TEXAS INSTRUMENTS

LM2840-Q1, LM2841-Q1, LM2842-Q1
LM2841, LM2842, LM2840

ZHCSAW6J – MARCH 2009 – REVISED FEBRUARY 2017

采用超薄 SOT 封装的 LM284x 和 LM284x-Q1 100、300 或 600mA、42V 输入 降压直流/直流稳压器

1 特性

- LM2840-Q1、LM2841-Q1 和 LM2842-Q1 符合汽车 应用要求
- 具有符合 AEC-Q100 测试指导的以下结果：
  - 器件温度 1 级：-40°C 至 125°C 的环境工作温度范围
  - 器件人体放电模式 (HBM) 静电放电 (ESD) 分类等级 2
- 输入电压范围：4.5V 至 42V
- 100mA、300mA 和 600mA 的输出电流选项
- 0.765V 反馈引脚电压
- 550kHz (X) 或 1.25MHz (Y) 开关频率
- 低关断 I_Q：16µA（典型值）
- 短路保护
- 内部补偿
- 软启动电路
- 小型总体解决方案尺寸（SOT-6L 封装）
- 使用 LM2840 并借助 WEBENCH® 电源设计器创建定制设计方案

2 应用

- 电池供电类设备
- 工业分布式电源 应用
- 便携式媒体播放器
- 便携式手持仪器

3 说明

LM284x 和 LM284x-Q1 器件是 PWM 直流/直流降压稳压器。该器件具有 4.5V 至 42V 的输入范围，适合各种 应用（例如，从非稳压源进行电源调节）。它们具有低 R_{DSON}（典型值 0.9Ω）内部开关，可实现最大效率（典型值 85%）。此外，它们还具有 550kHz（X 选项）和 1.25MHz（Y 选项）的固定工作频率，可在保证低输出电压纹波的同时支持小型外部组件。可通过结合使用关断 ($\overline{SHDN}$) 引脚和外部 RC 电路来执行软启动，从而方便用户根据特定应用调整软启动时间。

经过优化后，LM2840 和 LM2840-Q1 的负载电流高达 100mA，LM2841 和 LM2841-Q1 的负载电流高达 300mA，而 LM2842 和 LM2842-Q1 的负载电流高达 600mA。它们都具有 0.765V 的标称反馈电压。

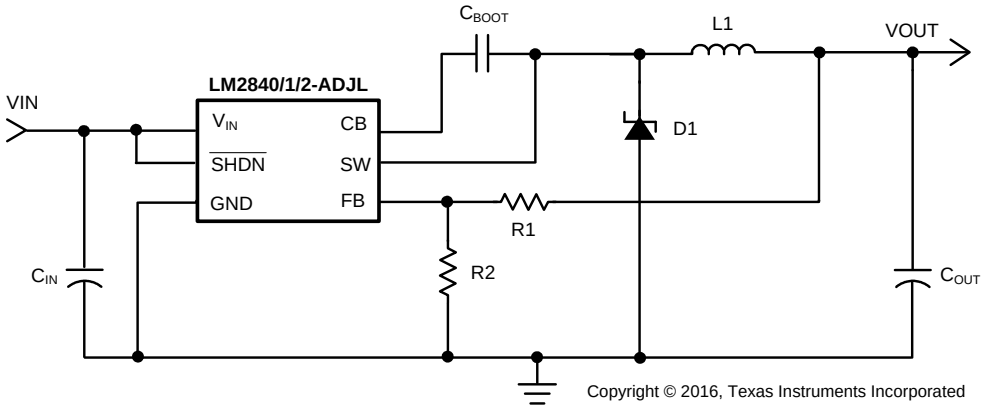
此器件还提供其他 功能， 例如热关断、V_{IN} 欠压锁定和栅极驱动欠压锁定。LM284x 和 LM284x-Q1 均采用低厚度 SOT-6L 封装。

器件信息(1)

器件型号	封装	封装尺寸（标称值）
LM2840、LM2840-Q1、LM2841、LM2841-Q1、LM2842、LM2842-Q1	SOT (6)	1.60mm x 2.90mm

(1) 如需了解所有可用封装，请参阅产品说明书末尾的可订购产品附录。

典型应用电路



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

Changes from Revision I (September 2016) to Revision J **Page**

- Added this new text for Pin 4 ... 3
- Added this new line of text in Shutdown Operation section ... 12

Changes from Revision H (April 2013) to Revision I **Page**

- 添加了 *ESD 额定值表*、*特性 说明*部分、*器件功能模式*、*应用和实施*部分、*电源相关建议*部分、*布局*部分、*器件和文档支持*部分以及*机械、封装和可订购信息*部分。 ... 1
- Added *Thermal Information* table ... 4

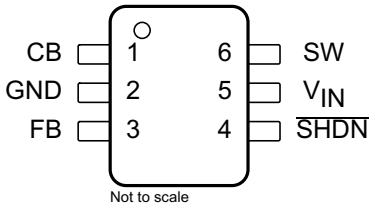
Changes from Revision G (April 2013) to Revision H **Page**

- 已更改 将 National Semiconductor 产品说明书的布局更改为 TI 格式 ... 1

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5 Pin Configuration and Functions

DDC Package
6-Pin SOT
Top View



Not to scale

Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
1	CB	I	SW FET gate bias voltage. Connect C_{BOOT} capacitor between CB and SW.
2	GND	—	Ground connection
3	FB	I	Feedback pin: Set feedback voltage divider ratio with $V_{OUT} = V_{FB}$ (1 + (R1 / R2)). Resistors must be from 100 Ω to 10 kΩ to avoid input bias errors.
4	$\overline{SHDN}$	I	Logic level shutdown input. Pull to GND to disable the device and pull high to enable the device. If this function is not used tie to V_{IN} . DO NOT ALLOW TO FLOAT.
5	V_{IN}	I	Power input voltage pin: 4.5-V to 42-V normal operating range.
6	SW	O	Power FET output: Connect to inductor, diode, and C_{BOOT} capacitor.

6 Specifications

6.1 Absolute Maximum Ratings

See (1)(2)

	MIN	MAX	UNIT
V_{IN}	–0.3	45	V
$\overline{SHDN}$	–0.3	(V_{IN} + 0.3 V) < 45	V
SW voltage	–0.3	45	V
CB voltage above SW voltage		7	V
FB voltage	–0.3	5	V
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 is a function of the maximum junction temperature, T_J(MAX), the junction-to-ambient thermal resistance, $R_{\theta JA}$, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: P_D (MAX) = ($T_{J(MAX)}$ − T_A)/$R_{\theta JA}$. Exceeding the maximum allowable power dissipation causes excessive die temperature, and the regulator goes into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage. Thermal shutdown engages at T_J=175°C (typical) and disengages at T_J= 155°C (typical).

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.

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6.3 Recommended Operating Conditions

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

	MIN	MAX	UNIT
Operating junction temperature (1)	–40	125	°C
Input voltage V_{IN}	4.5	42	V
SW voltage		42	V

(1) All limits specified at room temperature (T_A = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

6.4 Thermal Information

THERMAL METRIC (1)		LM284x, LM284x-Q1 DDC (SOT) 6 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance (2) (3)	121	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	94	°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 to JESD 51-7.
(3) Thermal Resistances were simulated on a 4-layer, JEDEC board

6.5 Electrical Characteristics

Specifications are for T_J = 25°C unless otherwise specified. Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only. Unless otherwise stated the following conditions apply: V_{IN} = 12 V. (1) (2) (3)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_Q	Quiescent current	$\overline{SHDN}$ = 0 V			16		µA
			T_J = −40°C to 125°C			40	
		Device ON, not switching			1.3		mA
			T_J = −40°C to 125°C			1.75	
		Device ON, no load			1.35		
			T_J = −40°C to 125°C			1.85	
R_{DSON}	Switch ON resistance	See (4)			0.9		Ω
			T_J = −40°C to 125°C			1.6	
I_{LSW}	Switch leakage current	V_{IN} = 42 V			0		µA
			T_J = −40°C to 125°C			0.5	
I_{CL}	Switch current limit	LM2840 (5)			525		mA
			T_J = −40°C to 125°C			900	
		LM2841 (5)			525		mA
			T_J = −40°C to 125°C			900	
		LM2842 (5)			1.15		A
			T_J = −40°C to 125°C			1.7	
I_{FB}	Feedback pin bias current	LM284[0,1,2] (6)			0.1		µA
			T_J = −40°C to 125°C			1	

(1) All limits specified at room temperature (T_A = 25°C) unless otherwise noted. Room temperature limits are production tested. Limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. Limits are used to calculate Average Outgoing Quality Level (AOQL).
(2) Typical numbers are at 25°C and represent the most likely norm.
(3) The part numbers in this table represent both the Q1 and non-Q1 versions of the respective parts.
(4) Includes the bond wires, R_{DSON} from V_{IN} pin to SW pin.
(5) Current limit at 0% duty cycle. May be lower at higher duty cycle or input voltages below 6 V.
(6) Bias currents flow into pin.

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Electrical Characteristics (continued)

Specifications are for T_J = 25°C unless otherwise specified. Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only. Unless otherwise stated the following conditions apply: V_{IN} = 12 V.(1)(2)(3)

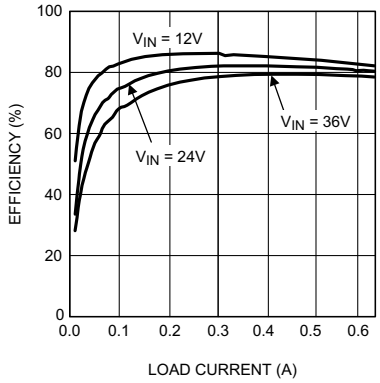
PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{FB}	FB Pin reference voltage				0.765		V
			T_J = −40°C to 125°C	0.747		0.782	
$t_{ON(min)}$	Minimum ON-time	See (7)			100		ns
			T_J = −40°C to 125°C			150	
$t_{OFF(min)}$	Minimum OFF-time	X option			110		ns
			T_J = −40°C to 125°C			370	
		Y option			104		ns
			T_J = −40°C to 125°C			200	
f_{SW}	Switching frequency	X option, V_{FB} = 0.5 V			550		kHz
			T_J = −40°C to 125°C	325		750	
		X option, V_{FB} = 0 V			140		
		Y option, V_{FB} = 0.5 V			1.25		MHz
			T_J = −40°C to 125°C	0.95		1.5	
		Y option, V_{FB} = 0 V			0.35		
D_{MAX}	Maximum duty cycle	X option			94%		
			T_J = −40°C to 125°C	88%			
		Y option			87%		
			T_J = −40°C to 125°C	81%			
V_{UVP}	Undervoltage lockout thresholds	On threshold			3.7		V
			T_J = −40°C to 125°C	4.4			
		Off threshold			3.5		
			T_J = −40°C to 125°C			3.25	
$V_{\overline{SHDN}}$	Shutdown threshold	Device ON			1		V
			T_J = −40°C to 125°C	2.3			
		Device OFF			0.9		
			T_J = −40°C to 125°C			0.3	
$I_{\overline{SHDN}}$	Shutdown pin input bias current	$V_{\overline{SHDN}}$ = 2.3 V(6)			0.05		µA
			T_J = −40°C to 125°C			1.5	
		$V_{\overline{SHDN}}$ = 0 V			0.02		
			T_J = −40°C to 125°C			1.5	

(7) Minimum ON-time specified by design and simulation.

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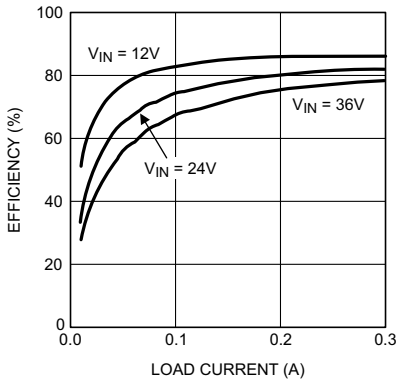
6.6 Typical Characteristics

The part numbers in this section represent both the Q1 and non-Q1 versions of the respective parts.



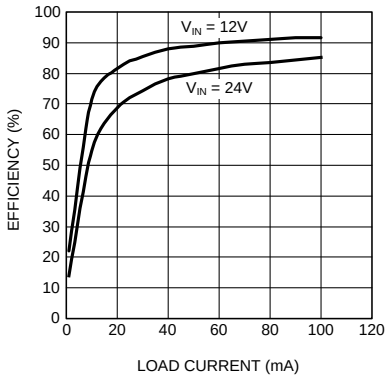
LM2842X V_{OUT} = 3.3 V

Figure 1. Efficiency vs Load Current



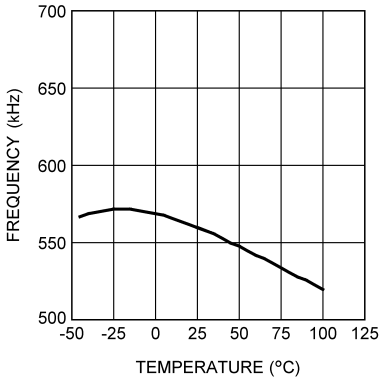
LM2841X V_{OUT} = 3.3 V

Figure 2. Efficiency vs Load Current



LM2840X V_{OUT} = 8 V

Figure 3. Efficiency vs Load Current



X option

Figure 4. Switching Frequency vs Temperature

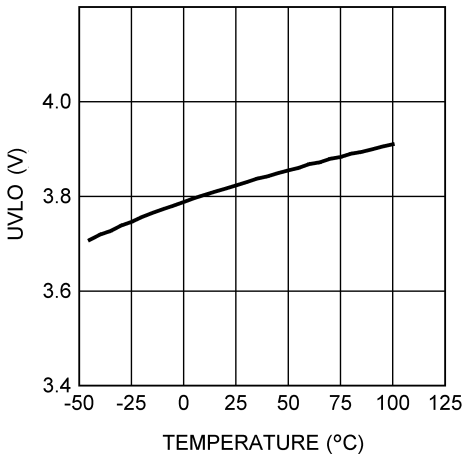
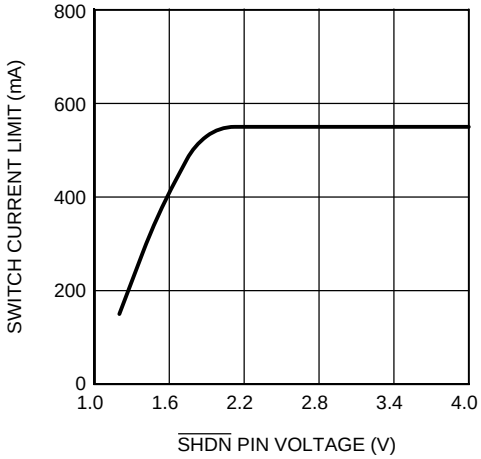


Figure 5. Input UVLO Voltage vs Temperature



Soft-Start Implementation LM284[0,1]

Figure 6. Switch Current Limit vs $\overline{\text{SHDN}}$ Pin Voltage

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Typical Characteristics (continued)

The part numbers in this section represent both the Q1 and non-Q1 versions of the respective parts.

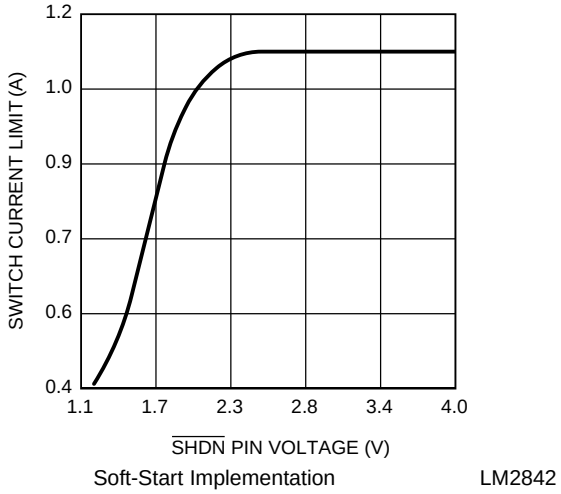


Figure 7. Switch Current Limit vs $\overline{\text{SHDN}}$ Pin Voltage

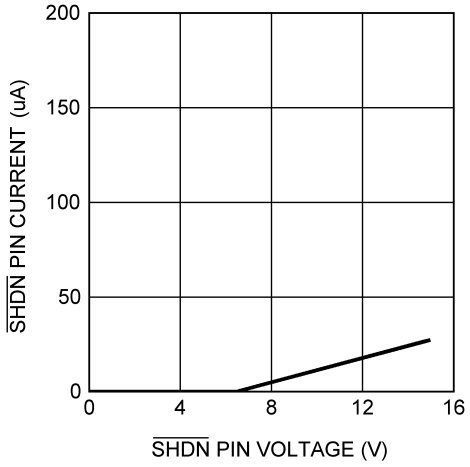


Figure 8. $\overline{\text{SHDN}}$ Pin Current vs $\overline{\text{SHDN}}$ Pin Voltage

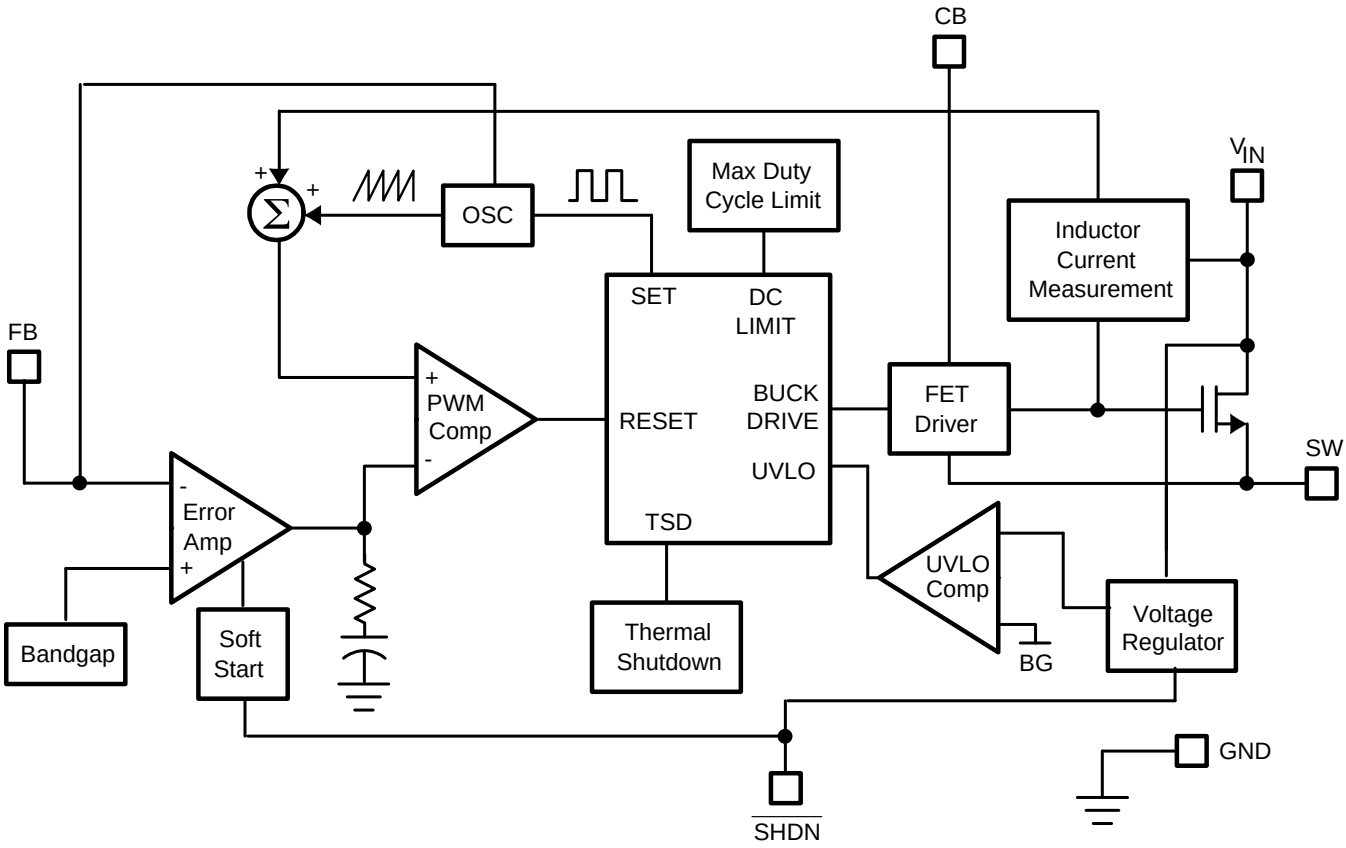
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7 Detailed Description

7.1 Overview

The LM284x and LM284x-Q1 SIMPLE SWITCHER® regulators are easy-to-use, non-synchronous, step-down DC-DC converters with a wide input voltage range up to 42 V. The devices are capable of delivering up to 100-mA, 300-mA, or 600-mA DC load current with excellent line and load regulation. These devices are available in fixed frequency of 550 kHz and 1.25 MHz. The family requires few external components, and the pin arrangement was designed for simple, optimum PCB layout.

7.2 Functional Block Diagram



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7.3 Feature Description

7.3.1 Protection

The LM284x and LM284x-Q1 have dedicated protection circuitry running during normal operation to protect the IC. The thermal shutdown circuitry turns off the power device when the die temperature reaches excessive levels. The UVLO comparator protects the power device during supply power start-up and shutdown to prevent operation at voltages less than the minimum input voltage. A gate drive (CB) undervoltage lockout is included to ensure that there is enough gate drive voltage to drive the MOSFET before the device tries to start switching. The LM284x and LM284x-Q1 also feature a shutdown mode decreasing the supply current to approximately 16 µA.

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7.4 Device Functional Modes

7.4.1 Continuous Conduction Mode

The LM284x and LM284x-Q1 contain a current-mode, PWM buck regulator. A buck regulator steps the input voltage down to a lower output voltage. In continuous conduction mode (when the inductor current never reaches zero at steady-state operation), the buck regulator operates in two cycles. The power switch is connected between V_{IN} and SW. In the first cycle of operation the transistor is closed and the diode is reverse biased. Energy is collected in the inductor and the load current is supplied by C_{OUT} and the rising current through the inductor. During the second cycle the transistor is open and the diode is forward biased due to the fact that the inductor current cannot instantaneously change direction. The energy stored in the inductor is transferred to the load and output capacitor. The ratio of these two cycles determines the output voltage. The output voltage is defined approximately as shown in Equation 1.

$$D = V_{OUT} / V_{IN} \quad (1)$$

$$D' = (1 – D)$$

where

- D is the duty cycle of the switch (2)

D and D' are required for design calculations.

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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 LM284x and LM284x-Q1 are step-down DC-DC regulators. It is typically used to convert a higher DC voltage to a lower DC voltage with a maximum output current of 100 mA, 300 mA, or 600 mA. The following design procedure can be used to select components for the LM284x and LM284x-Q1. Alternately, the WEBENCH® software may be used to generate complete designs. When generating a design, the WEBENCH software uses iterative design procedure and accesses comprehensive databases of components. See ti.com for more details

8.2 Typical Applications

8.2.1 Step-Down Converter With 3.3-V Output Voltage

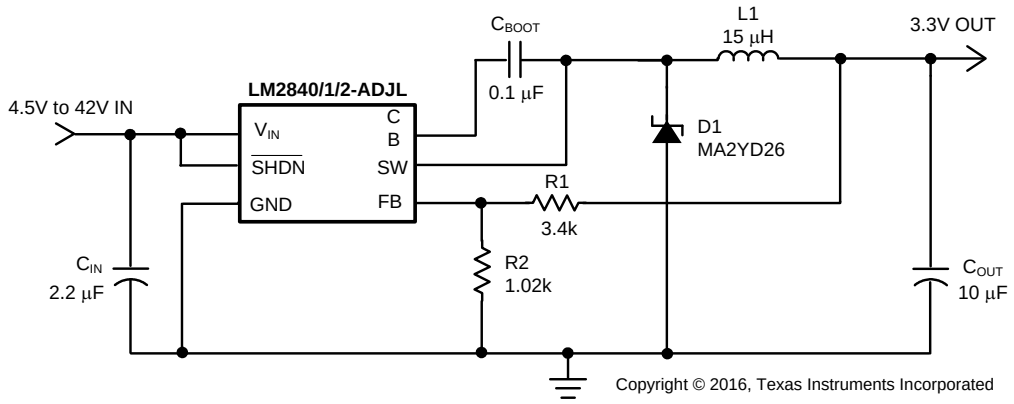


Figure 9. Application Circuit, 3.3-V Output at 100 mA

8.2.1.1 Design Requirements

Table 1 lists the design parameters for this example.

Table 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input voltage	4.5 V to 42 V
Output voltage	3.3 V
Output current	0.1 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 LM2840 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:

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- 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.

This section presents guidelines for selecting external components.

8.2.1.2.2 Setting the Output Voltage

The output voltage is set using the feedback pin and a resistor divider connected to the output as shown in *典型应用电路*. The feedback pin voltage 0.765 V, so the ratio of the feedback resistors sets the output voltage according to Equation 3:

$$V_{OUT} = 0.765\ V\ (1 + (R1 / R2)) \quad (3)$$

Typically R2 is given as 100 Ω to 10 kΩ for a starting value. To solve for R1 given R2 and V_{OUT}, use Equation 4:

$$R1 = R2\ ((V_{OUT} / 0.765\ V) – 1) \quad (4)$$

8.2.1.2.3 Inductor Selection

The most critical parameters for the inductor are the inductance, peak current, and the DC resistance. The inductance is related to the peak-to-peak inductor ripple current, the input and the output voltages.

$$L = \frac{(V_{IN} - V_{OUT})V_{OUT}}{V_{IN} \times I_{RIPPLE} \times f_{SW}} \quad (5)$$

A higher value of ripple current reduces inductance, but increases the conductance loss, core loss, and current stress for the inductor and switch devices. It also requires a bigger output capacitor for the same output voltage ripple requirement. A reasonable value is setting the ripple current to be 30% of the DC output current. Because the ripple current increases with the input voltage, the maximum input voltage is always used to determine the inductance. The DC resistance of the inductor is a key parameter for the efficiency. Lower DC resistance is available with a bigger winding area. A good tradeoff between the efficiency and the core size is letting the inductor copper loss equal 2% of the output power. See *Selecting Inductors for Buck Converters* for more information on selecting inductors. A good starting point for most applications is a 10 µH to 22 µH with 1.1 A or greater current rating for the LM2842 and LM2842-Q1 or a 0.7 A or greater current rating for the LM284x and LM284x-Q1. Using such a rating enables the device to current limit without saturating the inductor. This is preferable to the device going into thermal shutdown mode and the possibility of damaging the inductor if the output is shorted to ground or other long-term overload.

Table 2. Recommended Inductors

MANUFACTURER	INDUCTOR	CONTACT INFORMATION
Coilcraft	LPS4018, DO1608C, DO3308, and LPO2506 series	www.coilcraft.com 800-3222645
MuRata	LQH55D and LQH66S series	www.murata.com
Coiltronics	MP2 and MP2A series	www.cooperbussman.com

8.2.1.2.4 Input Capacitor

A low ESR ceramic capacitor ©$_{IN}$) is needed between the V_{IN} pin and GND pin. This capacitor prevents large voltage transients from appearing at the input. Use a 2.2-µF to 10-µF value with X5R or X7R dielectric. Depending on construction, a ceramic capacitor's value can decrease up to 50% of its nominal value when rated voltage is applied. Consult with the capacitor manufacturer's data sheet for information on capacitor derating over voltage and temperature.

8.2.1.2.5 Output Capacitor

The selection of C_{OUT} is driven by the maximum allowable output voltage ripple. The output ripple in the constant frequency, PWM mode is approximated by Equation 6.

$$V_{RIPPLE} = I_{RIPPLE}\ (ESR + (1 / (8f_{SW}C_{OUT}))) \quad (6)$$

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The ESR term usually plays the dominant role in determining the voltage ripple. Low-ESR ceramic capacitors are recommended. Capacitors in the range of 22 µF to 100 µF are a good starting point with an ESR of 0.1 Ω or less.

Table 3. Recommended Input and Output Capacitors

MANUFACTURER	CAPACITOR	CONTACT INFORMATION
Vishay Sprague	293D, 592D, and 595D series tantalum	www.vishay.com 407-324-4140
Taiyo Yuden	High capacitance MLCC ceramic	www.t-yuden.com 408-573-4150
Cornell Dubilier	ESRD seriec Polymer Aluminum Electrolytic SPV and AFK series V-chip series	www.cde.com
MuRata	High capacitance MLCC ceramic	www.murata.com

8.2.1.2.6 Bootstrap Capacitor

A 0.15-µF ceramic capacitor or larger is recommended for the bootstrap capacitor (C_{BOOT}). For applications where the input voltage is less than twice the output voltage a larger capacitor is recommended, generally 0.15 µF to 1 µF to ensure plenty of gate drive for the internal switches and a consistently low R_{DSON}.

8.2.1.2.7 Soft-Start Components

The LM284x and LM284x-Q1 have circuitry that is used in conjunction with the $\overline{SHDN}$ pin to limit the inrush current on start-up of the DC-DC switching regulator. The $\overline{SHDN}$ pin in conjunction with a RC filter is used to tailor the soft start for a specific application. When a voltage applied to the $\overline{SHDN}$ pin is between 0 V and up to 2.3 V it causes the cycle-by-cycle current limit in the power stage to be modulated for minimum current limit at 0 V up to the rated current limit at 2.3 V. Thus controlling the output rise time and inrush current at start-up. The resistor value must be selected so the current injected into the $\overline{SHDN}$ pin is greater then the leakage current of the $\overline{SHDN}$ pin (1.5 µA) when the voltage at $\overline{SHDN}$ is equal or greater then 2.3 V.

8.2.1.2.8 Shutdown Operation

The $\overline{SHDN}$ pin of the LM284x and LM284x-Q1 is designed so that it may be controlled using 2.3 V or higher logic signals. If the shutdown function is not to be used the $\overline{SHDN}$ pin may be tied to V_{IN}. This input should not be allowed to float

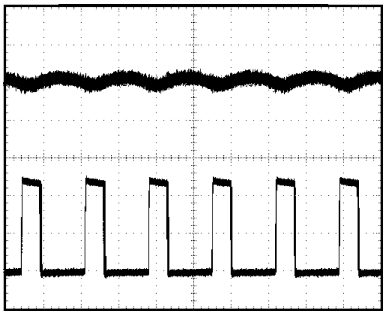
The maximum voltage to the $\overline{SHDN}$ pin should not exceed 42 V. If the use of a higher voltage is desired due to system or other constraints it may be used; however, a 100 kΩ or larger resistor is recommended between the applied voltage and the $\overline{SHDN}$ pin to protect the device.

8.2.1.2.9 Schottky Diode

The breakdown voltage rating of the diode (D1) is preferred to be 25% higher than the maximum input voltage. The current rating for the diode must be equal to the maximum output current for best reliability in most applications. In cases where the duty cycle is greater than 50%, the average diode current is lower. In this case it is possible to use a diode with a lower average current rating, approximately $(1 – D)I_{OUT}$; however, the peak current rating should be higher than the maximum load current. A 0.5-A to 1-A rated diode is a good starting point.

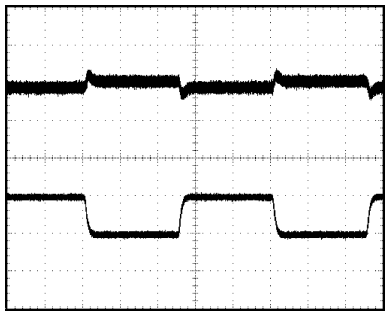
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8.2.1.3 Application Curves



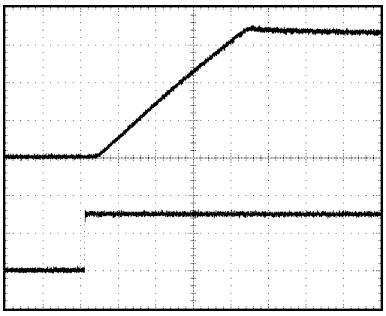
V_{IN} = 12 V
V_{OUT} = 3.3 V
T = 1 µs/div
I_{OUT} = 200 mA
Top trace: V_{OUT}, 10 mV/div, AC-Coupled
Bottom trace: SW, 5 V/div, DC-Coupled

Figure 10. Switching Node and Output Voltage Waveforms



V_{IN} = 12 V
V_{OUT} = 3.3 V
T = 200 µs/div
I_{OUT} = 300 mA to 200 mA to 300 mA
Top trace: V_{OUT}, 20 mV/div, AC-Coupled
Bottom trace: I_{OUT}, 100 mA/div, DC-Coupled

Figure 11. Load Transient Waveforms



V_{IN} = 12 V
V_{OUT} = 3.3 V
T = 40 µs/div
I_{OUT} = 50 mA
Top trace: V_{OUT}, 1V/div, DC-Coupled
Bottom trace: $\overline{SHDN}$, 2V/div, DC-Coupled

Figure 12. Start-Up Waveform

8.2.2 Other Application Circuits

Figure 13 to Figure 16 show application circuit examples using the LM284x and LM284x-Q1 devices. Customers must fully validate and test these circuits before implementing a design based on these examples. Unless otherwise noted, the design procedures in *Step-Down Converter With 3.3-V Output Voltage* are applicable to these designs.

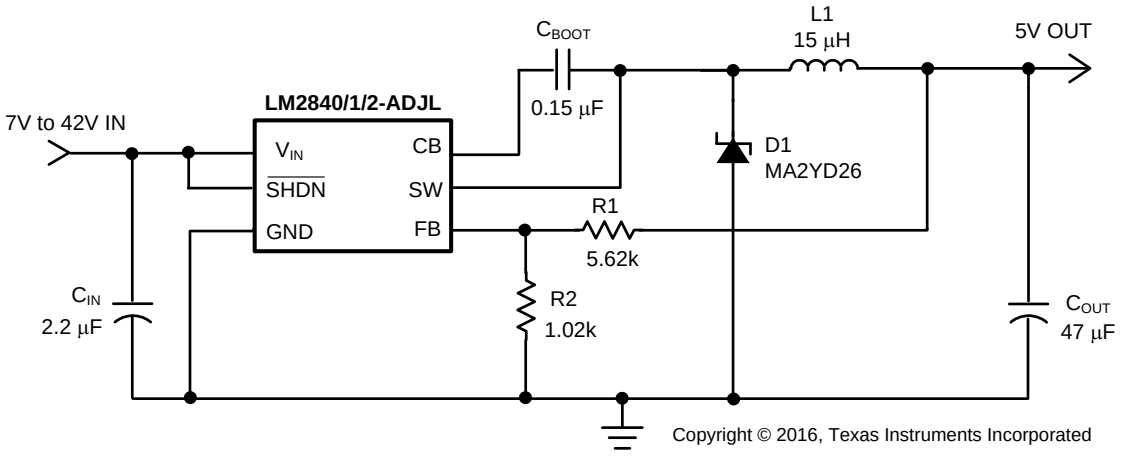


Figure 13. Step-Down Converter With 5-V Output Voltage

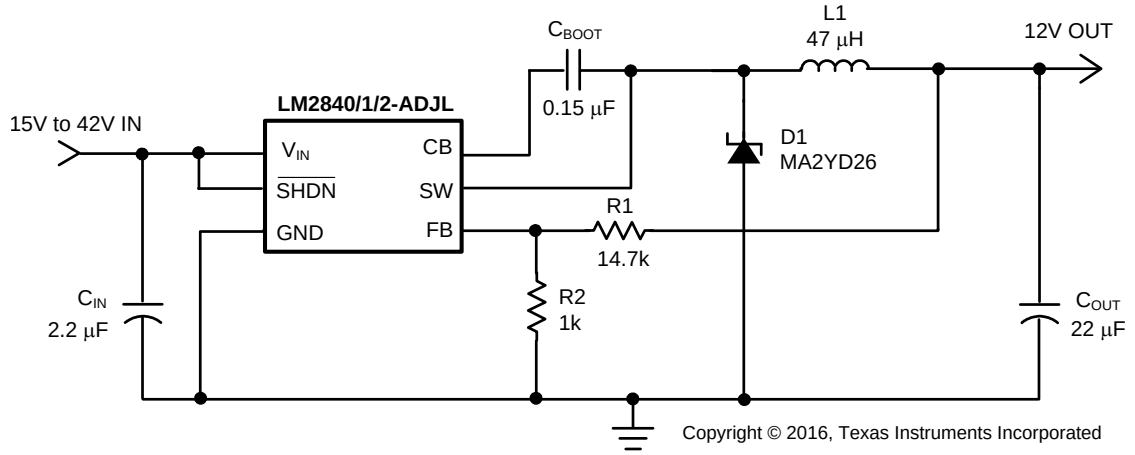


Figure 14. Step-Down Converter With 12-V Output Voltage

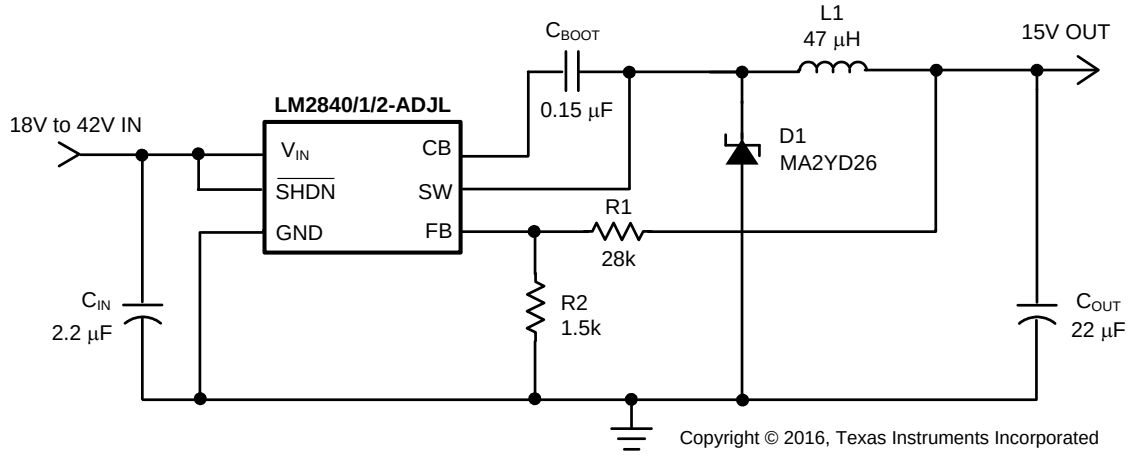


Figure 15. Step-Down Converter With 15-V Output Voltage

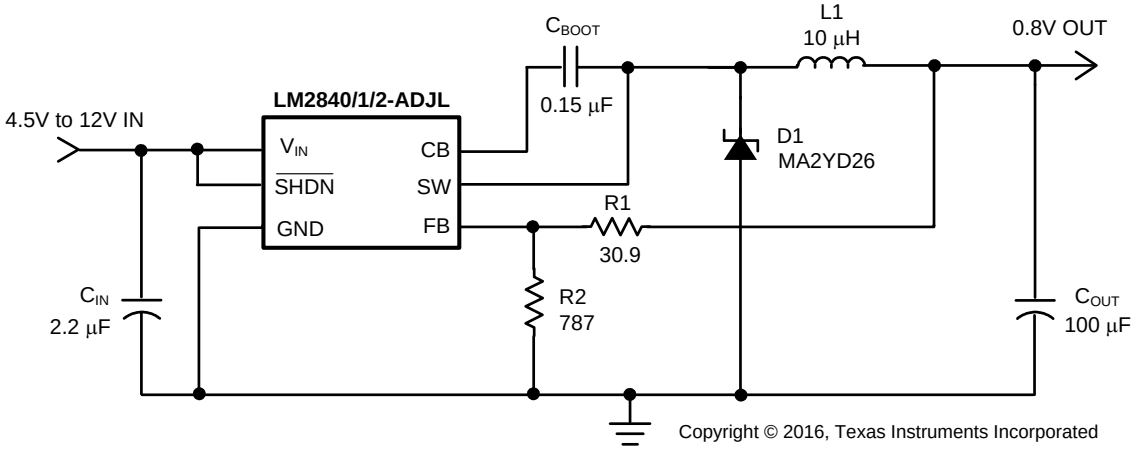


Figure 16. Step-Down Converter With 0.8-V Output Voltage

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9 Power Supply Recommendations

The LM284x and LM284x-Q1 are designed to operate from an input voltage supply range between 4 V and 42 V. This input supply must be able to withstand the maximum input current and maintain a voltage above 4.5 V. The resistance of the input supply rail must be low enough that an input current transient does not cause a drop at the device supply voltage high enough to cause a false UVLO fault triggering and system reset. If the input supply is located more than a few inches from the device, additional bulk capacitance may be required in addition to the ceramic input capacitors.

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10 Layout

10.1 Layout Guidelines

To reduce problems with conducted noise pickup, the ground side of the feedback network should be connected directly to the GND pin with its own connection. The feedback network, resistors R1 and R2, must be kept close to the FB pin, and away from the inductor to minimize coupling noise into the feedback pin. The input bypass capacitor C_{IN} must be placed close to the V_{IN} pin. This reduces copper trace resistance which effects input voltage ripple of the IC. The inductor L1 must be placed close to the SW pin to reduce EMI and capacitive coupling. The output capacitor, C_{OUT} must be placed close to the junction of L1 and the diode D1. The L1, D1, and C_{OUT} trace must be as short as possible to reduce conducted and radiated noise and increase overall efficiency. The ground connection for the diode, C_{IN}, and C_{OUT} should be as small as possible and tied to the system ground plane in only one spot (preferably at the C_{OUT} ground point) to minimize conducted noise in the system ground plane. See *Layout Guidelines for Switching Power Supplies* for more detail on switching power supply layout considerations.

10.2 Layout Example

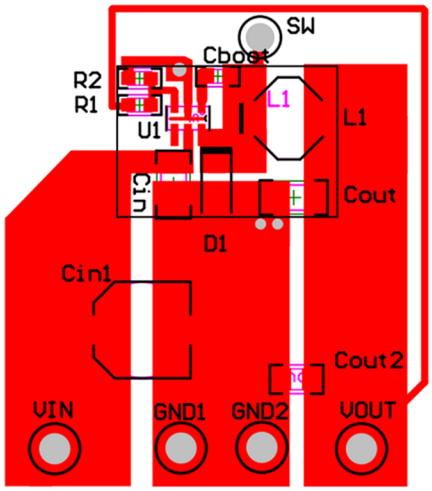


Figure 17. Recommended Layout

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11 器件和文档支持

11.1 使用 WEBENCH® 工具创建定制设计

请单击此处，使用 LM2840 器件并借助 WEBENCH® 电源设计器创建定制设计方案。

1. 在开始阶段键入输出电压 (V_{IN})、输出电压 (V_{OUT}) 和输出电流 (I_{OUT}) 要求。
2. 使用优化器拨盘优化关键设计参数，如效率、封装和成本。
3. 将生成的设计与德州仪器 (TI) 的其他解决方案进行比较。

WEBENCH Power Designer 提供一份定制原理图以及罗列实时价格和组件可用性的物料清单。

在多数情况下，可执行以下操作：

- 运行电气仿真，观察重要波形以及电路性能
- 运行热性能仿真，了解电路板热性能
- 将定制原理图和布局方案导出至常用 CAD 格式
- 打印设计方案的 PDF 报告并与同事共享

有关 WEBENCH 工具的详细信息，请访问 www.ti.com/WEBENCH。

11.2 器件支持

11.2.1 开发支持

WEBENCH 设计中心

11.3 文档支持

11.3.1 相关文档

相关文档如下：

- *《AN-1197 选择适用于降压转换器的电感器》* (SNVA038)
- *《AN-1149 开关电源布局指南》* (SNVA021)

11.4 相关链接

下面的表格列出了快速访问链接。类别包括技术文档、支持与社区资源、工具和软件，以及申请样片或购买产品的快速链接。

表 **4.** 相关链接

器件	产品文件夹	样片与购买	技术文档	工具和软件	支持和社区
LM2841	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
LM2842	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
LM2840	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
LM2840-Q1	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
LM2841-Q1	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
LM2842-Q1	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处

11.5 接收文档更新通知

要接收文档更新通知，请导航至德州仪器 TI.com.cn 上的器件产品文件夹。点击右上角的*提醒我* (Alert me) 注册后，即可每周定期收到已更改的产品信息。有关更改的详细信息，请查阅已修订文档中包含的修订历史记录。

11.6 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 《使用条款》。

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社区资源 **(**接下页**)**

设计支持 ***TI 参考设计支持*** 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

11.7 商标

E2E is a trademark of Texas Instruments.
WEBENCH, SIMPLE SWITCHER are registered trademarks of Texas Instruments.
All other trademarks are the property of their respective owners.

11.8 静电放电警告



这些装置包含有限的内置 ESD 保护。 存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

11.9 Glossary

SLYZ022 — *TI Glossary*.

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

12 机械、封装和可订购信息

以下页面包括机械、封装和可订购信息。这些信息是指定器件的最新可用数据。这些数据发生变化时，我们可能不会另行通知或修订此文档。如欲获取此产品说明书的浏览器版本，请参阅左侧的导航栏。

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM2840XMK-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SE8B	Samples
LM2840XMKX-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SE8B	Samples
LM2840XQMK/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SE9B	Samples
LM2840YMK-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SF1B	Samples
LM2840YQMK/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SF2B	Samples
LM2840YQMKX/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SF2B	Samples
LM2841XMK-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	STFB	Samples
LM2841XMKX-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	STFB	Samples
LM2841XQMK/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SB1B	Samples
LM2841YMK-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	STTB	Samples
LM2841YMKX-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	STTB	Samples
LM2841YQMK/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SB2B	Samples
LM2841YQMKX/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SB2B	Samples
LM2842XMK-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	STVB	Samples
LM2842XMKX-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	STVB	Samples
LM2842XQMK/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SB3B	Samples
LM2842XQMKX/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SB3B	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM2842YMK-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	STXB	Samples
LM2842YMKX-ADJL/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	STXB	Samples
LM2842YQMK/NOPB	ACTIVE	SOT-23-THIN	DDC	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SB4B	Samples
LM2842YQMKX/NOPB	ACTIVE	SOT-23-THIN	DDC	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	SB4B	Samples

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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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.

OTHER QUALIFIED VERSIONS OF LM2840, LM2840-Q1, LM2841, LM2841-Q1, LM2842, LM2842-Q1 :

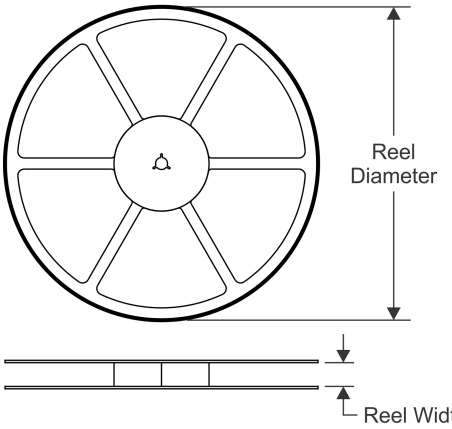
- Catalog: LM2840, LM2841, LM2842
- Automotive: LM2840-Q1, LM2841-Q1, LM2842-Q1

NOTE: Qualified Version Definitions:

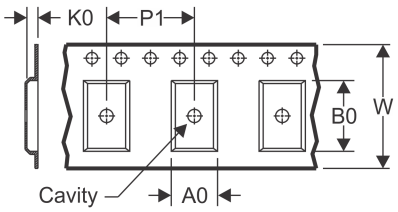
- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

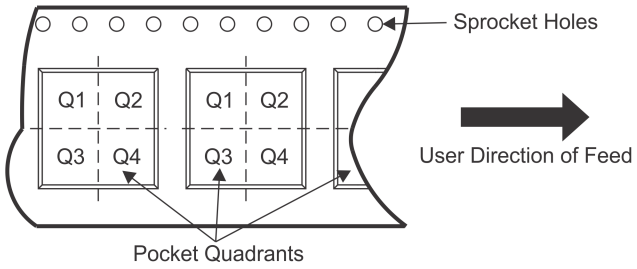


TAPE DIMENSIONS



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

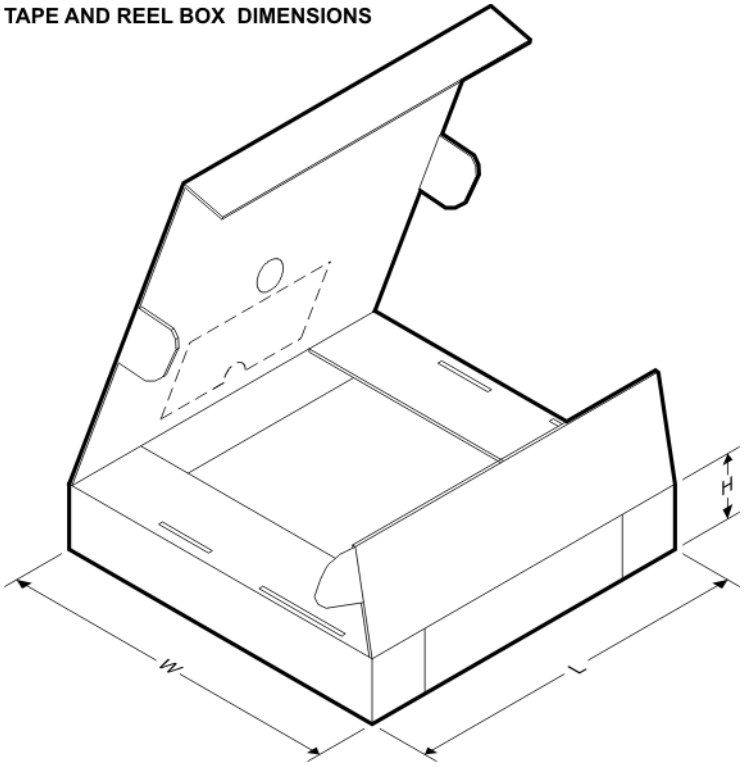


*All dimensions are nominal

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
LM2840XMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2840XMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2840XQMK/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2840YMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2840YQMK/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2840YQMKX/NOPB	SOT-23-THIN	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2841XMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2841XMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2841XQMK/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2841YMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2841YMKX-ADJL/NOP	SOT-	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

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
B	23-THIN											
LM2841YQMK/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2841YQMKX/NOPB	SOT-23-THIN	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2842XMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2842XMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2842XQMK/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2842XQMKX/NOPB	SOT-23-THIN	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2842YMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2842YMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2842YQMK/NOPB	SOT-23-THIN	DDC	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM2842YQMKX/NOPB	SOT-23-THIN	DDC	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

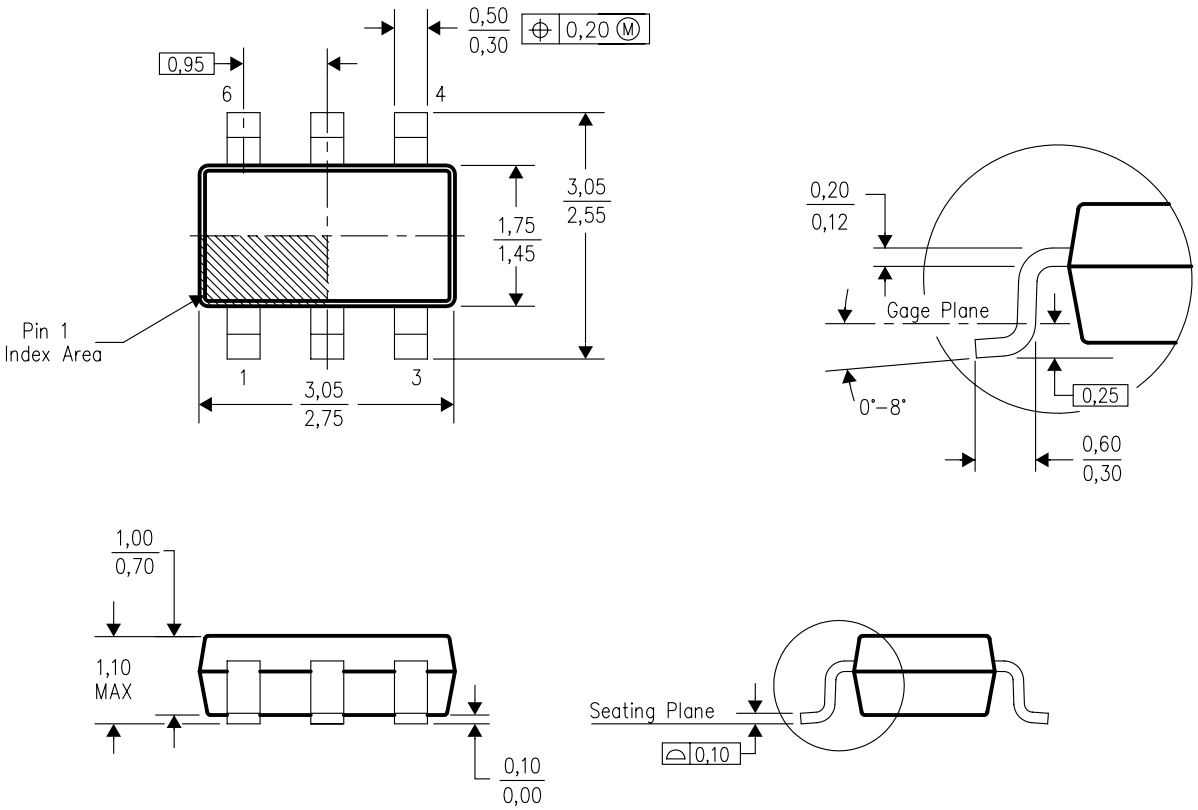
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM2840XMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2840XMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0
LM2840XQMK/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2840YMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2840YQMK/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2840YQMKX/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0
LM2841XMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2841XMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0
LM2841XQMK/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2841YMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2841YMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0
LM2841YQMK/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2841YQMKX/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0
LM2842XMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2842XMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0
LM2842XQMK/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2842XQMKX/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0
LM2842YMK-ADJL/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2842YMKX-ADJL/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0
LM2842YQMK/NOPB	SOT-23-THIN	DDC	6	1000	210.0	185.0	35.0
LM2842YQMKX/NOPB	SOT-23-THIN	DDC	6	3000	210.0	185.0	35.0

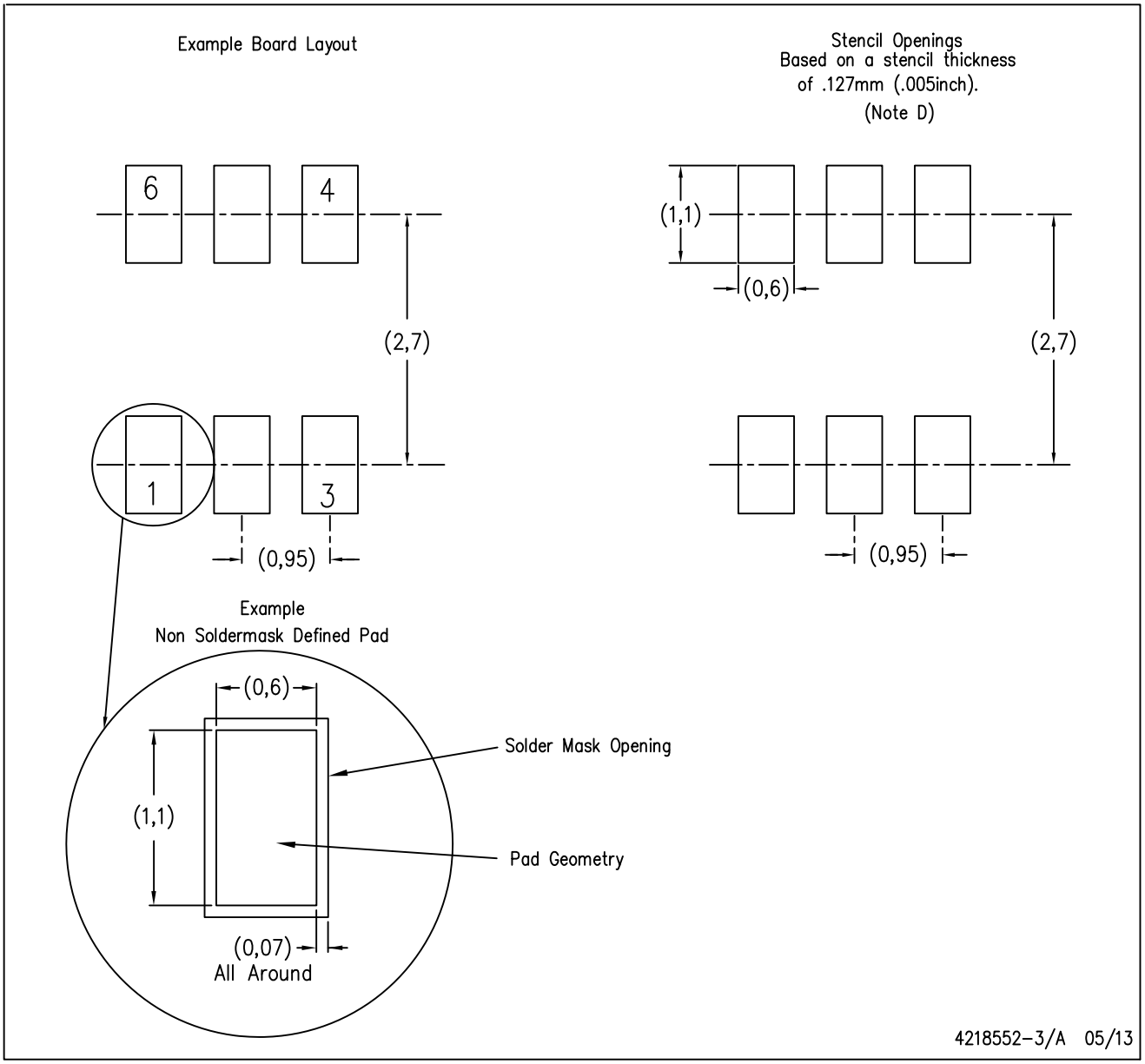
DDC (R–PDSO–G6) PLASTIC SMALL–OUTLINE



4204403–3/E 06/05

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO–193 variation AA (6 pin).

DDC (R–PDSO–G6) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

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