参考資料

LM2574x SIMPLE SWITCHER® 0.5A降圧型電圧レギュレータ

1 特長

- 3.3V/5V/12V/15V版および可変出力版
- 可変版は1.23V～37V (HV版は57V)の出力電圧範囲で、ラインおよび負荷の全条件で最大±4%の許容誤差
- 0.5Aの出力電流を保証
- 広い入力電圧範囲: 40V、HV版は最大60V
- 4個の外付け部品で動作可能
- 52kHz固定周波数の内部発振器
- TTLシャットダウン機能、低消費電力のスタンバイ・モード
- 高効率
- 容易に入手可能な標準インダクタ使用
- サーマル・シャットダウンおよび電流制限保護
- WEBENCH® Power Designerにより、LM2574を使用するカスタム設計を作成

2 アプリケーション

- シンプルな高効率降圧型(バック)レギュレータ
- リニア・レギュレータ用の高効率プリレギュレータ
- オンカードのスイッチング・レギュレータ
- 反転型コンバータ(昇降圧)

3 概要

LM2574xxシリーズのレギュレータは、降圧型(バック)スイッチング・レギュレータのすべてのアクティブ機能を内蔵したモノリシックICで、優れたラインおよび負荷レギュレーションで0.5Aの負荷を駆動できます。3.3V、5V、12V、15Vの固定出力電圧版と可変出力版があります。

必要な外付け部品が最小限で済み、使い方が簡単な上に、内部での周波数補償、固定周波数発振器も搭載されています。

LM2574シリーズは、一般的な3端子リニア・レギュレータの代替になる高効率な製品です。効率が高いため、通常はプリント基板の銅配線のみで十分なヒートシンクになります。

LM2574での使用に最適化された標準のインダクタをいくつかのメーカーから入手できます。このため、スイッチング電源の設計が大幅に簡素化されます。

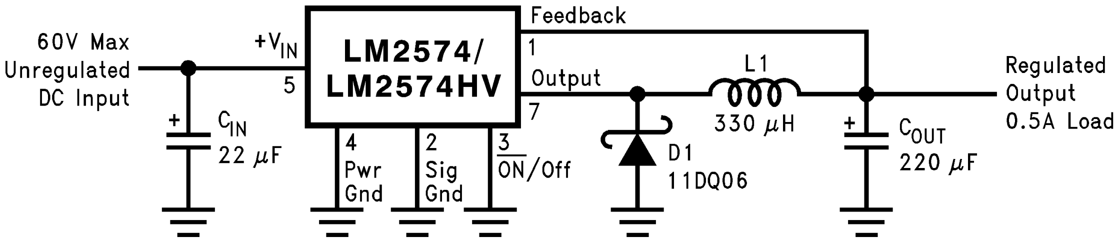
また、入力電圧と出力負荷のあらゆる条件において、出力電圧について±4%、発振器周波数について±10%の許容誤差が保証されています。外部シャットダウンが搭載されており、スタンバイ電流は50µA (標準値)です。出力スイッチにはサイクル単位の電流制限と、障害状態における完全な保護を行うためのサーマル・シャットダウンが含まれています。

製品情報(1)

型番	パッケージ	本体サイズ(公称)
LM2574、LM2574HV	SOIC (14)	8.992mm×7.498mm
	PDIP (8)	6.35mm×9.81mm

(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。

代表的なアプリケーション(固定出力電圧版)



目次

4 改訂履歴

Revision D (April 2016) から Revision E に変更 — Page

- WEBENCHへのリンク 追加 ... 1
- maximum supply voltage in *Abs Max Ratings* from "4.5" to "45" to correct typo ... 4

Revision C (April 2013) から Revision D に変更 — Page

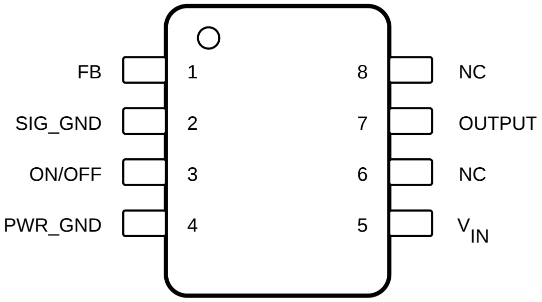
- *製品情報の表、「ESD定格」の表、「機能説明」セクション、「デバイスの機能モード」、「アプリケーションと実装」セクション、「電源に関する推奨事項」セクション、「レイアウト」セクション、「デバイスおよびドキュメントのサポート」セクション、「メカニカル、パッケージ、および注文情報」セクションを追加* ... 1
- Changed $R_{\theta JA}$ value in SOIC column to 77.1 ... 4
- Split test conditions row of the *Electrical Characteristics* table to include T_J = 25°C and T_J < 25°C MIN, TYP, and MAX values ... 5
- Split test conditions in I_L row to rearrange the MIN, TYP, and MAX values ... 5

Revision B (November 2004) から Revision C に変更 — Page

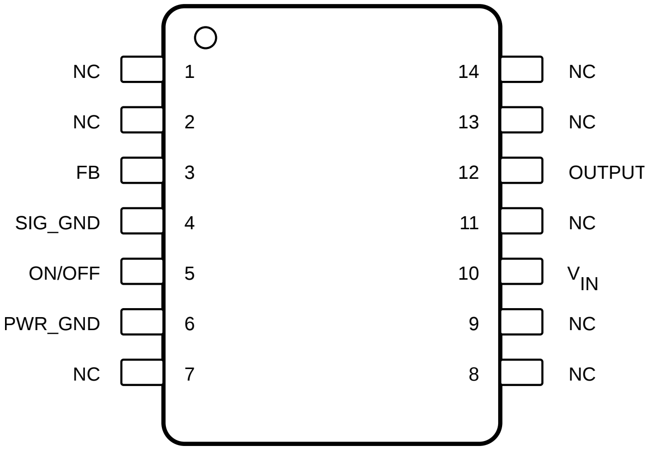
- ナショナル・セミコンダクターのデータシートのレイアウトをTI形式に変更 ... 1

5 Pin Configuration and Functions

**P Package
8-Pin PDIP
Top View**



**NPA Package
14-Pin SOIC
Top View**



Pin Functions

PIN			I/O	DESCRIPTION
NAME	PDIP	SOIC		
FB	1	3	I	Feedback sense input pin. Connect to the midpoint of feedback divider to set VOUT for ADJ version or connect this pin directly to the output capacitor for a fixed output version.
NC	8, 6	1, 2, 7, 8, 9, 11, 13, 14	—	No internal connection, but must be soldered to PCB for best heat transfer.
ON/OFF	3	5	I	Enable input to the voltage regulator. High = OFF and low = ON. Connect to GND to enable the voltage regulator. Do not leave this pin float.
OUTPUT	7	12	O	Emitter pin of the power transistor. This is a switching node. Attached this pin to an inductor and the cathode of the external diode.
PWR_GND	4	6	—	Power ground pins. Connect to system ground and SIF GND, ground pins of C_{IN} and C_{OUT}. Path to C_{IN} must be as short as possible.
SIG_GND	2	4	—	Signal ground pin. Ground reference for internal references and logic. Connect to system ground.
V_{IN}	5	10	I	Supply input pin to collector pin of high-side transistor. Connect to power supply and input bypass capacitors C_{IN}. Path from VIN pin to high frequency bypass C_{IN} and PWR GND must be as short as possible.

6 Specifications

6.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
Maximum supply voltage	LM2574		45	V
	LM2574HV		63	
$\overline{\text{ON}}$/OFF pin input voltage		–0.3	V_{IN}	V
Output voltage to ground, steady-state			–1	V
Power dissipation		Internally limited		
Lead temperature, soldering (10 s)			260	°C
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.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±2000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

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

			MIN	NOM	MAX	UNIT
	Supply voltage	LM2574			40	V
		LM2574HV			60	
T_J	Temperature		–40		125	°C

6.4 Thermal Information

THERMAL METRIC(1)(2)		LM2574, LM2574HV		UNIT
		P (PDIP)	NPA (SOIC)	
		8 PINS	14 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance(3)	60.4	77.1	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance(3)	59.9	29.2	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance(3)	37.9	33.3	°C/W
ψ_{JT}	Junction-to-top characterization parameter	17.1	2	°C/W
ψ_{JB}	Junction-to-board characterization parameter	37.7	32.8	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance(3)	—	—	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report.
(2) The package thermal impedance is calculated in accordance with JESD 51-7.
(3) Thermal resistances were simulated on a 4-layer, JEDEC board.

6.5 Electrical Characteristics for All Output Voltage Versions

T_J = 25°C, and MIN and MAX apply over full operating temperature range. V_{IN} = 12 V for the 3.3-V, 5-V, and adjustable version, V_{IN} = 25 V for the 12-V version, and V_{IN} = 30 V for the 15-V version, I_{LOAD} = 100 mA (unless otherwise noted).

PARAMETER		TEST CONDITIONS		MIN(1)	TYP	MAX(1)	UNIT
I_b	Feedback bias current	Adjustable version only, V_{OUT} = 5 V	T_J = 25°C		50	100	nA
			–40°C < T_J < 125°C			500	
f_O	Oscillator frequency	See(2)	T_J = 25°C	47	52	58	kHz
			–40°C < T_J < 125°C	42		63	
V_{SAT}	Saturation voltage	I_{OUT} = 0.5 A(3)	T_J = 25°C		0.9	1.2	V
			–40°C < T_J < 125°C			1.4	
DC	Maximum duty cycle (ON)	See(4)		93%	98%		
I_{CL}	Current limit	Peak current(2)(3)		0.7	1	1.6	A
				0.65		1.8	
I_L	Current output leakage	Output = 0 V				2	mA
		Output = –1 V(5)(6)			7.5	30	
I_Q	Quiescent current	See(5)			5	10	mA
I_{STBY}	Standby quiescent current	$\overline{ON}$/OFF pin = 5 V (OFF)			50	200	µA
$\overline{ON}$/OFF CONTROL (SEE Figure 27)							
V_{IH}	$\overline{ON}$/OFF pin logic input level	V_{OUT} = 0 V	T_J = 25°C	2.2	1.4		V
			–40°C < T_J < 125°C	2.4			
V_{IL}		V_{OUT} = Nominal output voltage	T_J = 25°C		1.2	1	V
			–40°C < T_J < 125°C			0.8	
I_H	$\overline{ON}$/OFF pin input current	$\overline{ON}$/OFF pin = 5 V (OFF)			12	30	µA
I_{IL}		$\overline{ON}$/OFF pin = 0 V (ON)			0	10	µA

(1) All limits specified at room temperature TYP and MAX. All room temperature limits are 100% production tested. All limits at temperature extremes are specified through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level.
(2) The oscillator frequency reduces to approximately 18 kHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protection feature lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2% (see Figure 6).
(3) Output pin sourcing current. No diode, inductor or capacitor connected to output pin.
(4) Feedback pin removed from output and connected to 0 V.
(5) Feedback pin removed from output and connected to 12 V for the adjustable, 3.3-V, and 5-V versions, and 25 V for the 12-V and 15-V versions, to force the output transistor OFF.
(6) V_{IN} = 40 V (60 V for high voltage version).

6.6 Electrical Characteristics – 3.3-V Version

T_J = 25°C, and all MIN and MAX apply over full operating temperature range (unless otherwise noted).

PARAMETER(1)		TEST CONDITIONS		MIN(2)	TYP	MAX(2)	UNIT
V_{OUT}	Output voltage	V_{IN} = 12 V, I_{LOAD} = 100 mA		3.234	3.3	3.366	V
		LM2574, 4.75 V ≤ V_{IN} ≤ 40 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A	T_J = 25°C	3.168	3.3	3.432	
			−40°C ≤ T_J ≤ 125°C	3.135		3.465	
		LM2574HV, 4.75 V ≤ V_{IN} ≤ 60 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A	T_J = 25°C	3.168	3.3	3.45	
			−40°C ≤ T_J ≤ 125°C	3.135		3.482	
η	Efficiency	V_{IN} = 12 V, I_{LOAD} = 0.5 A			72%		

(1) Test Circuit in Figure 22 and Figure 27.
(2) All limits specified at room temperature and at temperature extremes . All room temperature limits are 100% production tested. All limits at temperature extremes are specified via correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level.

6.7 Electrical Characteristics – 5-V Version

T_J = 25°C, and all MIN and MAX apply over full operating temperature range (unless otherwise noted).

PARAMETER(1)		TEST CONDITIONS		MIN	TYP(2)	MAX(2)	UNIT
V_{OUT}	Output voltage	V_{IN} = 12 V, I_{LOAD} = 100 mA		4.9	5	5.1	V
		LM2574, 7 V ≤ V_{IN} ≤ 40 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A	T_J = 25°C	4.8	5	5.2	
			−40°C ≤ T_J ≤ 125°C	4.75		5.25	
		LM2574HV, 7 V ≤ V_{IN} ≤ 60 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A	T_J = 25°C	4.8	5	5.225	
			−40°C ≤ T_J ≤ 125°C	4.75		5.275	
η	Efficiency	V_{IN} = 12 V, I_{LOAD} = 0.5 A			77%		

(1) Test circuit in Figure 22 and Figure 27.
(2) All limits specified at room temperature TYP and MAX. All room temperature limits are 100% production tested. All limits at temperature extremes are specified through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level.

6.8 Electrical Characteristics – 12-V Version

T_J = 25°C, and all MIN and MAX apply over full operating temperature range (unless otherwise noted).

PARAMETER(1)		CONDITIONS		MIN	TYP(2)	MAX(2)	UNIT
V_{OUT}	Output voltage	V_{IN} = 25 V, I_{LOAD} = 100 mA		11.76	12	12.24	V
		LM2574, 15 V ≤ V_{IN} ≤ 40 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A	T_J = 25°C	11.52	12	12.48	
			−40°C ≤ T_J ≤ 125°C	11.4		12.6	
		LM2574HV, 15 V ≤ V_{IN} ≤ 60 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A	T_J = 25°C	11.52	12	12.54	
			−40°C ≤ T_J ≤ 125°C	11.4		12.66	
η	Efficiency	V_{IN} = 15 V, I_{LOAD} = 0.5 A			88%		

(1) Test circuit in Figure 22 and Figure 27.
(2) All limits specified at room temperature TYP and MAX. All room temperature limits are 100% production tested. All limits at temperature extremes are specified through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level.

6.9 Electrical Characteristics – 15-V Version

T_J = 25°C, and all MIN and MAX apply over full operating temperature range (unless otherwise noted).

PARAMETER(1)		TEST CONDITIONS		MIN	TYP(2)	MAX(2)	UNIT
V_{OUT}	Output voltage	V_{IN} = 30 V, I_{LOAD} = 100 mA		14.7	15	15.3	V
		LM2574, 18 V ≤ V_{IN} ≤ 40 V, 0.1A ≤ I_{LOAD} ≤ 0.5 A	T_J = 25°C	14.4	15	15.6	
			−40°C ≤ T_J ≤ 125°C	14.25		15.75	
		LM2574HV, 18 V ≤ V_{IN} ≤ 60 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A	T_J = 25°C	14.4	15	15.68	
			−40°C ≤ T_J ≤ 125°C	14.25		15.83	
η	Efficiency	V_{IN} = 18 V, I_{LOAD} = 0.5 A			88%		

(1) Test circuit in Figure 22 and Figure 27.
(2) All limits specified at room temperature TYP and MAX. All room temperature limits are 100% production tested. All limits at temperature extremes are specified through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level.

6.10 Electrical Characteristics – Adjustable Version

T_J = 25°C, and all MIN and MAX apply over full operating temperature range. V_{IN} = 12 V, I_{LOAD} = 100 mA (unless otherwise noted).

PARAMETER(1)		TEST CONDITIONS		MIN	TYP(2)	MAX(2)	UNIT
V_{FB}	Feedback voltage	V_{IN} = 12 V, I_{LOAD} = 100 mA		1.217	1.23	1.243	V
		LM2574, 7 V ≤ V_{IN} ≤ 40 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A, V_{OUT} programmed for 5 V	T_J = 25°C	1.193	1.23	1.267	
			−40°C ≤ T_J ≤ 125°C	1.18		1.28	
		LM2574HV, 7 V ≤ V_{IN} ≤ 60 V, 0.1 A ≤ I_{LOAD} ≤ 0.5 A, V_{OUT} programmed for 5 V	T_J = 25°C	1.193	1.23	1.273	
			−40°C ≤ T_J ≤ 125°C	1.18		1.286	
η	Efficiency	V_{IN} = 12 V, V_{OUT} = 5 V, I_{LOAD} = 0.5 A			77%		

(1) Test circuit in Figure 22 and Figure 27.

(2) All limits specified at room temperature TYP and MAX. All room temperature limits are 100% production tested. All limits at temperature extremes are specified through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level.

6.11 Typical Characteristics

See Figure 27.

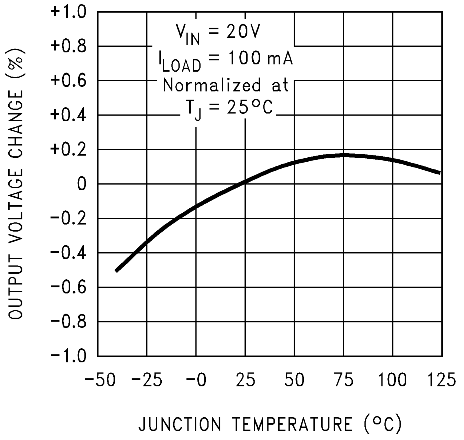


Figure 1. Normalized Output Voltage

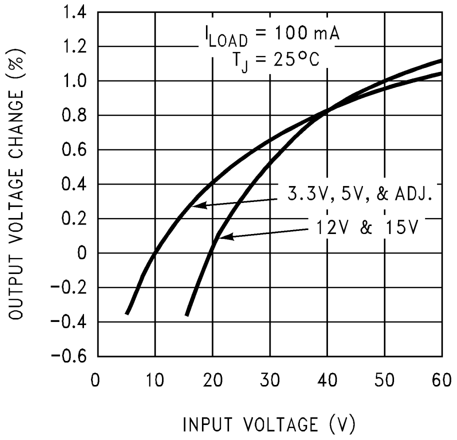


Figure 2. Line Regulation

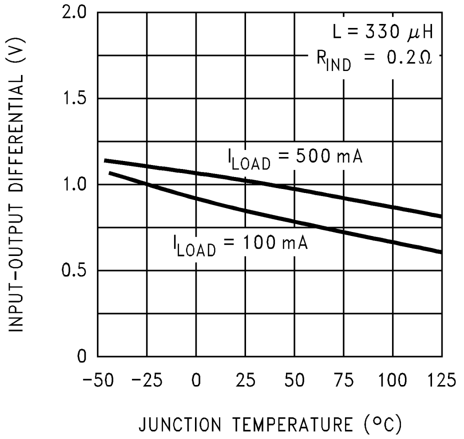


Figure 3. Dropout Voltage

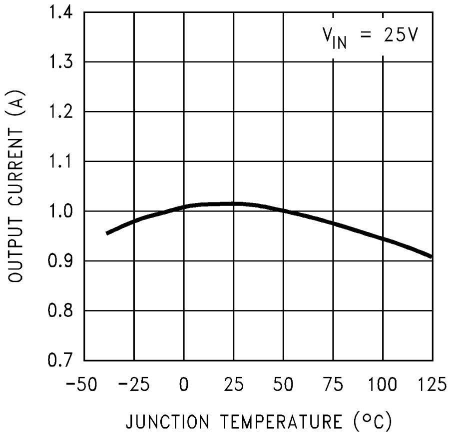


Figure 4. Current Limit

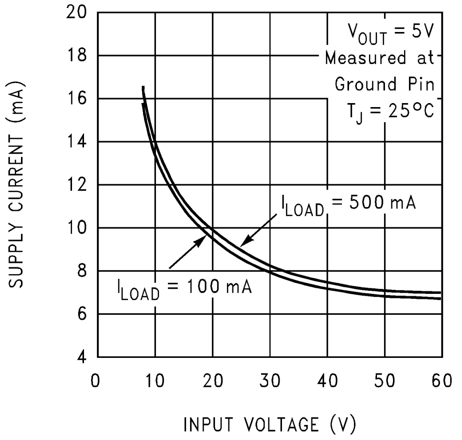


Figure 5. Supply Current

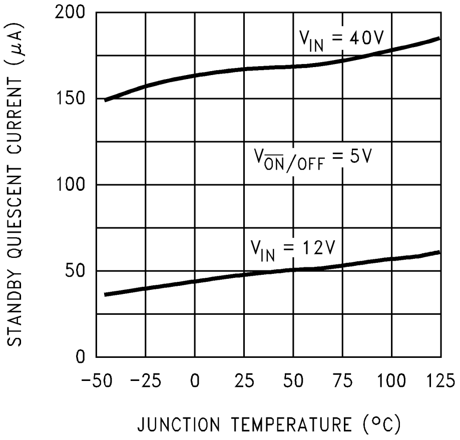


Figure 6. Standby Quiescent Current

Typical Characteristics (continued)

See Figure 27.

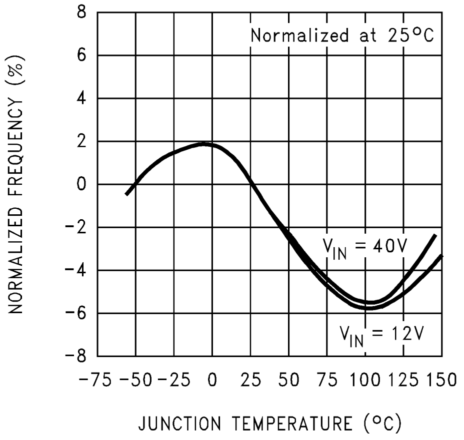


Figure 7. Oscillator Frequency

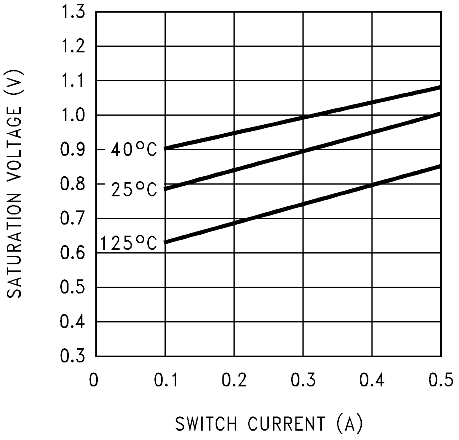


Figure 8. Switch Saturation Voltage

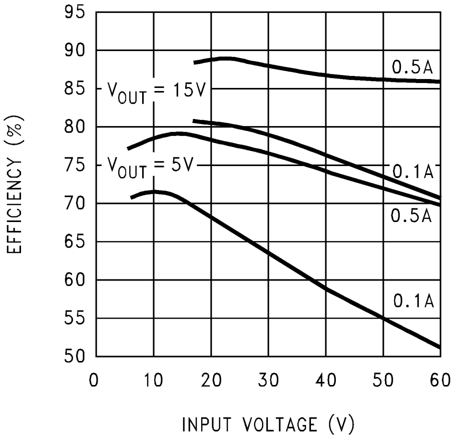


Figure 9. Efficiency

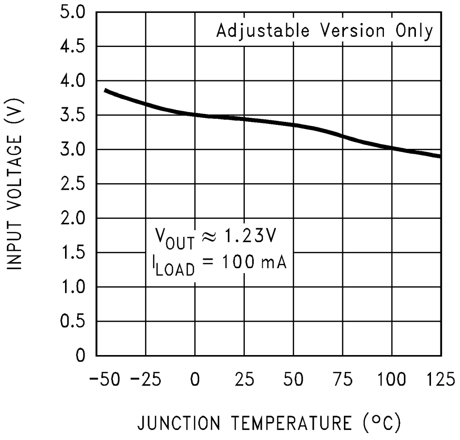


Figure 10. Minimum Operating Voltage

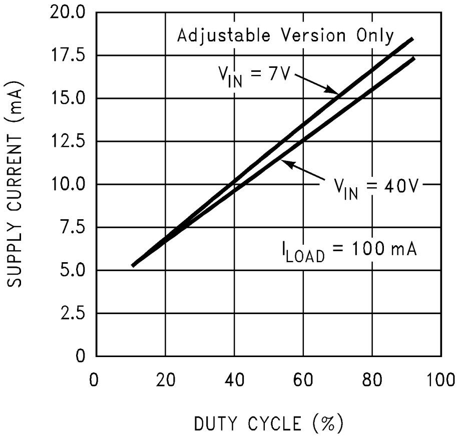


Figure 11. Supply Current vs Duty Cycle

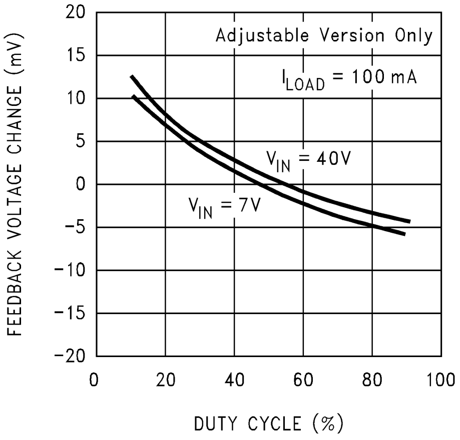


Figure 12. Feedback Voltage vs Duty Cycle

Typical Characteristics (continued)

See Figure 27.

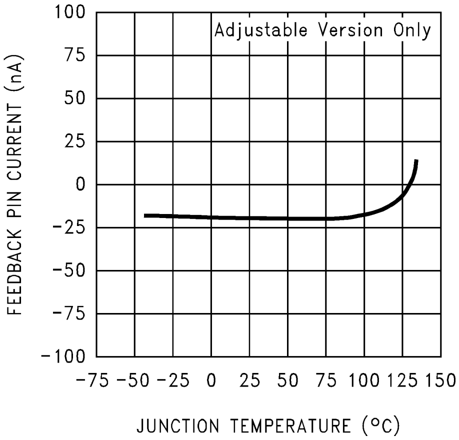


Figure 13. Feedback Pin Current

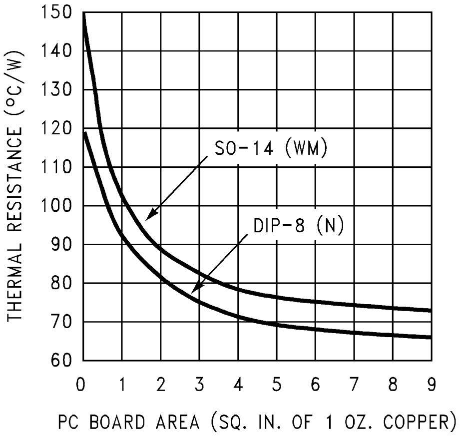


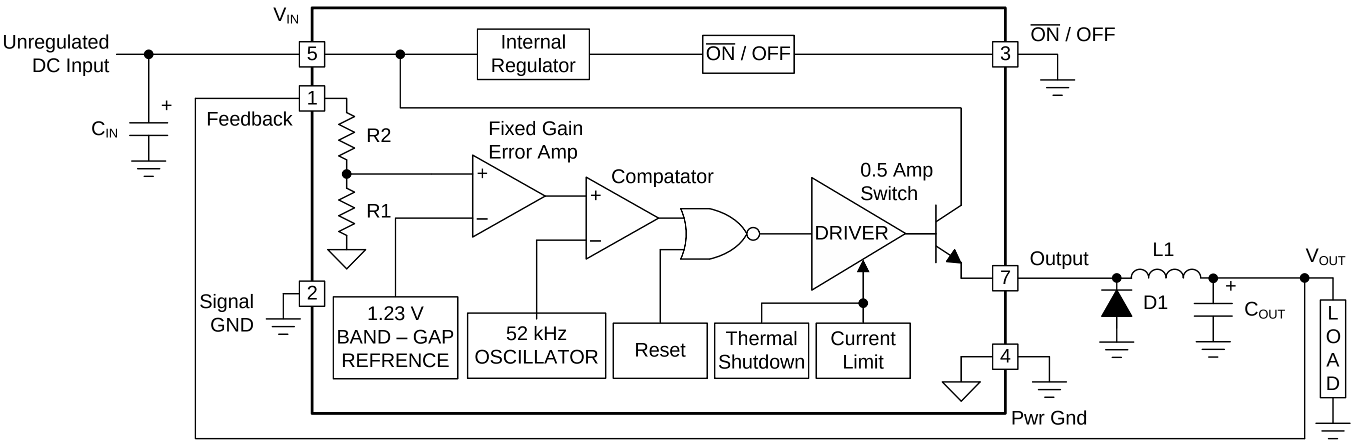
Figure 14. Junction-to-Ambient Thermal Resistance

7 Detailed Description

7.1 Overview

The LM2574 SIMPLE SWITCHER® regulator is an easy-to-use, non-synchronous, step-down DC-DC converter with a wide input voltage range from 40 V to up to 60 V for a HV version. It is capable of delivering up to 0.5-A DC load current with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, 15 V, and an adjustable output version. The family requires few external components and the pin arrangement was designed for simple, optimum PCB layout.

7.2 Functional Block Diagram



Note: Pin numbers are for the 8-pin PDIP package
R1 = 1 k
3.3 V, R2 = 1.7 k
5 V, R2 = 3.1 k
12 V, R2 = 8.84 k
15 V, R2 = 11.3 k
For adjustable version,
R1 = Open, R2 = 0 Ω

7.3 Feature Description

7.3.1 Current Limit

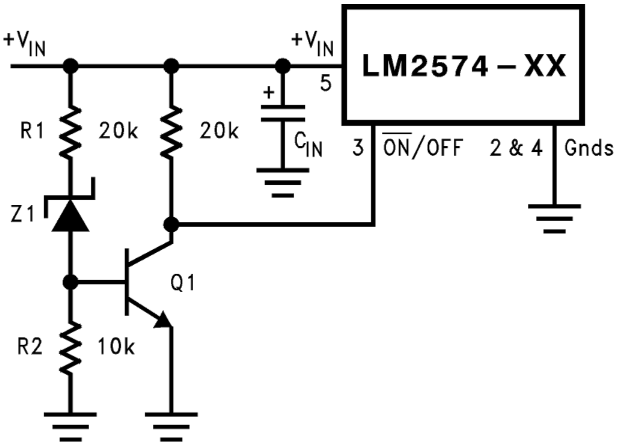
The LM2574 device has current limiting to prevent the switch current from exceeding safe values during an accidental overload on the output. This value (I_{CL}) can be found in *Electrical Characteristics for All Output Voltage Versions*.

7.3.2 Undervoltage Lockout

In some applications, it is desirable to keep the regulator off until the input voltage reaches a certain threshold. An undervoltage lockout circuit which accomplishes this task is shown in Figure 15 while Figure 16 shows the same circuit applied to a buck-boost configuration. These circuits keep the regulator off until the input voltage reaches a predetermined level in Equation 1.

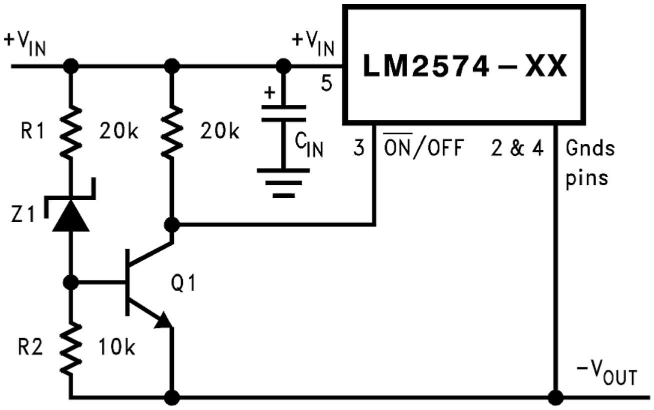
$$V_{TH} \approx V_{Z1} + 2\ V_{BE} \quad (1)$$

Feature Description (continued)



Note: Complete circuit not shown (see Figure 20).
Note: Pin numbers are for 8-pin PDIP package.

Figure 15. Undervoltage Lockout for Buck Circuit



Note: Complete circuit not shown (see Figure 20).
Note: Pin numbers are for 8-pin PDIP package.

Figure 16. Undervoltage Lockout for Buck-Boost Circuit

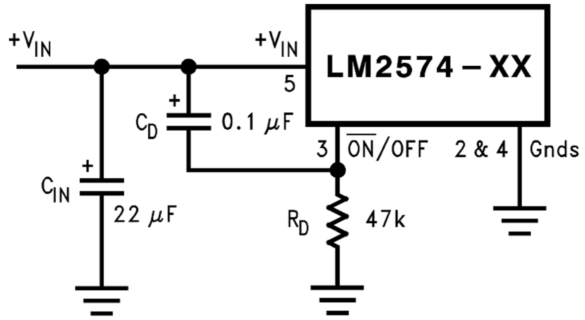
7.3.3 Delayed Start-Up

The $\overline{\text{ON}}$/OFF pin can be used to provide a delayed start-up feature as shown in Figure 17. With an input voltage of 20 V and for the part values shown, the circuit provides approximately 10 ms of delay time before the circuit begins switching. Increasing the RC time constant can provide longer delay times. But excessively large RC time constants can cause problems with input voltages that are high in 60-Hz or 120-Hz ripple, by coupling the ripple into the $\overline{\text{ON}}$/OFF pin.

7.3.4 Adjustable Output, Low-Ripple Power Supply

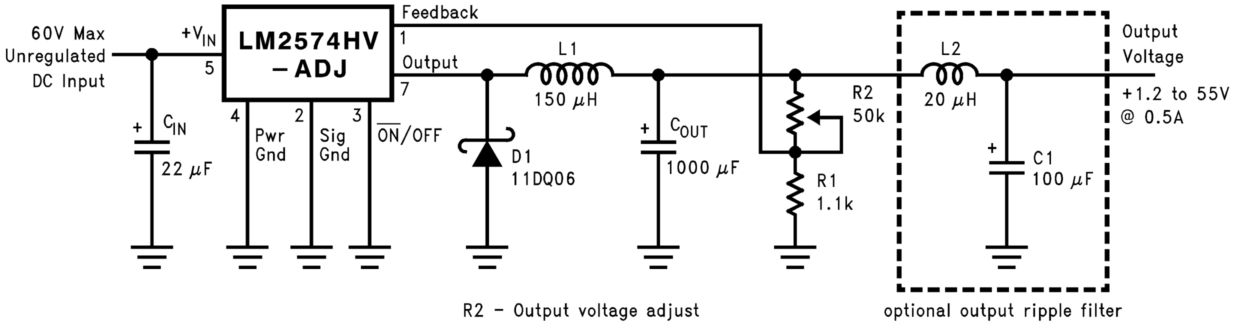
A 500-mA power supply that features an adjustable output voltage is shown in Figure 18. An additional L-C filter that reduces the output ripple by a factor of 10 or more is included in this circuit.

Feature Description (continued)



Note: Complete circuit not shown.
Note: Pin numbers are for 8-pin PDIP package.

Figure 17. Delayed Start-Up



Note: Pin numbers are for 8-pin PDIP package.

Figure 18. 1.2-V to 55-V Adjustable 500-mA Power Supply With Low-Output Ripple

7.4 Device Functional Modes

7.4.1 Shutdown Mode

The $\overline{\text{ON}}$/OFF pin provides electrical ON and OFF control for the LM2574. When the voltage of this pin is higher than 1.4 V, the device is shutdown mode. The typical standby current in this mode is 50 µA.

7.4.2 Active Mode

When the voltage of the ON/OFF pin is below 1.2 V, the device starts switching and the output voltage rises until it reaches a normal regulation voltage.

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

8.1.1 Input Capacitor (C_{IN})

To maintain stability, the regulator input pin must be bypassed with at least a 22-µF electrolytic capacitor. The leads of the capacitor must be kept short, and located near the regulator.

If the operating temperature range includes temperatures below −25°C, the input capacitor value may need to be larger. With most electrolytic capacitors, the capacitance value decreases and the ESR increases with lower temperatures and age. Paralleling a ceramic or solid tantalum capacitor increases the regulator stability at cold temperatures. For maximum capacitor operating lifetime, the RMS ripple current rating of the capacitor must be greater than Equation 2.

$$1.2 \times \frac{t_{ON}}{T} \times I_{LOAD}$$

where

- $\frac{t_{ON}}{T} = \frac{V_{OUT}}{V_{IN}}$ for a buck regulator
- $\frac{t_{ON}}{T} = \frac{|V_{OUT}|}{|V_{OUT}| + V_{IN}}$ for a buck-boost regulator (2)

8.1.2 Inductor Selection

All switching regulators have two basic modes of operation: continuous and discontinuous. The difference between the two types relates to the inductor current, whether it is flowing continuously, or if it drops to zero for a period of time in the normal switching cycle. Each mode has distinctively different operating characteristics, which can affect the regulator performance and requirements.

The LM2574 (or any of the SIMPLE SWITCHER family) can be used for both continuous and discontinuous modes of operation.

In many cases the preferred mode of operation is in the continuous mode. It offers better load regulation, lower peak switch, inductor, and diode currents, and can have lower output ripple voltage. But it does require relatively large inductor values to keep the inductor current flowing continuously, especially at low output load currents.

To simplify the inductor selection process, an inductor selection guide (nomograph) was designed. This guide assumes continuous mode operation, and selects an inductor that allows a peak-to-peak inductor ripple current (ΔI_{IND}) to be a certain percentage of the maximum design load current. In the LM2574 SIMPLE SWITCHER, the peak-to-peak inductor ripple current percentage (of load current) is allowed to change as different design load currents are selected. By allowing the percentage of inductor ripple current to increase for lower current applications, the inductor size and value can be kept relatively low.

8.1.3 Inductor Ripple Current

When the switcher is operating in the continuous mode, the inductor current waveform ranges from a triangular to a sawtooth type of waveform (depending on the input voltage). For a given input voltage and output voltage, the peak-to-peak amplitude of this inductor current waveform remains constant. As the load current rises or falls, the entire sawtooth current waveform also rises or falls. The average DC value of this waveform is equal to the DC load current (in the buck regulator configuration).

Application Information (continued)

If the load current drops to a low enough level, the bottom of the sawtooth current waveform reaches zero, and the switcher changes to a discontinuous mode of operation. This is a perfectly acceptable mode of operation. Any buck switching regulator (no matter how large the inductor value is) is forced to run discontinuous if the load current is light enough.

The curve shown in Figure 19 illustrates how the peak-to-peak inductor ripple current (ΔI_{IND}) is allowed to change as different maximum load currents are selected, and also how it changes as the operating point varies from the upper border to the lower border within an inductance region (see *Inductor Selection*).

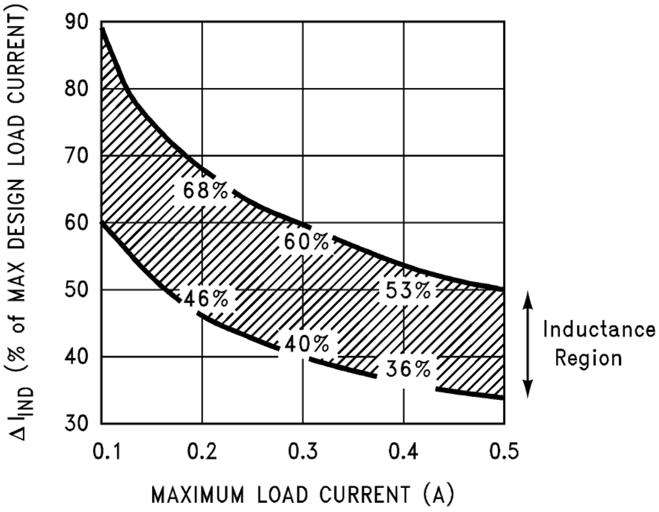


Figure 19. Inductor Ripple Current (Δi_{IND}) Range

Consider the following example:

V_{OUT} = 5 V at 0.4 A

V_{IN} = 10-V minimum up to 20-V maximum

The selection guide in Figure 24 shows that for a 0.4-A load current, and an input voltage range between 10 V and 20 V, the inductance region selected by the guide is 330 µH. This value of inductance allows a peak-to-peak inductor ripple current (ΔI_{IND}) to flow that is a percentage of the maximum load current. For this inductor value, the ΔI_{IND} also varies depending on the input voltage. As the input voltage increases to 20 V, it approaches the upper border of the inductance region, and the inductor ripple current increases. Referring to the curve in Figure 19, it can be seen that at the 0.4-A load current level, and operating near the upper border of the 330-µH inductance region, the ΔI_{IND} is 53% of 0.4 A, or 212 $mA_{p\text{-}p}$.

This ΔI_{IND} is important because from this number the peak inductor current rating can be determined, the minimum load current required before the circuit goes to discontinuous operation, and also, knowing the ESR of the output capacitor, the output ripple voltage can be calculated, or conversely, measuring the output ripple voltage and knowing the ΔI_{IND}, the ESR can be calculated.

From the previous example, the peak-to-peak inductor ripple current (ΔI_{IND}) = 212 $mA_{p\text{-}p}$. When the Δ_{IND} value is known, the following three formulas can be used to calculate additional information about the switching regulator circuit:

1. Peak inductor or peak switch current in Equation 3.

$$= \left(I_{LOAD} + \frac{\Delta I_{IND}}{2} \right) = \left(0.4\text{ A} + \frac{212}{2} \right) = 506\text{ mA} \quad (3)$$

2. Minimum load current before the circuit becomes discontinuous in Equation 4.

$$= \frac{\Delta I_{IND}}{2} = \frac{212}{2} = 106\text{ mA} \quad (4)$$

3. Output ripple voltage = (ΔI_{IND}) × (ESR of C_{OUT})

Application Information (continued)

The selection guide chooses inductor values suitable for continuous mode operation, but if the inductor value chosen is prohibitively high, the designer should investigate the possibility of discontinuous operation.

Inductors are available in different styles such as pot core, toroid, E-frame, bobbin core, and so forth, as well as different core materials, such as ferrites and powdered iron. The least expensive, the bobbin core type, consists of wire wrapped on a ferrite rod core. This type of construction makes for an inexpensive inductor, but because the magnetic flux is not completely contained within the core, it generates more electro-magnetic interference (EMI). This EMI can cause problems in sensitive circuits, or can give incorrect scope readings because of induced voltages in the scope probe.

The inductors listed in the selection chart include powdered iron toroid for Pulse Engineering, and ferrite bobbin core for Renco.

An inductor must not be operated beyond its maximum rated current because it may saturate. When an inductor begins to saturate, the inductance decreases rapidly and the inductor begins to look mainly resistive (the DC resistance of the winding). This can cause the inductor current to rise very rapidly and affects the energy storage capabilities of the inductor and could cause inductor overheating. Different inductor types have different saturation characteristics, and consider this when selecting an inductor. The inductor manufacturers' data sheets include current and energy limits to avoid inductor saturation.

8.1.4 Output Capacitor

An output capacitor is required to filter the output voltage and is needed for loop stability. The capacitor must be located near the LM2574 using short PCB traces. Standard aluminum electrolytics are usually adequate, but low ESR types are recommended for low output ripple voltage and good stability. The ESR of a capacitor depends on many factors, some which are: the value, the voltage rating, physical size, and the type of construction. In general, low-value or low-voltage (less than 12 V) electrolytic capacitors usually have higher ESR numbers.

The amount of output ripple voltage is primarily a function of the equivalent series resistance (ESR) of the output capacitor and the amplitude of the inductor ripple current, ΔI_{IND} (see *インダクタのリップル電流(ΔI_{IND})*).

The lower capacitor values (100 μF to 330 μF) allows typically 50 mV to 150 mV of output ripple voltage, while larger-value capacitors reduce the ripple to approximately 20 mV to 50 mV (as seen in Equation 5).

$$\text{Output Ripple Voltage} = (\Delta I_{IND})\ (\text{ESR of } C_{OUT}) \tag{5}$$

To further reduce the output ripple voltage, several standard electrolytic capacitors may be paralleled, or a higher-grade capacitor may be used. Such capacitors are often called high-frequency, low-inductance, or low-ESR. These reduce the output ripple to 10 mV or 20 mV. However, when operating in the continuous mode, reducing the ESR below 0.03 Ω can cause instability in the regulator.

Tantalum capacitors can have a very low ESR, and must be carefully evaluated if it is the only output capacitor. Because of their good low temperature characteristics, a tantalum can be used in parallel with aluminum electrolytics, with the tantalum making up 10% or 20% of the total capacitance.

The ripple current rating of the capacitor at 52 kHz must be at least 50% higher than the peak-to-peak inductor ripple current.

8.1.5 Catch Diode

Buck regulators require a diode to provide a return path for the inductor current when the switch is off. This diode must be located close to the LM2574 using short leads and short printed-circuit traces.

Because of their fast switching speed and low forward voltage drop, Schottky diodes provide the best efficiency, especially in low output voltage switching regulators (less than 5 V). fast-recovery, high-efficiency, or ultra-fast recovery diodes are also suitable, but some types with an abrupt turnoff characteristic may cause instability and EMI problems. A fast-recovery diode with soft recovery characteristics is a better choice. Standard 60-Hz diodes (for example, 1N4001 or 1N5400, and so forth) are also not suitable. See Table 1 for Schottky and soft fast-recovery diode selection guide.

Table 1. Diode Selection Guide

V_R	1-A DIODES	
	SCHOTTKY	FAST RECOVERY
20 V	1N5817 SR102 MBR120P	The following diodes are all rated to 100 V 11DF1 10JF1 MUR110 HER102
30 V	1N5818 SR103 11DQ03 MBR130P 10JQ030	
40 V	1N5819 SR104 11DQ04 11JQ04 MBR140P	
50 V	MBR150 SR105 11DQ05 11JQ05	
60 V	MBR160 SR106 11DQ06 11JQ06	
90 V	11DQ09	

8.1.6 Output Voltage Ripple and Transients

The output voltage of a switching power supply contains a sawtooth ripple voltage at the switcher frequency, typically about 1% of the output voltage, and may also contain short voltage spikes at the peaks of the sawtooth waveform.

The output ripple voltage is due mainly to the inductor sawtooth ripple current multiplied by the ESR of the output capacitor (see *Inductor Selection*).

The voltage spikes are present because of the fast switching action of the output switch, and the parasitic inductance of the output filter capacitor. To minimize these voltage spikes, special low inductance capacitors can be used, and their lead lengths must be kept short. Wiring inductance, stray capacitance, as well as the scope probe used to evaluate these transients, all contribute to the amplitude of these spikes.

An additional small LC filter (20 µH and 100 µF) can be added to the output (as shown in Figure 18) to further reduce the amount of output ripple and transients. A 10 × reduction in output ripple voltage and transients is possible with this filter.

8.1.7 Feedback Connection

The LM2574 (fixed voltage versions) feedback pin must be wired to the output voltage point of the switching power supply. When using the adjustable version, physically locate both output voltage programming resistors near the LM2574 to avoid picking up unwanted noise. Avoid using resistors greater than 100 kΩ because of the increased chance of noise pickup.

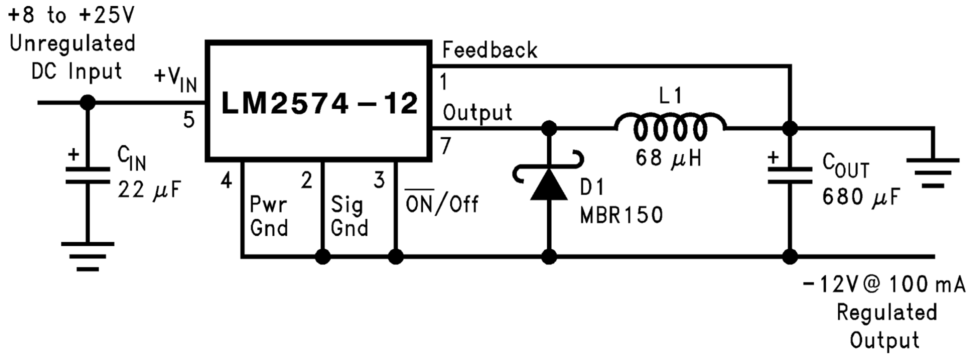
8.1.8 $\overline{\text{ON}}$/OFF Input

For normal operation, the $\overline{\text{ON}}$/OFF pin must be grounded or driven with a low-level TTL voltage (typically less than 1.6 V). To put the regulator into standby mode, drive this pin with a high-level TTL or CMOS signal. The $\overline{\text{ON}}$/OFF pin can be safely pulled up to $+V_{IN}$ without a resistor in series with it. The $\overline{\text{ON}}$/OFF pin must not be left open.

8.1.9 Additional Applications

8.1.9.1 Inverting Regulator

Figure 20 shows a LM2574-12 in a buck-boost configuration to generate a negative 12-V output from a positive input voltage. This circuit bootstraps the ground pin of the regulator to the negative output voltage, then by grounding the feedback pin, the regulator senses the inverted output voltage and regulates it to −12 V.



Note: Pin numbers are for the 8-pin PDIP package.

Figure 20. Inverting Buck-Boost Develops, 12 V

For an input voltage of 8 V or more, the maximum available output current in this configuration is approximately 100 mA. At lighter loads, the minimum input voltage required drops to approximately 4.7 V.

The switch currents in this buck-boost configuration are higher than in the standard buck-mode design, thus lowering the available output current. Also, the start-up input current of the buck-boost converter is higher than the standard buck-mode regulator, and this may overload an input power source with a current limit less than 0.6 A. Using a delayed turnon or an undervoltage lockout circuit (described in *Negative Boost Regulator*) would allow the input voltage to rise to a high enough level before the switcher would be allowed to turn on.

Because of the structural differences between the buck and the buck-boost regulator topologies, the design procedure can not be used to select the inductor or the output capacitor. The recommended range of inductor values for the buck-boost design is between 68 μH and 220 μH, and the output capacitor values must be larger than what is normally required for buck designs. Low-input voltages or high-output currents require a large value output capacitor (in the thousands of micro Farads).

The peak inductor current, which is the same as the peak switch current, can be calculated from Equation 6.

$$I_P \approx \frac{I_{LOAD} \times \left(V_{IN} + |V_{OUT}|\right)}{V_{IN}} + \frac{V_{IN} \times |V_{OUT}|}{V_{IN} + |V_{OUT}|} \times \frac{1}{2 \times L_1 \times f_{OSC}}$$

where

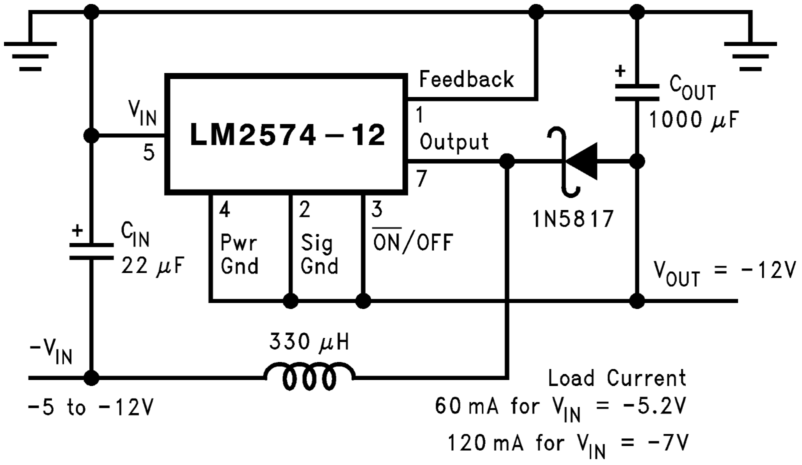
- f_{osc} = 52 kHz. Under normal continuous inductor current operating conditions,
- the minimum V_{IN} represents the worst case. Select an inductor that is rated for the peak current anticipated.

(6)

Also, the maximum voltage appearing across the regulator is the absolute sum of the input and output voltage. For a −12-V output, the maximum input voltage for the LM2574 is 28 V, or 48 V for the LM2574HV.

8.1.9.2 Negative Boost Regulator

Another variation on the buck-boost topology is the negative boost configuration. The circuit in Figure 21 accepts an input voltage ranging from −5 V to −12 V and provides a regulated −12-V output. Input voltages greater than −12 V causes the output to rise greater than −12 V, but does not damage the regulator.



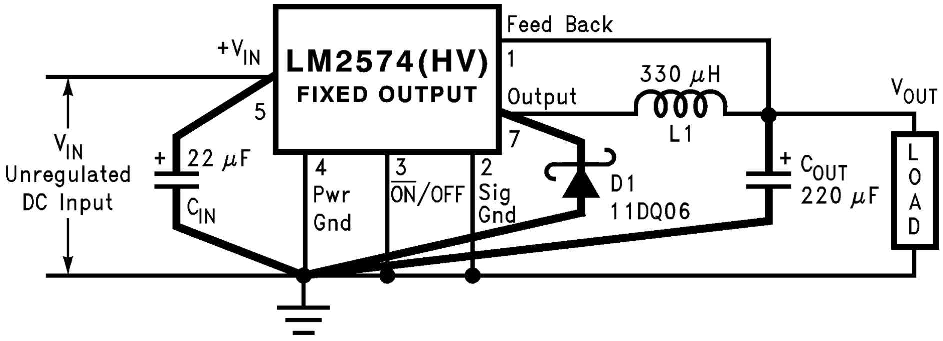
Note: Pin numbers are for 8-pin PDIP package.

Figure 21. Negative Boost

Because of the boosting function of this type of regulator, the switch current is relatively high, especially at low input voltages. Output load current limitations are a result of the maximum current rating of the switch. Also, boost regulators can not provide current-limiting load protection in the event of a shorted load, so some other means (such as a fuse) may be necessary.

8.2 Typical Applications

8.2.1 Fixed Output Voltage Applications



C_{IN}: 22 µF, 75 V
Aluminum electrolytic
C_{OUT}: 220 µF, 25 V
Aluminum electrolytic
D1: Schottky, 11DQ06
L1: 330 µH, 52627
(for 5 V in, 3.3 V out, use
100 µH, RL-1284-100)
R1: 2k, 0.1%
R2: 6.12k, 0.1%

Figure 22. Fixed Output Voltage Versions

Typical Applications (continued)

8.2.1.1 Design Requirements

The design requirements for the fixed output voltage application is provided in Table 2.

Table 2. Design Parameters

PARAMETER	EXAMPLE VALUE
Regulated output voltage (3.3 V, 5 V, 12 V, or 15 V), V_{OUT}	5 V
Maximum input voltage, V_{IN}(Max)	15 V
Maximum load current, I_{LOAD}(Max)	0.4 A

8.2.1.2 Detailed Design Procedure

8.2.1.2.1 Custom Design With WEBENCH® Tools

Click here to create a custom design using the LM2574 device with the WEBENCH® Power Designer.

1. Start by entering the input voltage (V_{IN}), output voltage (V_{OUT}), and output current (I_{OUT}) requirements.
2. Optimize the design for key parameters such as efficiency, footprint, and cost using the optimizer dial.
3. Compare the generated design with other possible solutions from Texas Instruments.

The WEBENCH Power Designer provides a customized schematic along with a list of materials with real-time pricing and component availability.

In most cases, these actions are available:

- Run electrical simulations to see important waveforms and circuit performance
- Run thermal simulations to understand board thermal performance
- Export customized schematic and layout into popular CAD formats
- Print PDF reports for the design, and share the design with colleagues

Get more information about WEBENCH tools at www.ti.com/WEBENCH.

8.2.1.2.2 Inductor Selection (L1)

Select the correct Inductor value selection guide from Figure 23, Figure 24, Figure 25, or Figure 26 (output voltages of 3.3 V, 5 V, 12 V, or 15 V respectively).

From the inductor value selection guide, identify the inductance region intersected by V_{IN}(Max) and I_{LOAD}(Max). The inductance area intersected by the 15-V line and 0.4-A line is 330.

Select an appropriate inductor from Table 3. Part numbers are listed for three inductor manufacturers. The inductor chosen must be rated for operation at the LM2574 switching frequency (52 kHz) and for a current rating of 1.5 × I_{LOAD}. For additional inductor information, see *Inductor Selection*. The required inductor value is 330 μH. From Table 3, choose Pulse Engineering PE-52627, Renco RL-1284-330, or NPI NP5920/5921.

Table 3. Inductor Selection By Manufacturer's Part Number

INDUCTOR VALUE	PULSE ENG.	RENCO	NPI
68 µH	*	RL-1284-68-43	NP5915
100 µH	*	RL-1284-100-43	NP5916
150 µH	52625	RL-1284-150-43	NP5917
220 µH	52626	RL-1284-220-43	NP5918/5919
330 µH	52627	RL-1284-330-43	NP5920/5921
470 µH	52628	RL-1284-470-43	NP5922
680 µH	52629	RL-1283-680-43	NP5923
1000 µH	52631	RL-1283-1000-43	*
1500 µH	*	RL-1283-1500-43	*
2200 µH	*	RL-1283-2200-43	*

8.2.1.2.3 Output Capacitor Selection (C_{OUT})

The value of the output capacitor together with the inductor defines the dominate pole-pair of the switching regulator loop. For stable operation and an acceptable output ripple voltage, (approximately 1% of the output voltage) a value between 100 µF and 470 µF is recommended. C_{OUT} = 100-µF to 470-µF standard aluminum electrolytic.

The voltage rating of the capacitor must be at least 1.5 times greater than the output voltage. For a 5-V regulator, a rating of at least 8 V is appropriate, and a 10-V or 15-V rating is recommended. Capacitor voltage rating = 20 V.

Higher voltage electrolytic capacitors generally have lower ESR numbers, and for this reason it may be necessary to select a capacitor rated for a higher voltage than would normally be needed.

8.2.1.2.4 Catch Diode Selection (D1)

The catch-diode current rating must be at least 1.5 times greater than the maximum load current. Also, if the power supply design must withstand a continuous output short, the diode must have a current rating equal to the maximum current limit of the LM2574. The most stressful condition for this diode is an overload or shorted output condition. For this example, a 1-A current rating is adequate.

The reverse voltage rating of the diode must be at least 1.25 times the maximum input voltage. Use a 20-V 1N5817 or SR102 Schottky diode, or any of the suggested fast-recovery diodes shown in Table 1.

8.2.1.2.5 Input Capacitor (C_{IN})

An aluminum or tantalum electrolytic bypass capacitor located close to the regulator is needed for stable operation. A 22-µF aluminum electrolytic capacitor located near the input and ground pins provides sufficient bypassing.

8.2.1.3 Application Curves

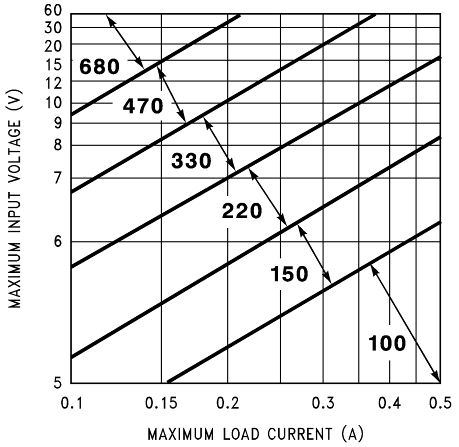


Figure 23. 3.3-V LM2574HV Inductor Selection Guide

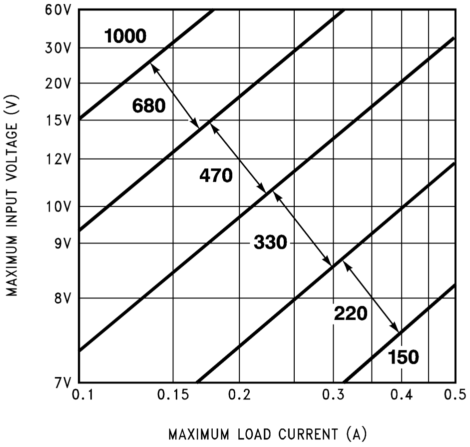


Figure 24. 5-V LM2574HV Inductor Selection Guide

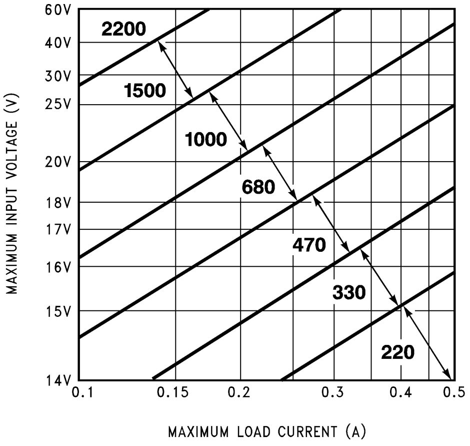


Figure 25. 12-V LM2574HV Inductor Selection Guide

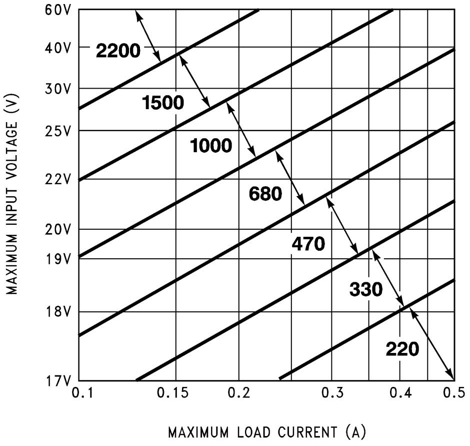


Figure 26. 15-V LM2574HV Inductor Selection Guide

8.2.2 Adjustable Output Voltage Applications

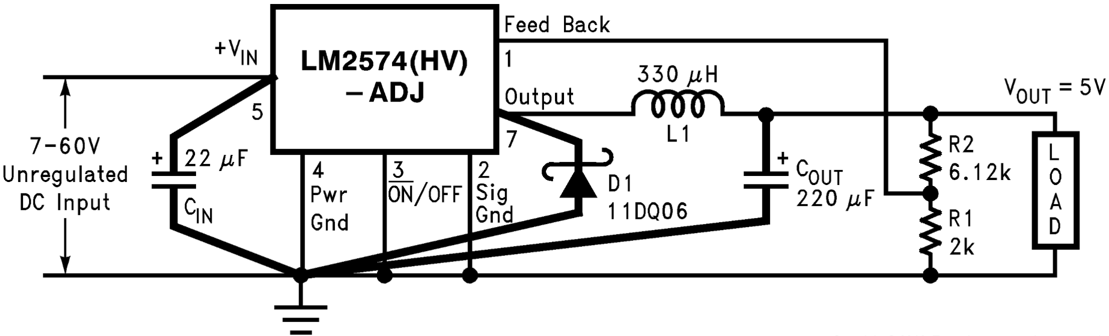


Figure 27. Adjustable Output Voltage Version

8.2.2.1 Design Requirements

The design requirements for the fixed output voltage application is provided in Table 4.

Table 4. Design Parameters

PARAMETER	EXAMPLE VALUE
Regulated output voltage, V_{OUT}	24 V
Maximum input voltage, V_{IN}(Max)	40 V
Maximum load current, I_{LOAD}(Max)	0.4 A
Switching frequency, F	52 kHz

8.2.2.2 Detailed Design Procedure

8.2.2.2.1 Programming Output Voltage

Selecting R1 and R2, as shown in Figure 27.

Use Equation 7 to select the appropriate resistor values.

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_2}{R_1}\right)$$

where

- $V_{REF} = 1.23$ V (7)

R_1 can be between 1k and 5k as in Equation 8. For best temperature coefficient and stability with time, use 1% metal film resistors.

$$R_2 = R_1 \times \left(\frac{V_{OUT}}{V_{REF}} - 1\right) \tag{8}$$

For this example, use Equation 9 and Equation 10.

$$V_{OUT} = 1.23 \times \left(1 + \frac{R_2}{R_1}\right)$$

select

- R1 = 1k (9)

$$R_2 = R_1 \times \left(\frac{V_{OUT}}{V_{REF}} - 1\right) = 1\text{k} \times \left(\frac{24\text{ V}}{1.23\text{ V}} - 1\right) \tag{10}$$

R_2 = 1k (19.51−1) = 18.51k, closest 1% value is 18.7k

8.2.2.2.2 Inductor Selection (L1)

Calculate the inductor Volt × microsecond constant, E × T (V × µs), from Equation 11.

$$E \times T = \left(V_{IN} - V_{OUT}\right) \times \frac{V_{OUT}}{V_{IN}} \times \frac{1000}{F\left(kHz\right)} \left(V \times \mu s\right) \tag{11}$$

For this example, calculate E × T (V × µs) using Equation 12.

$$E \times T = \left(40 - 24\right) \times \frac{24}{40} \times \frac{1000}{52} = 185\ V \times \mu s \tag{12}$$

Use the E × T value from the previous formula and match it with the E × T number on the vertical axis of the inductor value selection guide shown in Figure 32. For this example, E × T = 185 V × µs.

On the horizontal axis, select the maximum load current, I_{LOAD}(Max) = 0.4 A.

Identify the inductance region intersected by the E × T value and the maximum load current value, and note the inductor value for that region, inductance region = 1000.

Select an appropriate inductor from the table shown in Table 3. Part numbers are listed for three inductor manufacturers. The inductor chosen must be rated for operation at the LM2574 switching frequency (52 kHz) and for a current rating of 1.5 × I_{LOAD}. For additional inductor information, see *Inductor Selection*.

8.2.2.2.3 Output Capacitor Selection (C_{OUT})

The value of the output capacitor together with the inductor defines the dominate pole-pair of the switching regulator loop. For stable operation, the capacitor must satisfy the requirement in Equation 13.

$$C_{OUT} \geq 13300 \times \frac{V_{IN(MAX)}}{V_{OUT} \times L\left(\mu H\right)} \left(\mu F\right) \tag{13}$$

Equation 13 yields capacitor values between 5 µF and 1000 µF that satisfies the loop requirements for stable operation. But to achieve an acceptable output ripple voltage, (approximately 1% of the output voltage) and transient response, the output capacitor may need to be several times larger than the above formula yields.

The voltage rating of the capacitor must be at last 1.5 times greater than the output voltage. For a 24-V regulator, a rating of at least 35 V is recommended. Higher voltage electrolytic capacitors generally have lower ESR numbers, and for this reasion it may be necessary to select a capacitor rate for a higher voltage than would normally be needed.

$$C_{OUT} > 13300 \times \frac{40}{24 \times 1000} = 22.2\ \mu F \tag{14}$$

However, for acceptable output ripple voltage select:

C_{OUT} ≥ 100 µF

C_{OUT} = 100 µF electrolytic capacitor

8.2.2.2.4 Catch Diode Selection (D1)

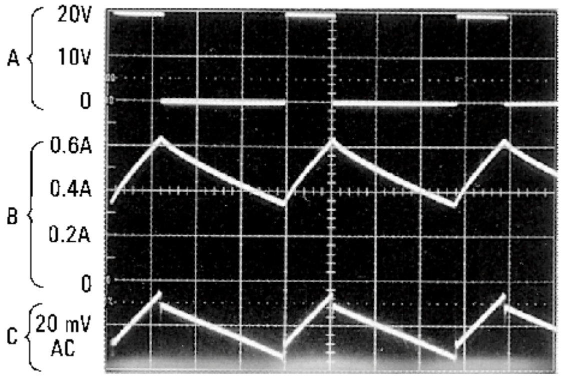
The catch-diode current rating must be at least 1.5 times greater than the maximum load current. Also, if the power supply design must withstand a continuous output short, the diode must have a current rating equal to the maximum current limit of the LM2574. The most stressful condition for this diode is an overload or shorted output condition. Suitable diodes are shown in Table 1. For this example, a 1-A current rating is adequate.

The reverse voltage rating of the diode must be at least 1.25 times the maximum input voltage. Use a 50-V MBR150 or 11DQ05 Schottky diode, or any of the suggested fast-recovery diodes in Table 1.

8.2.2.2.5 Input Capacitor (C_{IN})

An aluminum or tantalum electrolytic bypass capacitor located close to the regulator is needed for stable operation. A 22-µF aluminum electrolytic capacitor located near the input and ground pins provides sufficient bypassing (see Table 1).

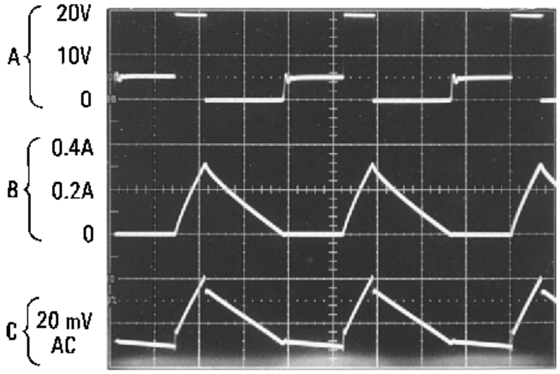
8.2.2.3 Application Curves



Output pin voltage, 10 V/div,
Inductor current, 0.2 A/div,
Output ripple voltage,
20 mV/div,
AC-coupled

Horizontal time base,
5 µs/div,
V_{OUT} = 5 V,
500-mA load current,
L = 330 Mh

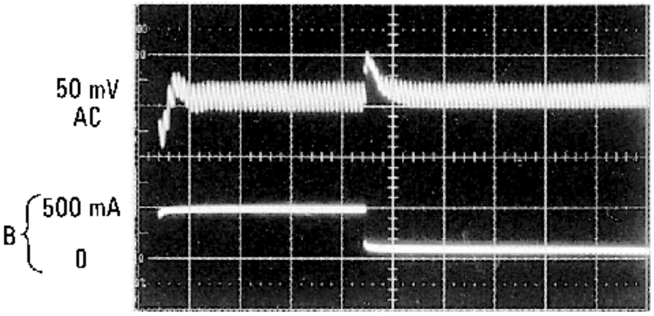
Figure 28. Continuous Mode Switching Waveforms



Output pin voltage, 10 V/div,
Inductor current, 0.2 A/div,
Output ripple voltage,
20 mV/div,
AC-coupled

Horizontal time base,
5 µs/div,
V_{OUT} = 5 V,
100-mA load current,
L = 100 Mh

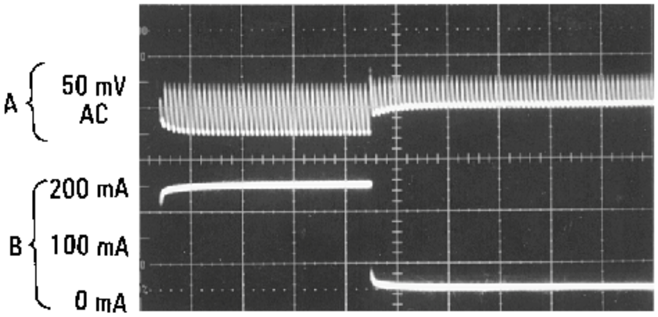
Figure 29. Discontinuous Mode Switching Waveforms



Output voltage, 50 V/div,
AC-coupled,
100-mA to 500-mA load pulse,
Horizontal time base: 200 µs/div

500 mA load,
L = 330 Mh,
C_{OUT} = 300 Mf,

Figure 30. Transient Response for Continuous Mode Operation



Output voltage, 50 V/div,
AC-coupled,
50-mA to 250-mA load pulse,
Horizontal time base: 200 µs/div

250 mA load,
L = 68 Mh,
C_{OUT} = 470 Mf,

Figure 31. Transient Response for Discontinuous Mode Operation

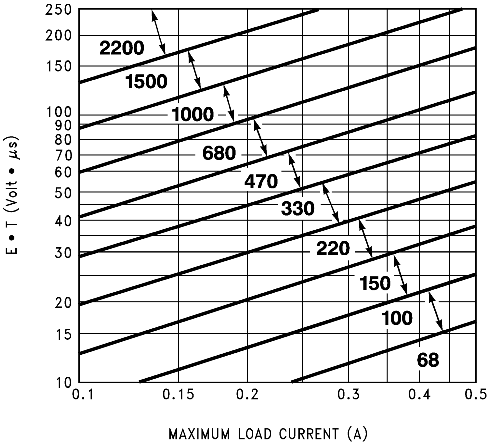


Figure 32. Adjustable LM2574HV Inductor Selection Guide

9 Power Supply Recommendations

As in any switching regulator, layout is very important. Rapidly switching currents associated with wiring inductance generate voltage transients which can cause problems. For minimal inductance and ground loops, the length of the leads indicated by heavy lines must be kept as short as possible. Single-point grounding (as indicated) or ground plane construction must be used for best results. When using the adjustable version, physically locate the programming resistors near the regulator, to keep the sensitive feedback wiring short.

10 Layout

10.1 Layout Guidelines

The layout is critical for the proper operation of switching power supplies. First, the ground plane area must be sufficient for thermal dissipation purposes. Second, appropriate guidelines must be followed to reduce the effects of switching noise. Switch mode converters are very fast switching devices. In such cases, the rapid increase of input current combined with the parasitic trace inductance generates unwanted L di/dt noise spikes. The magnitude of this noise tends to increase as the output current increases. This noise may turn into electromagnetic interference (EMI) and can also cause problems in device performance. Therefore, take care in the layout to minimize the effect of this switching noise.

The most important layout rule is to keep the AC current loops as small as possible. Figure 33 shows the current flow in a buck converter. The top schematic shows a dotted line which represents the current flow during the top switch ON-state. The middle schematic shows the current flow during the top switch OFF-state. The bottom schematic shows the currents referred to as AC currents. These AC currents are the most critical because they are changing in a very short time period. The dotted lines of the bottom schematic are the traces to keep as short and wide as possible. This also yields a small loop area reducing the loop inductance. To avoid functional problems due to layout, review the PCB layout example. Best results are achieved if the placement of the LM2574 device, the bypass capacitor, the Schottky diode, RFBB, RFBT, and the inductor are placed as shown in the example. In the layout shown, R1 = RFBB and R2 = RFBT. TI also recommends using 2-oz. copper boards or heavier to help thermal dissipation and to reduce the parasitic inductances of board traces. See the application note *AN-1229 SIMPLE SWITCHER® PCB Layout Guidelines* (SNVA054) for more information.

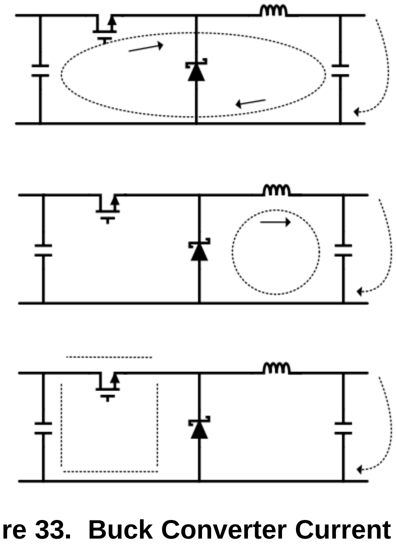


Figure 33. Buck Converter Current Flow

10.2 Layout Example

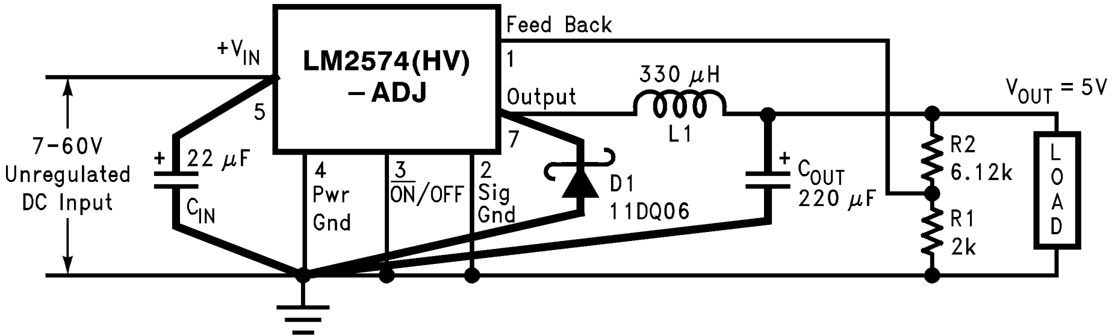


Figure 34. LM2574 Adjustable Output Voltage Layout

10.3 Grounding

The 8-pin molded PDIP and the 14-pin SOIC package have separate power and signal ground pins. Both ground pins must be soldered directly to wide printed-circuit board copper traces to assure low inductance connections and good thermal properties.

10.4 Thermal Considerations

The 8-pin PDIP (P) package and the 14-pin SOIC (NPA) package are molded plastic packages with solid copper lead frames. The copper lead frame conducts the majority of the heat from the die, through the leads, to the printed-circuit board copper, which acts as the heat sink. For best thermal performance, wide copper traces must be used, and all ground and unused pins must be soldered to generous amounts of printed-circuit board copper, such as a ground plane. Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and even double-sided or multilayer boards provide better heat paths to the surrounding air. Unless the power levels are small, using a socket for the 8-pin package is not recommended because of the additional thermal resistance it introduces, and the resultant higher junction temperature.

Because of the 0.5-A current rating of the LM2574, the total package power dissipation for this switcher is quite low, ranging from approximately 0.1 W up to 0.75 W under varying conditions. In a carefully engineered printed-circuit board, both the P and the NPA package can easily dissipate up to 0.75 W, even at ambient temperatures of 60°C, and still keep the maximum junction temperature less than 125°C.

A curve, Figure 14, displaying thermal resistance versus PCB area for the two packages is shown in *Typical Characteristics*.

These thermal resistance numbers are approximate, and there can be many factors that affect the final thermal resistance. Some of these factors include board size, shape, thickness, position, location, and board temperature. Other factors are, the area of printed-circuit copper, copper thickness, trace width, multi-layer, single- or double-sided, and the amount of solder on the board. The effectiveness of the PCB to dissipate heat also depends on the size, number and spacing of other components on the board. Furthermore, some of these components, such as the catch diode and inductor generate some additional heat. Also, the thermal resistance decreases as the power level increases because of the increased air current activity at the higher power levels, and the lower surface to air resistance coefficient at higher temperatures.

The data sheet thermal resistance curves can estimate the maximum junction temperature based on operating conditions. In addition, the junction temperature can be estimated in actual circuit operation by using Equation 15.

$$T_j = T_{cu} + (\theta_{j\text{-}cu} \times P_D) \tag{15}$$

Thermal Considerations (continued)

With the switcher operating under worst case conditions and all other components on the board in the intended enclosure, measure the copper temperature (T_{cu}) near the IC. This can be done by temporarily soldering a small thermocouple to the PCB copper near the IC, or by holding a small thermocouple on the PCB copper using thermal grease for good thermal conduction.

The thermal resistance ($\theta_{j\text{-}cu}$) for the two packages is:

$\theta_{j\text{-}cu}$ = 42°C/W for the P-8 package

$\theta_{j\text{-}cu}$ = 52°C/W for the NPA-14 package

The power dissipation (P_D) for the IC could be measured, or it can be estimated by using Equation 16.

$$P_D = V_{IN} \times I_S + \frac{V_{OUT}}{V_{IN}} \times I_{LOAD} \times V_{SAT} \tag{16}$$

where

- I_S is obtained from the typical supply current curve (adjustable version use the supply current vs duty cycle curve)

11 デバイスおよびドキュメントのサポート

11.1 デバイス・サポート

11.1.1 デベロッパー・ネットワークの製品に関する免責事項

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11.1.2 WEBENCH®ツールによるカスタム設計

ここをクリックすると、WEBENCH® Power Designerにより、LM2574を使用するカスタム設計を作成できます。

1. 最初に、入力電圧(V_{IN})、出力電圧(V_{OUT})、出力電流(I_{OUT})の要件を入力します。
2. オプティマイザのダイヤルを使用して、効率、占有面積、コストなどの主要なパラメータについて設計を最適化します。
3. 生成された設計を、テキサス・インスツルメンツが提供する他の方式と比較します。

WEBENCH Power Designerでは、カスタマイズされた回路図と部品リストを、リアルタイムの価格と部品の在庫情報と併せて参照できます。

通常、次の操作を実行可能です。

- 電気的なシミュレーションを実行し、重要な波形と回路の性能を確認する。
- 熱シミュレーションを実行し、基板の熱特性を把握する。
- カスタマイズされた回路図やレイアウトを、一般的なCADフォーマットで出力する。
- 設計のレポートをPDFで印刷し、設計を共有する。

WEBENCHツールの詳細は、www.ti.com/WEBENCHでご覧になれます。

11.1.3 デバイスの項目表記

11.1.3.1 降圧レギュレータ

スイッチング・レギュレータのトポロジで、高い電圧から低い電圧への変換を行うもの。降圧型スイッチング・レギュレータとも呼ばれます。

11.1.3.2 昇降圧レギュレータ

スイッチング・レギュレータのトポロジで、正の電圧を変圧器なしに負の電圧へ変換するもの。

11.1.3.3 デューティ・サイクル(D)

発振器の周期に対する出力スイッチのオン時間の比率。降圧レギュレータの場合は 式 17 で、降昇圧レギュレータの場合は 式 18 で計算します。

$$D = \frac{t_{ON}}{T} = \frac{V_{OUT}}{V_{IN}} \tag{17}$$

$$D = \frac{t_{ON}}{T} = \frac{|V_{OUT}|}{|V_{OUT}| + V_{IN}} \tag{18}$$

11.1.3.4 キャッチ・ダイオードまたは電流ステアリング・ダイオード

LM2574スイッチがOFFのとき、負荷電流の復帰パスを提供するダイオード。

効率(η)は、入力電力のうち、実際に負荷へ供給される電力の割合。式 19 で計算します。

$$\eta = \frac{P_{OUT}}{P_{IN}} = \frac{P_{OUT}}{P_{OUT} + P_{LOSS}} \tag{19}$$

デバイス・サポート (continued)

11.1.3.5　コンデンサの等価直列抵抗(ESR)

実際のコンデンサのインピーダンスのうち、純粋に抵抗性の成分(図 35 を参照)。この成分は電力損失を引き起こし、コンデンサの発熱の原因となり、コンデンサの動作寿命に直接影響します。スイッチング・レギュレータの出力フィルタとして使用される場合、ESRの値が大きいと、出力リップル電圧の増大の原因となります。

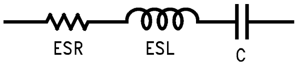

図 35. 実際のコンデンサの単純なモデル

ほとんどの標準的な、100µF〜1000µFの範囲のアルミニウム電解コンデンサでは、ESRは0.5Ω〜0.1Ωです。より高グレードのコンデンサ(*低ESR*、*高周波数*、または*低インダクタンス*)では、100µF〜1000µFの範囲でESRは一般に0.15Ω未満です。

11.1.3.6　等価直列インダクタンス(ESL)

コンデンサの純粋なインダクタンス成分(図 35 を参照)。インダクタンスの量は、主にコンデンサの構造で決定されます。降圧レギュレータでは、この望ましくないインダクタンスにより、出力に電圧スパイクが出現します。

11.1.3.7　出力リップル電圧

スイッチング・レギュレータの出力電圧のAC成分。通常は、出力コンデンサのESRと、インダクタのリップル電流(ΔI_{IND})とを掛け合わせた結果により、ほぼ決定されます。このこぎり波リップル電流のピーク・ツー・ピーク値は、「*インダクタのリップル電流(ΔI_{IND})*」を参照して決定できます。

11.1.3.8　コンデンサのリップル電流

指定された温度において、コンデンサが継続的に動作可能な、許容される最大の交流電流のRMS値。

11.1.3.9　スタンバイ時静止電流(I_{STBY})

LM2574がスタンバイ・モード($\overline{ON}$/OFFピンがTTL-High電圧に駆動され、出力スイッチがOFFになっている)のときに必要な供給電流。

11.1.3.10　インダクタのリップル電流(ΔI_{IND})

インダクタの電流波形のピーク・ツー・ピーク値で、レギュレータが連続モードで(不連続モードではなく)動作しているときは、一般にのこぎり波です。

11.1.3.11　連続/不連続モードの動作

インダクタの電流に関係します。連続モードでは、インダクタの電流は常に流れ続け、0に落ちることはありません。これに対して不連続モードでは、通常のスイッチング・サイクルにおいて一定時間、インダクタの電流が0に落ちます。

11.1.3.12　インダクタの飽和

インダクタがそれ以上の磁束を保持できなくなる条件。インダクタが飽和すると、そのインダクタは誘導性が低くなり、抵抗性の成分が主になります。このとき、インダクタの電流は配線のDC抵抗と、利用可能なソース電流のみによって制限されます。

11.1.3.13　動作電圧のマイクロ秒定数($E \cdot T_{op}$)

インダクタに印加される電圧とその電圧が印加される時間との積(単位: Volt•µs)です。このE•T_{op}定数は、インダクタのエネルギー処理能力の指標で、コアの種類、コアの面積、巻数、デューティ・サイクルに依存します。

11.2　ドキュメントのサポート

11.2.1　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-1229 SIMPLE SWITCHER® PCBレイアウト・ガイドライン』、SNVA054

11.3 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。

11.4 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.

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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。

11.5 商標

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WEBENCH, SIMPLE SWITCHER are registered trademarks of Texas Instruments.
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11.7 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 part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM2574HVM-12/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -12 P+
LM2574HVM-12/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -12 P+
LM2574HVM-15/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -15 P+
LM2574HVM-15/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -15 P+
LM2574HVM-3.3/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -3.3 P+
LM2574HVM-3.3/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -3.3 P+
LM2574HVM-5.0/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -5.0 P+
LM2574HVM-5.0/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -5.0 P+
LM2574HVM-ADJ/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -ADJ P+
LM2574HVM-ADJ/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -ADJ P+
LM2574HVMX-12/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -12 P+
LM2574HVMX-12/NOPB.B	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -12 P+
LM2574HVMX-15/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -15 P+
LM2574HVMX-15/NOPB.B	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -15 P+
LM2574HVMX-3.3/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -3.3 P+
LM2574HVMX-5.0/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -5.0 P+

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM2574HVMX-ADJ/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574HVM -ADJ P+
LM2574HVN-12/NOPB	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	Call TI | Nipdau	Level-1-NA-UNLIM	-40 to 125	LM2574HVN -12 P+
LM2574HVN-12/NOPB.B	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574HVN -12 P+
LM2574HVN-15/NOPB	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574HVN -15 P+
LM2574HVN-15/NOPB.B	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574HVN -15 P+
LM2574HVN-5.0/NOPB	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574HVN -5.0 P+
LM2574HVN-5.0/NOPB.B	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574HVN -5.0 P+
LM2574HVN-ADJ/NOPB	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574HVN -ADJ P+
LM2574HVN-ADJ/NOPB.B	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574HVN -ADJ P+
LM2574M-12/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -12 P+
LM2574M-12/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -12 P+
LM2574M-3.3/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -3.3 P+
LM2574M-3.3/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -3.3 P+
LM2574M-5.0/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -5.0 P+
LM2574M-5.0/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -5.0 P+
LM2574M-ADJ/NOPB	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -ADJ P+
LM2574M-ADJ/NOPB.B	Active	Production	SOIC (NPA) | 14	50 | TUBE	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -ADJ P+

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM2574MX-12/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -12 P+
LM2574MX-12/NOPB.B	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -12 P+
LM2574MX-3.3/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -3.3 P+
LM2574MX-3.3/NOPB.B	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -3.3 P+
LM2574MX-5.0/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -5.0 P+
LM2574MX-5.0/NOPB.B	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -5.0 P+
LM2574MX-ADJ/NOPB	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -ADJ P+
LM2574MX-ADJ/NOPB.B	Active	Production	SOIC (NPA) | 14	1000 | LARGE T&R	Yes	SN	Level-3-260C-168 HR	-40 to 125	LM2574M -ADJ P+
LM2574N-12/NOPB	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574N -12 P+
LM2574N-12/NOPB.B	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574N -12 P+
LM2574N-3.3/NOPB	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574N -3.3 P+
LM2574N-3.3/NOPB.B	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574N -3.3 P+
LM2574N-5.0/NOPB	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574N -5.0 P+
LM2574N-5.0/NOPB.B	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574N -5.0 P+
LM2574N-ADJ/NOPB	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574N -ADJ P+
LM2574N-ADJ/NOPB.B	Active	Production	PDIP (P) | 8	40 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	-40 to 125	LM2574N -ADJ P+

[1] **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

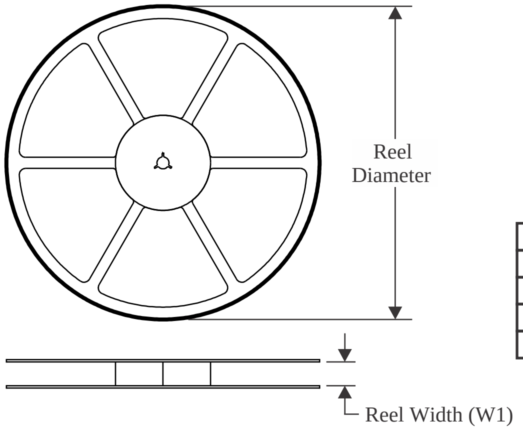
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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.

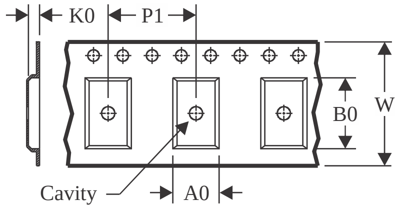
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

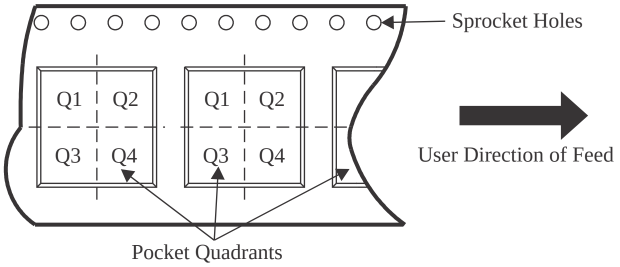


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

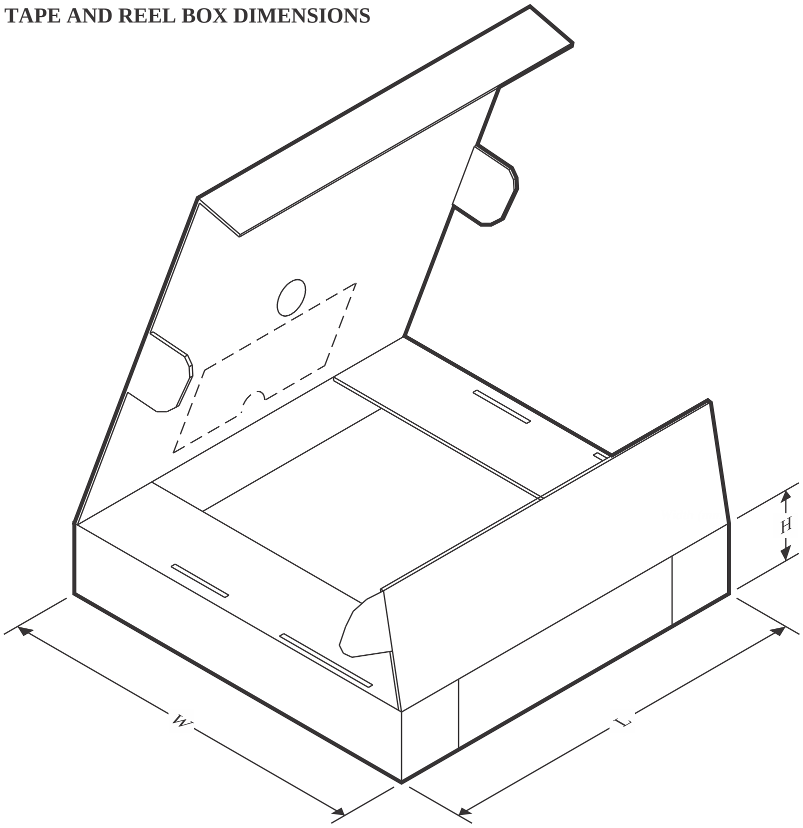
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM2574HVMX-12/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1
LM2574HVMX-15/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1
LM2574HVMX-3.3/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1
LM2574HVMX-5.0/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1
LM2574HVMX-ADJ/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1
LM2574MX-12/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1
LM2574MX-3.3/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1
LM2574MX-5.0/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1
LM2574MX-ADJ/NOPB	SOIC	NPA	14	1000	330.0	16.4	10.9	9.5	3.2	12.0	16.0	Q1

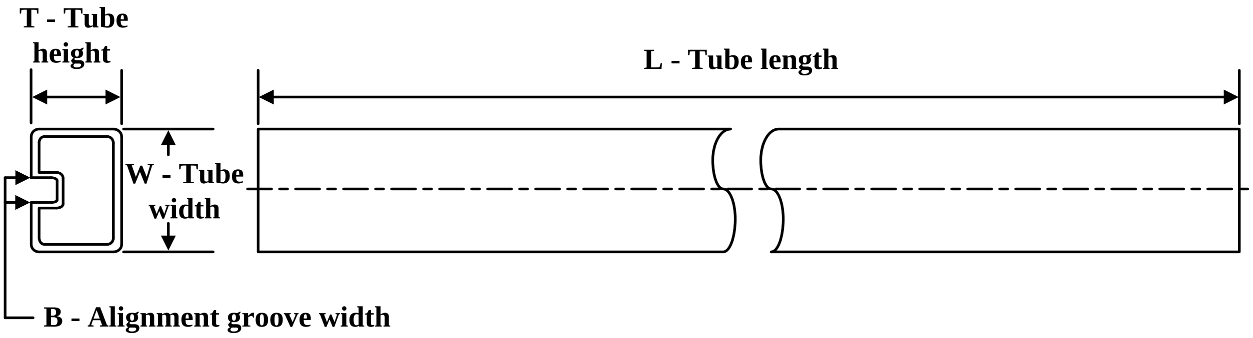
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM2574HVMX-12/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0
LM2574HVMX-15/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0
LM2574HVMX-3.3/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0
LM2574HVMX-5.0/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0
LM2574HVMX-ADJ/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0
LM2574MX-12/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0
LM2574MX-3.3/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0
LM2574MX-5.0/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0
LM2574MX-ADJ/NOPB	SOIC	NPA	14	1000	356.0	356.0	36.0

TUBE

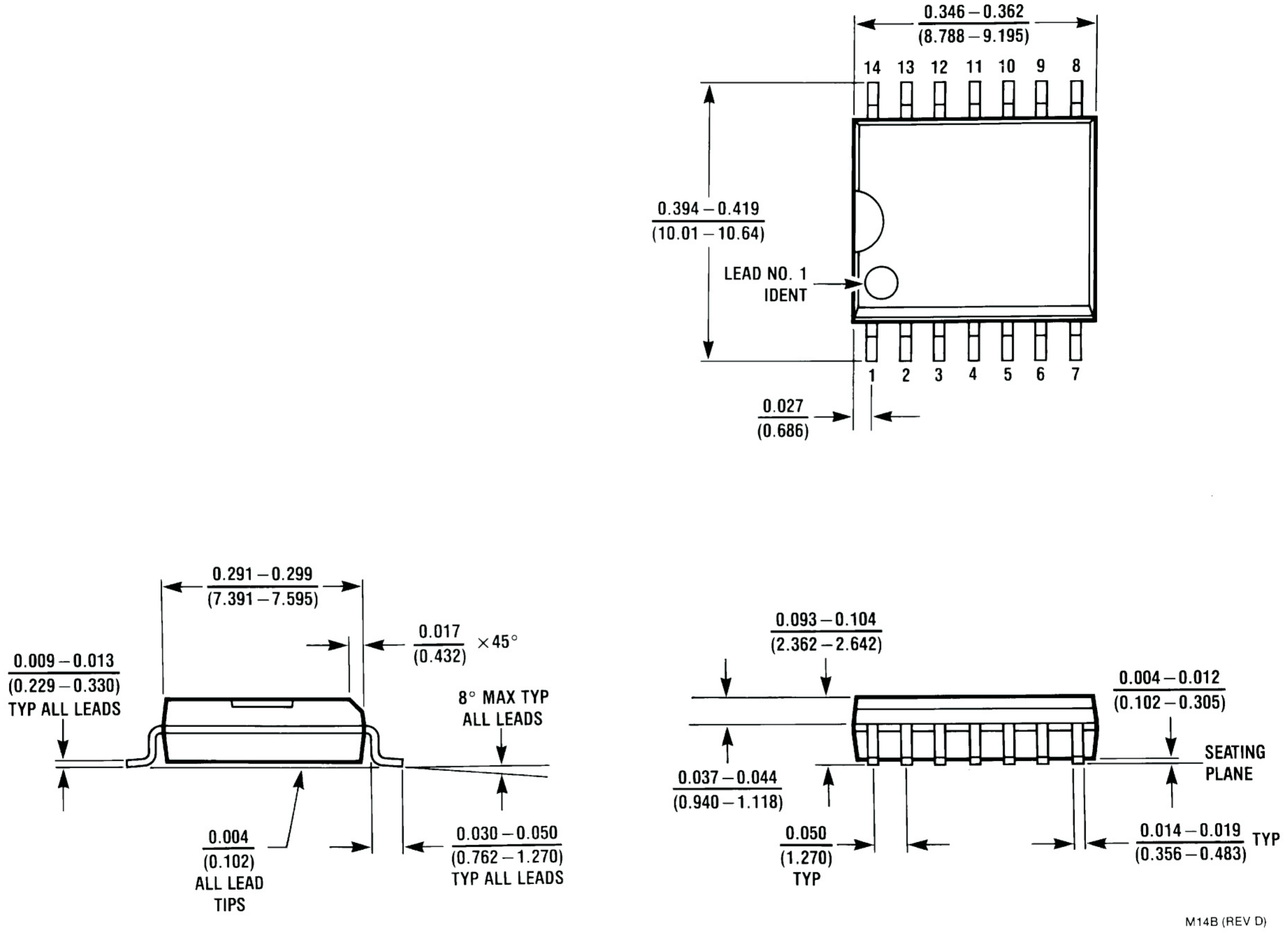


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LM2574HVM-12/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-12/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-15/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-15/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-3.3/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-3.3/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-5.0/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-5.0/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-ADJ/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVM-ADJ/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574HVN-12/NOPB	P	PDIP	8	40	502	14	11938	4.32
LM2574HVN-12/NOPB.B	P	PDIP	8	40	502	14	11938	4.32
LM2574HVN-15/NOPB	P	PDIP	8	40	502	14	11938	4.32
LM2574HVN-15/NOPB.B	P	PDIP	8	40	502	14	11938	4.32
LM2574HVN-5.0/NOPB	P	PDIP	8	40	502	14	11938	4.32
LM2574HVN-5.0/NOPB.B	P	PDIP	8	40	502	14	11938	4.32
LM2574HVN-ADJ/NOPB	P	PDIP	8	40	502	14	11938	4.32
LM2574HVN-ADJ/NOPB.B	P	PDIP	8	40	502	14	11938	4.32
LM2574M-12/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574M-12/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574M-3.3/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574M-3.3/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574M-5.0/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574M-5.0/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574M-ADJ/NOPB	NPA	SOIC	14	50	495	15	5842	7.87
LM2574M-ADJ/NOPB.B	NPA	SOIC	14	50	495	15	5842	7.87
LM2574N-12/NOPB	P	PDIP	8	40	502	14	11938	4.32
LM2574N-12/NOPB.B	P	PDIP	8	40	502	14	11938	4.32
LM2574N-3.3/NOPB	P	PDIP	8	40	502	14	11938	4.32

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LM2574N-3.3/NOPB.B	P	PDIP	8	40	502	14	11938	4.32
LM2574N-5.0/NOPB	P	PDIP	8	40	502	14	11938	4.32
LM2574N-5.0/NOPB.B	P	PDIP	8	40	502	14	11938	4.32
LM2574N-ADJ/NOPB	P	PDIP	8	40	502	14	11938	4.32
LM2574N-ADJ/NOPB.B	P	PDIP	8	40	502	14	11938	4.32

NPA0014B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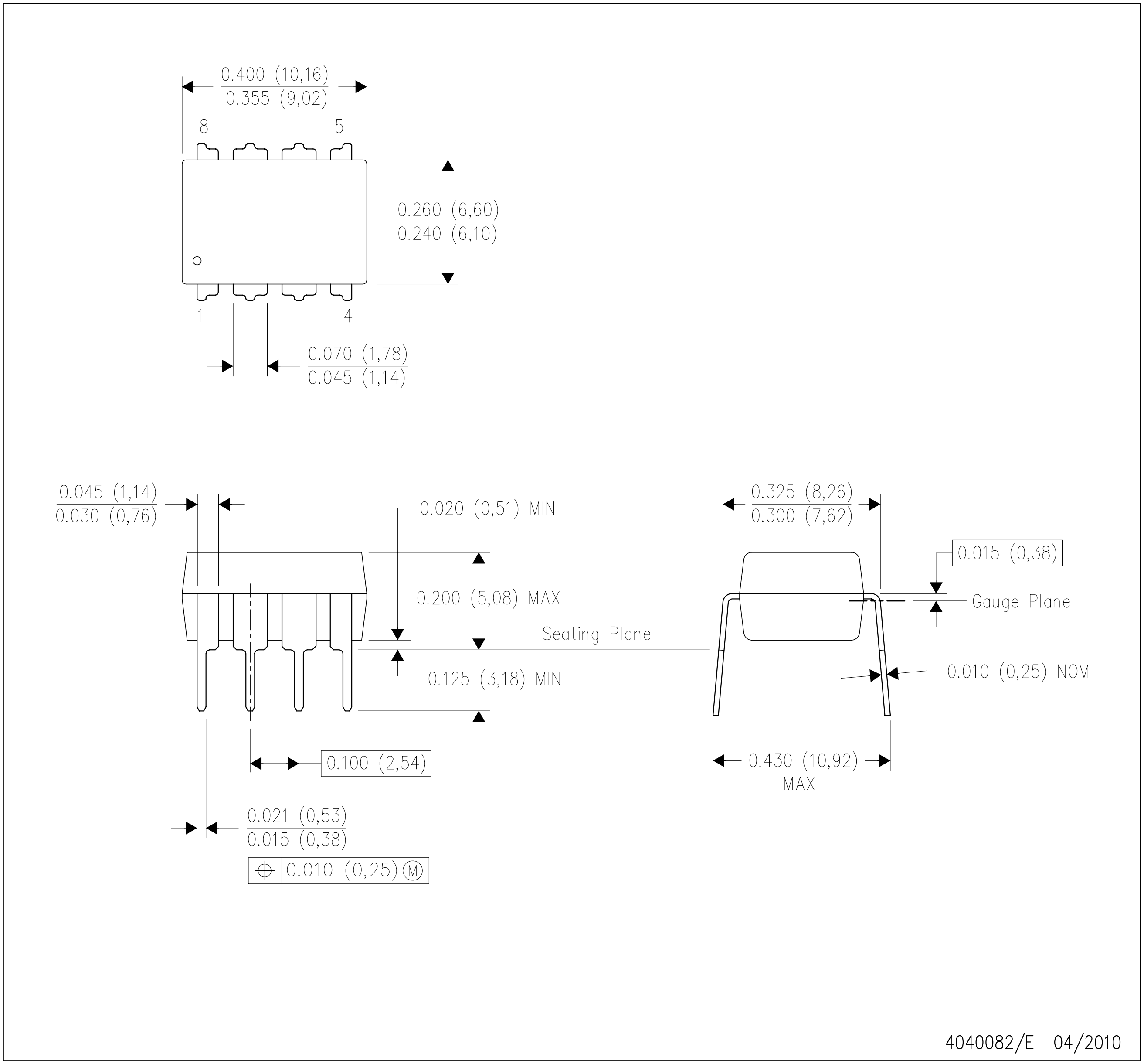
(8.788 – 9.195)
14
13
12
11
10
9
8
0.394 – 0.419
(10.01 – 10.64)
LEAD NO. 1
IDENT
1
2
3
4
5
6
7
0.027
(0.686)
0.291 – 0.299
(7.391 – 7.595)
0.017
(0.432)
×45°
0.009 – 0.013
(0.229 – 0.330)
TYP ALL LEADS
8° MAX TYP
ALL LEADS
0.004
(0.102)
ALL LEAD
TIPS
0.030 – 0.050
(0.762 – 1.270)
TYP ALL LEADS
0.093 – 0.104
(2.362 – 2.642)
0.004 – 0.012
(0.102 – 0.305)
SEATING
PLANE
0.037 – 0.044
(0.940 – 1.118)
0.050
(1.270)
TYP
0.014 – 0.019
(0.356 – 0.483)
TYP
M14B (REV D)

P (R-PDIP-T8) PLASTIC DUAL-IN-LINE PACKAGE



NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Falls within JEDEC MS-001 variation BA.

重要なお知らせと免責事項