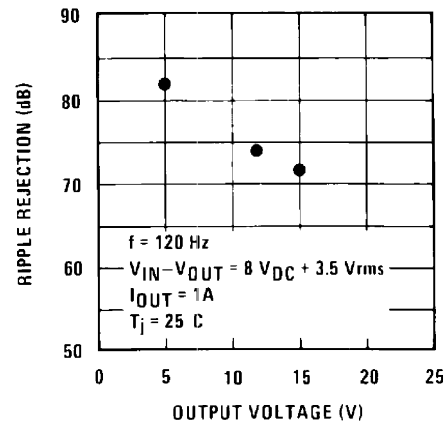


Figure 6. Ripple Rejection

Typical Characteristics (continued)

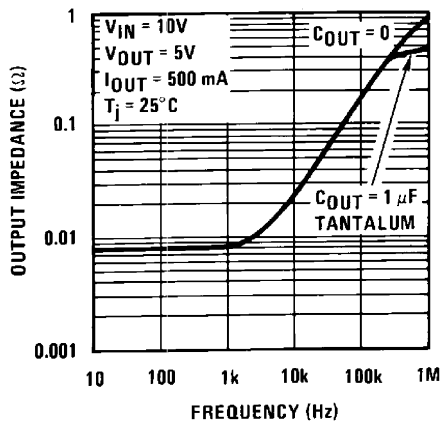


Figure 7. Output Impedance

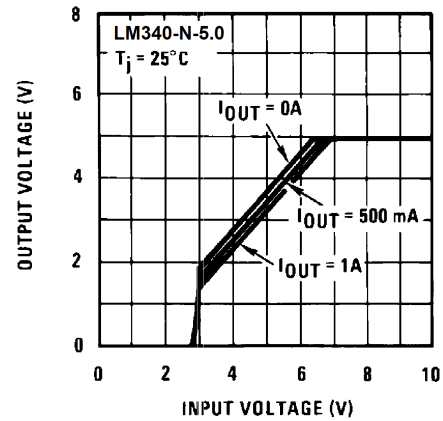


Figure 8. Dropout Characteristics

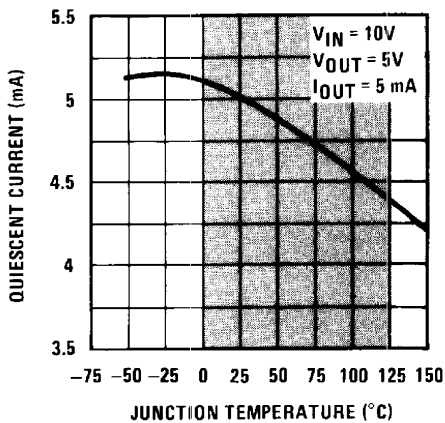


Figure 9. Quiescent Current

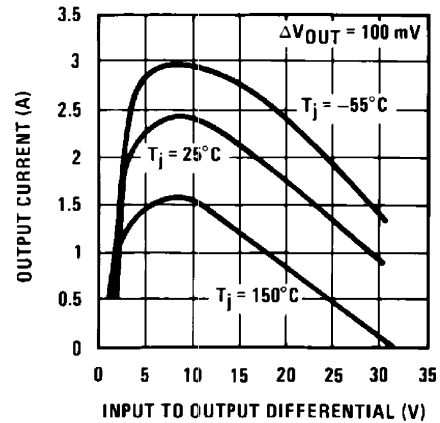


Figure 10. Peak Output Current

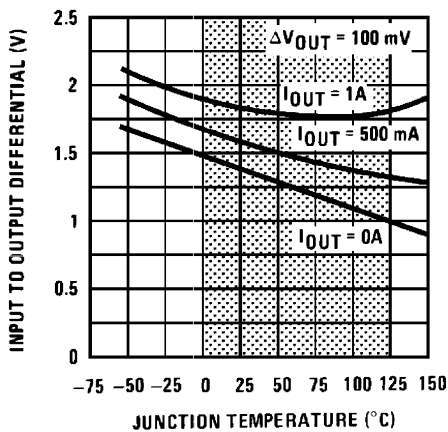


Figure 11. Dropout Voltage

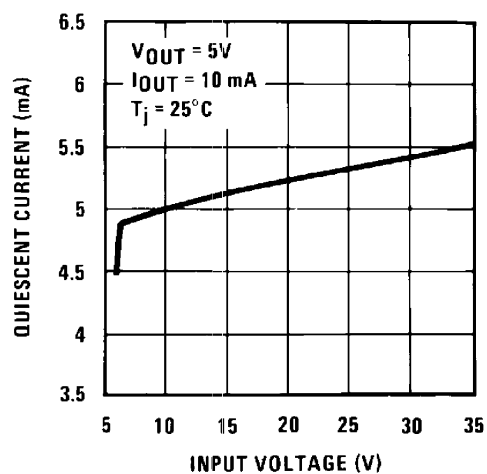
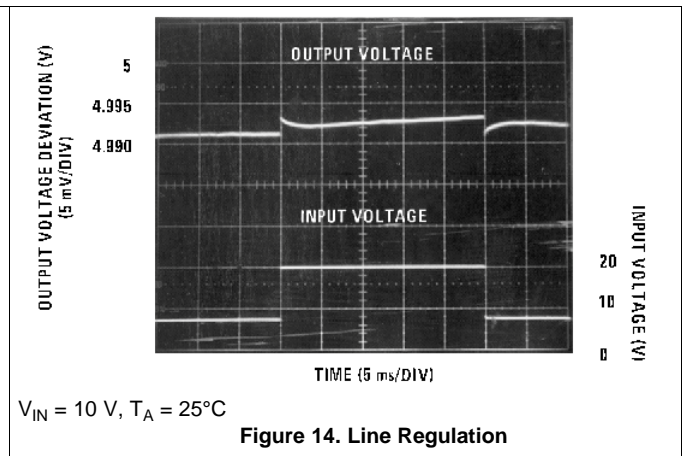
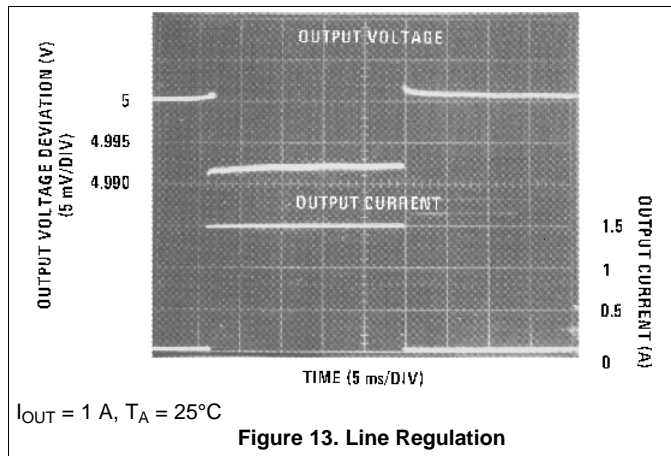


Figure 12. Quiescent Current

Typical Characteristics (continued)

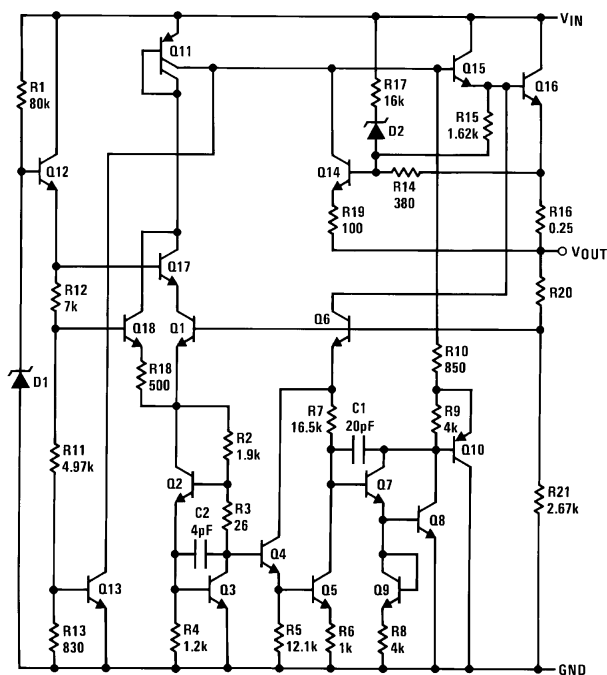


7 Detailed Description

7.1 Overview

The LM340-MIL device is a fixed-output positive-voltage regulator with outputs ranging from 3 V to 15 V. The device accepts up to 35 V of input voltage and, with proper heat dissipation, can provide over 1.5 A of current. With a combination of current limiting, thermal shutdown, and safe area protection, this regulator helps eliminate any concern of damage. These features paired with excellent line and load regulation make the LM340-MIL device a versatile solution to a wide range of power management designs. Although the LM340-MIL device was designed primarily as fixed-voltage regulators, the device can be used with external component for adjustable voltage and current.

7.2 Functional Block Diagram



Copyright © 2017, Texas Instruments Incorporated

7.3 Feature Description

7.3.1 Output Current

With proper considerations, the LM340-MIL device can exceed 1.5-A output current. Depending on the desired package option, the effective junction-to-ambient thermal resistance can be reduced through heat sinking, allowing more power to be dissipated in the device.

7.3.2 Current Limiting Feature

In the event of a short circuit at the output of the regulator, each device has an internal current limit to protect it from damage. The typical current limits for the LM340-MIL device is 2.4 A.

7.3.3 Thermal Shutdown

Each package type employs internal current limiting and thermal shutdown to provide safe operation area protection. If the junction temperature is allowed to rise to 150°C, the device will go into thermal shutdown.

7.4 Device Functional Modes

There are no functional modes for this device.

8 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

The LM340-MIL device is designed with thermal protection, output short-circuit protection, and output transistor safe area protection. However, as with any IC regulator, it becomes necessary to take precautions to assure that the regulator is not inadvertently damaged. The following describes possible misapplications and methods to prevent damage to the regulator.

8.1.1 Shorting the Regulator Input

When using large capacitors at the output of these regulators, a protection diode connected input to output (Figure 15) may be required if the input is shorted to ground. Without the protection diode, an input short causes the input to rapidly approach ground potential, while the output remains near the initial V_{OUT} because of the stored charge in the large output capacitor. The capacitor will then discharge through a large internal input to output diode and parasitic transistors. If the energy released by the capacitor is large enough, this diode, low current metal, and the regulator are destroyed. The fast diode in Figure 15 shunts most of the capacitors discharge current around the regulator. Generally no protection diode is required for values of output capacitance $\leq 10 \mu\text{F}$.

8.1.2 Raising the Output Voltage Above the Input Voltage

Because the output of the device does not sink current, forcing the output high can cause damage to internal low current paths in a manner similar to that just described in [Shorting the Regulator Input](#).

8.1.3 Regulator Floating Ground

When the ground pin alone becomes disconnected, the output approaches the unregulated input, causing possible damage to other circuits connected to V_{OUT} . If ground is reconnected with power ON, damage may also occur to the regulator. This fault is most likely to occur when plugging in regulators or modules with on card regulators into powered up sockets. The power must be turned off first, the thermal limit ceases operating, or the ground must be connected first if power must be left on. See [Figure 16](#).

8.1.4 Transient Voltages

If transients exceed the maximum rated input voltage of the device, or reach more than 0.8 V below ground and have sufficient energy, they will damage the regulator. The solution is to use a large input capacitor, a series input breakdown diode, a choke, a transient suppressor or a combination of these.

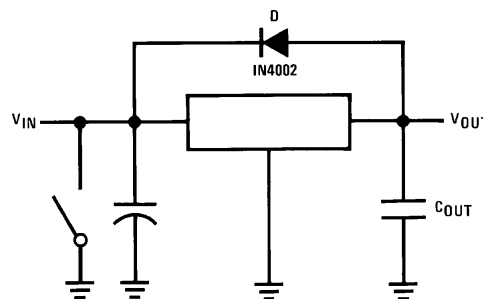


Figure 15. Input Short

Application Information (continued)

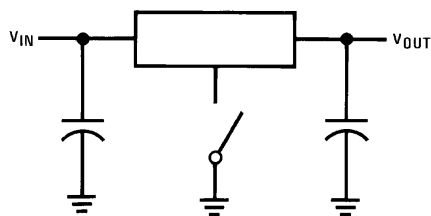


Figure 16. Regulator Floating Ground

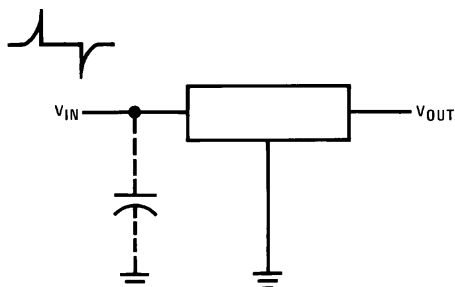


Figure 17. Transients

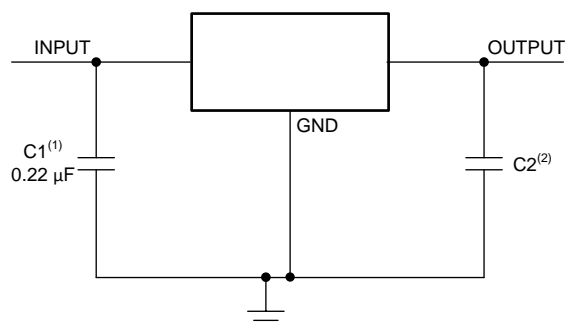
When a value for $\theta_{(H-A)}$ is found, a heat sink must be selected that has a value that is less than or equal to this number.

$\theta_{(H-A)}$ is specified numerically by the heat sink manufacturer in this catalog or shown in a curve that plots temperature rise vs power dissipation for the heat sink.

8.2 Typical Application

8.2.1 Fixed Output Voltage Regulator

The LM340-MIL device is primarily designed to provide fixed output voltage regulation. Figure 18 shows the simplest implementation of the LM340-MIL device.



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

Figure 18. Fixed Output Voltage Regulator

Typical Application (continued)

8.2.1.1 Design Requirements

The device component count is very minimal. Although not required, TI recommends employing bypass capacitors at the output for optimum stability and transient response. These capacitors must be placed as close as possible to the regulator. If the device is located more than 6 inches from the power supply filter, it is required to employ input capacitor.

8.2.1.2 Detailed Design Procedure

The output voltage is set based on the device variant. LM340-MIL device is available in 5-V, 12-V and 15-V regulator options.

8.2.1.3 Application Curve

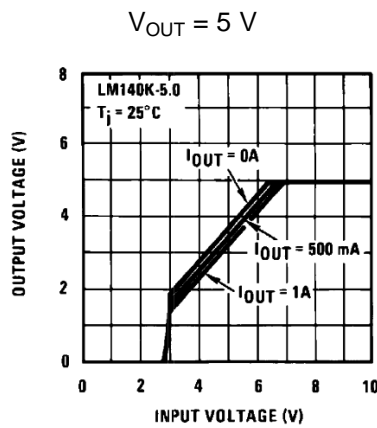
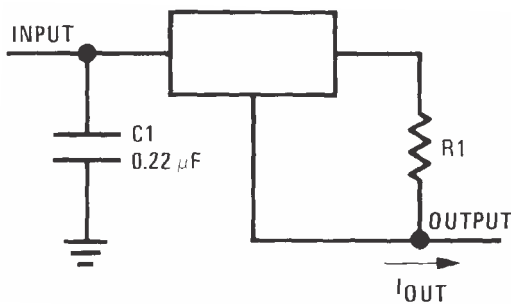


Figure 19. Output Voltage vs Input Voltage

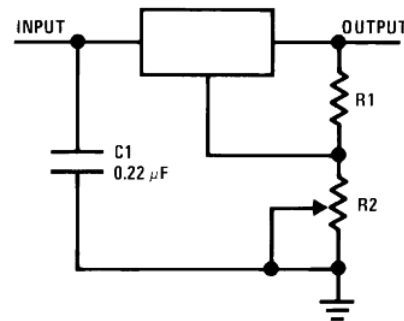
8.3 System Examples



$$I_{OUT} = V_{2-3} / R1 + I_Q$$

$$\Delta I_Q = 1.3 \text{ mA over line and load changes.}$$

Figure 20. Current Regulator



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

$$R2 \geq 5 \text{ V}/R1 > 3 I_Q, \text{ load regulation } (L_r) \approx [(R1 + R2)/R1]$$

$$(L_r \text{ of LM340-MIL-5}).$$

Figure 21. Adjustable Output Regulator

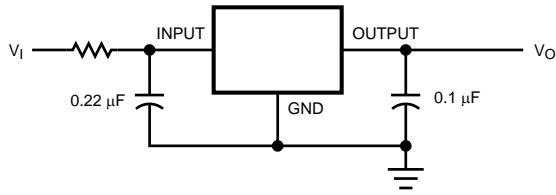


Figure 22. High Input Voltage Circuit With Series Resistor

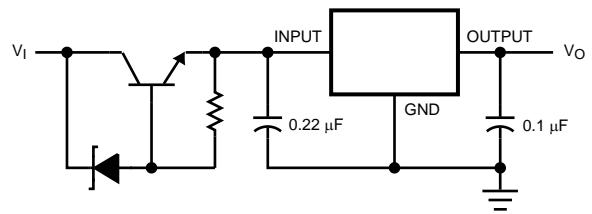
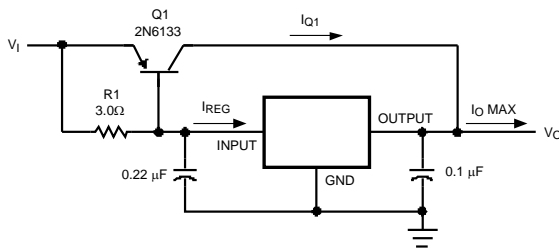


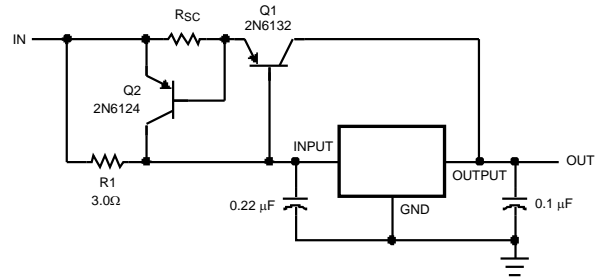
Figure 23. High Input Voltage Circuit implementation With Transistor



$$\beta(Q1) \geq I_{O \text{ Max}} / I_{REG \text{ Max}}$$

$$R1 = 0.9 / I_{REG} = \beta(Q1) V_{BE(Q1)} / I_{REG \text{ Max}} (\beta + 1) - I_{O \text{ Max}}$$

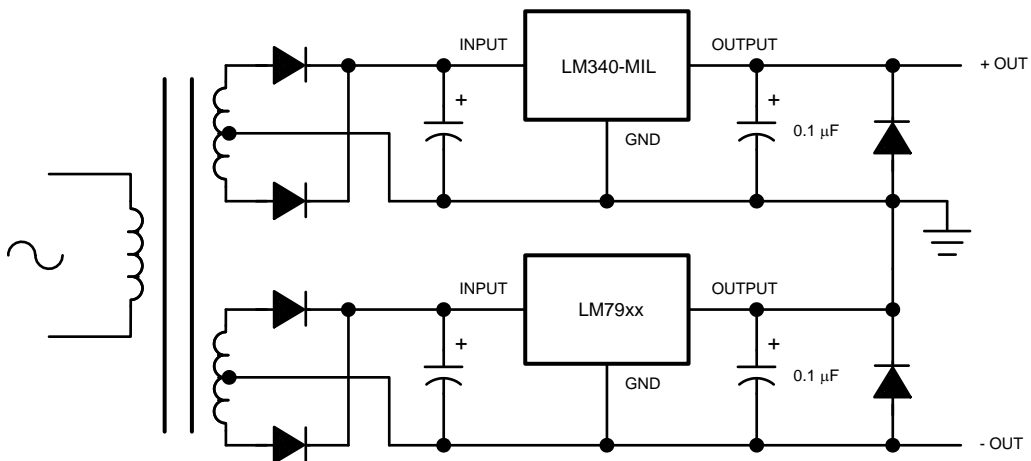
Figure 24. High Current Voltage Regulator



$$R_{sc} = 0.8 / I_{sc}$$

$$R1 = \beta V_{BE(Q1)} / I_{REG \text{ Max}} (\beta + 1) - I_{O \text{ Max}}$$

Figure 25. High Output Current With Short-Circuit Protection



Copyright © 2017, Texas Instruments Incorporated

Figure 26. Device Used With Negative Regulator LM79xx

9 Power Supply Recommendations

The LM340-MIL is designed to operate from a wide input voltage up to 35 V. Please refer to electrical characteristics tables for the minimum input voltage required for line/load regulation. If the device is more than six inches from the input filter capacitors, an input bypass capacitor, 0.1 μF or greater, of any type is needed for stability.

10 Layout

10.1 Layout Guidelines

Some layout guidelines must be followed to ensure proper regulation of the output voltage with minimum noise. Traces carrying the load current must be wide to reduce the amount of parasitic trace inductance. To improve PSRR, a bypass capacitor can be placed at the OUTPUT pin and must be placed as close as possible to the IC. All that is required for the typical fixed output regulator application circuit is the LM340-MIL IC and a 0.22- μF input capacitor if the regulator is placed far from the power supply filter. A 0.1- μF output capacitor is recommended to help with transient response. In cases when VIN shorts to ground, an external diode must be placed from VOUT to VIN to divert the surge current from the output capacitor and help protect the device.

10.2 Layout Example

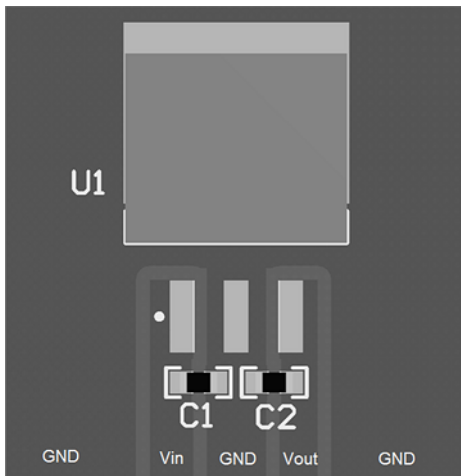


Figure 27. Layout Example DDPAK

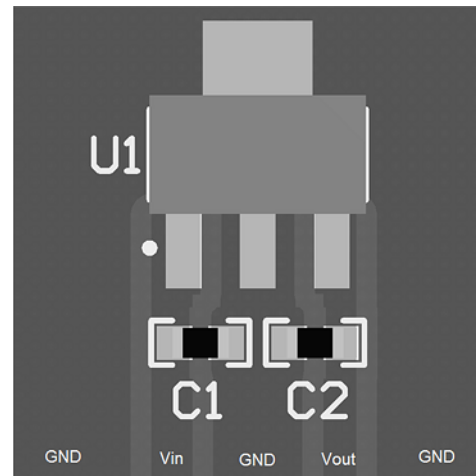


Figure 28. Layout Example SOT-223

10.3 Heat Sinking DDPAK/TO-263 and SOT-223 Package Parts

Both the DDPAK/TO-263 (KTT) and SOT-223 (DCY) packages use a copper plane on the PCB and the PCB itself as a heat sink. To optimize the heat sinking ability of the plane and PCB, solder the tab of the plane.

Figure 29 shows for the DDPAK/TO-263 the measured values of $\theta_{(J-A)}$ for different copper area sizes using a typical PCB with 1-oz copper and no solder mask over the copper area used for heat sinking.

As shown in Figure 29, increasing the copper area beyond 1 square inch produces very little improvement. It should also be observed that the minimum value of $\theta_{(J-A)}$ for the DDPAK/TO-263 package mounted to a PCB is 32°C/W.

As a design aid, Figure 30 shows the maximum allowable power dissipation compared to ambient temperature for the DDPAK/TO-263 device (assuming $\theta_{(J-A)}$ is 35°C/W and the maximum junction temperature is 125°C).

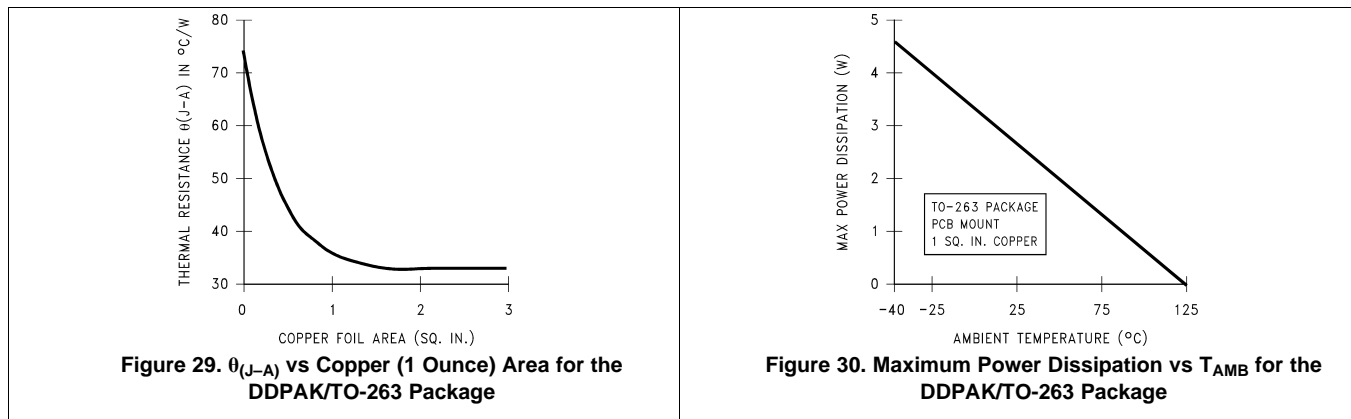
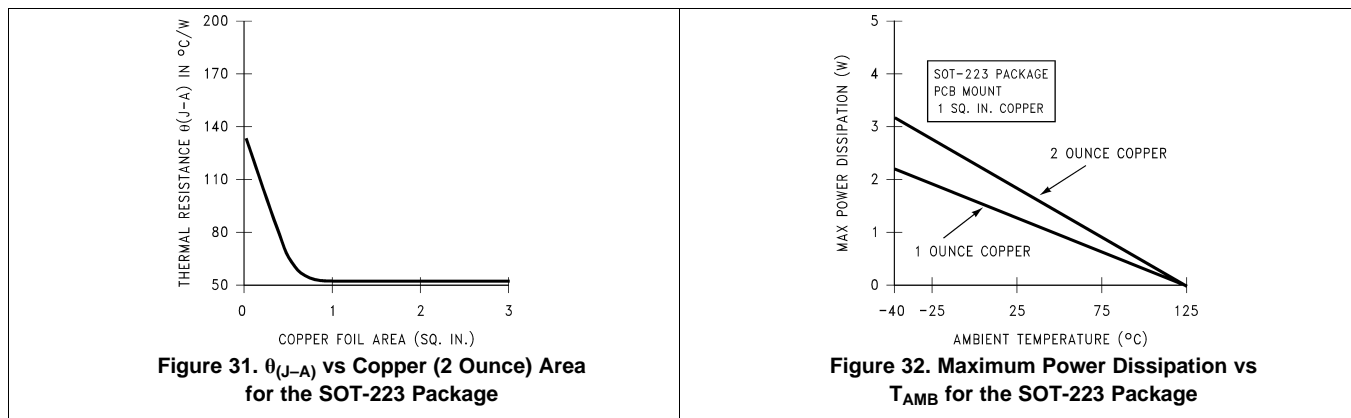


Figure 31 and Figure 32 show the information for the SOT-223 package. Figure 31 assumes a $\theta_{(J-A)}$ of 74°C/W for 1-oz. copper and 51°C/W for 2-oz. copper and a maximum junction temperature of 125°C.



See AN-1028 LMX2370 PLLatinum Dual Freq Synth for RF Pers Comm LMX2370 2.5GHz/1.2GHz for power enhancement techniques to be used with the SOT-223 package.

11 デバイスおよびドキュメントのサポート

11.1 ドキュメントのサポート

11.1.1 関連資料

関連資料については、以下を参照してください:

- 『AN-1028 LMX2370 PLLatinumデュアル周波数シンセサイザ、RFパーソナル通信用、LMX2370 2.5GHz/1.2GHz』
- 『LM79XXシリーズ3ピン負レギュレータ』

11.2 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、ti.comのデバイス製品フォルダを開いてください。右上の隅にある「通知を受け取る」をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取れます。変更の詳細については、修正されたドキュメントに含まれている改訂履歴をご覧ください。

11.3 コミュニティ・リソース

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™オンライン・コミュニティ *TIのE2E (Engineer-to-Engineer)* コミュニティ。エンジニア間の共同作業を促進するために開設されたものです。e2e.ti.comでは、他のエンジニアに質問し、知識を共有し、アイデアを検討して、問題解決に役立てることができます。

設計サポート *TIの設計サポート* 役に立つE2Eフォーラムや、設計サポート・ツールをすばやく見つけることができます。技術サポート用の連絡先情報も参照できます。

11.4 商標

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

11.5 静電気放電に関する注意事項



すべての集積回路は、適切なESD保護方法を用いて、取扱いと保存を行うようにして下さい。

静電気放電はわずかな性能の低下から完全なデバイスの故障に至るまで、様々な損傷を与えます。高精度の集積回路は、損傷に対して敏感であり、極めてわずかなパラメータの変化により、デバイスに規定された仕様に適合しなくなる場合があります。

11.6 Glossary



[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

12 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM340K-5.0	ACTIVE	TO-3	NDS	2	50	Non-RoHS & Non-Green	Call TI	Call TI	0 to 125	LM340K -5.0 7805P+	
LM340K-5.0/NOPB	ACTIVE	TO-3	NDS	2	50	RoHS & Green	Call TI	Level-1-NA-UNLIM	0 to 125	LM340K -5.0 7805P+	

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

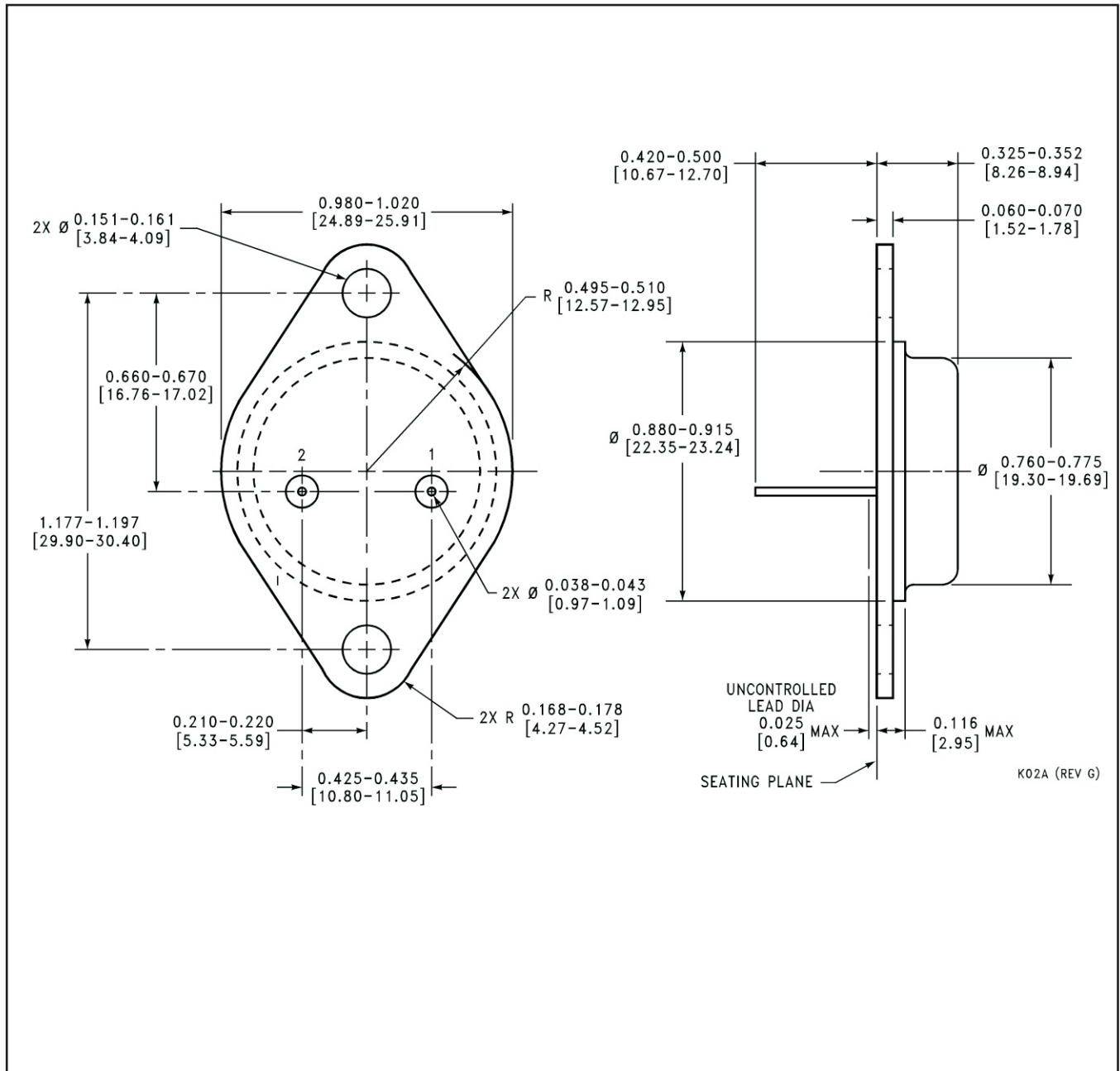
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

NDS0002A



重要なお知らせと免責事項

TI は、技術データと信頼性データ(データシートを含みます)、設計リソース(リファレンス・デザインを含みます)、アプリケーションや設計に関する各種アドバイス、Web ツール、安全性情報、その他のリソースを、欠陥が存在する可能性のある「現状のまま」提供しており、商品性および特定目的に対する適合性の黙示保証、第三者の知的財産権の非侵害保証を含むいかなる保証も、明示的または黙示的にかかわらず拒否します。

これらのリソースは、TI 製品を使用する設計の経験を積んだ開発者への提供を意図したものです。(1) お客様のアプリケーションに適した TI 製品の選定、(2) お客様のアプリケーションの設計、検証、試験、(3) お客様のアプリケーションが適用される各種規格や、その他のあらゆる安全性、セキュリティ、またはその他の要件を満たしていることを確実にする責任を、お客様のみが単独で負うものとします。上記の各種リソースは、予告なく変更される可能性があります。これらのリソースは、リソースで説明されている TI 製品を使用するアプリケーションの開発の目的でのみ、TI はその使用をお客様に許諾します。これらのリソースに関して、他の目的で複製することや掲載することは禁止されています。TI や第三者の知的財産権のライセンスが付与されている訳ではありません。お客様は、これらのリソースを自身で使用した結果発生するあらゆる申し立て、損害、費用、損失、責任について、TI およびその代理人を完全に補償するものとし、TI は一切の責任を拒否します。

TI の製品は、TI の販売条件 (www.tij.co.jp/ja-jp/legal/termsofsale.html)、または ti.com やかかる TI 製品の関連資料などのいずれかを通じて提供する適用可能な条項の下で提供されています。TI がこれらのリソースを提供することは、適用される TI の保証または他の保証の放棄の拡大や変更を意味するものではありません。

Copyright © 2020, Texas Instruments Incorporated

日本語版 日本テキサス・インスツルメンツ株式会社