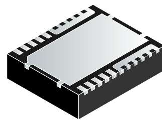




# CSD95372BQ5M 同步降压 NexFET™ 智能功率级

## 1 特性

- 60A 持续运行电流能力
- 电流 30A 时，系统效率达到 93.4%
- 电流 30A 时，2.8W 低功率损耗
- 高频运行（高达 1.25MHz）
- 支持强制连续传导模式 (FCCM) 的二极管仿真模式
- 温度补偿双向电流感测
- 模拟温度输出（0°C 时 600mV）
- 故障监控
  – 高端短路、过流和过热保护
- 输入电压高达 14.5V
- 与 3.3 和 5V 脉宽调制 (PWM) 信号兼容
- 三态 PWM 输入
- 集成型自举二极管
- 针对击穿保护的经优化死区时间
- 高密度小外形尺寸无引线 (SON) 5mm x 6mm 封装
- 超低电感封装
- 系统已优化的印刷电路板 (PCB) 封装
- 双冷却封装
- 符合 RoHS 绿色环保标准-无铅端子镀层
- 无卤素

## 2 应用范围

- 多相位同步降压转换器
  – 高频应用
  – 高电流、低占空比应用
- 负载点 (POL) 直流 - 直流转换器
- 内存和图形卡
- 台式机和服务器 VR11.x / VR12.x V 内核和存储器同步转换器

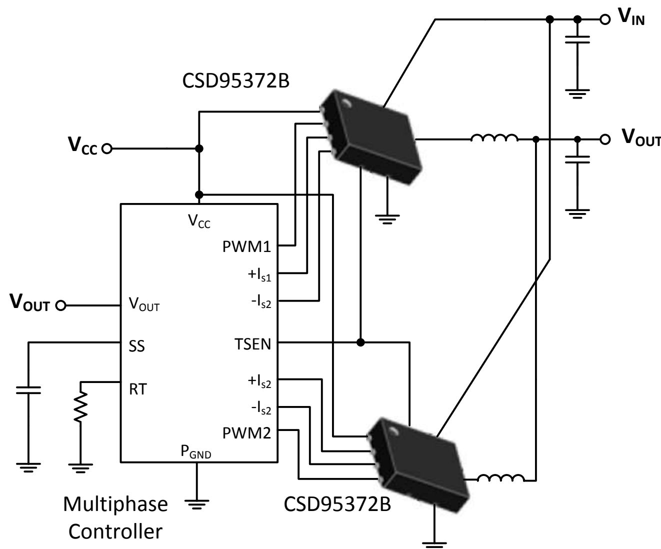
## 3 说明

CSD95372BQ5M NexFET™ 功率级的设计针对高功率、高密度同步降压转换器中的使用进行了高度优化。这个产品集成了驱动器集成电路 (IC) 和功率金属氧化物半导体场效应晶体管 (MOSFET) 来完善功率级开关功能。 这个组合在小型 5mm x 6mm 外形尺寸封装中提供高电流、高效和高速开关功能。 它还集成了准确电流感测和温度感测功能，以简化系统设计并提高准确度。 此外，已经 PCB 封装进行了优化以帮助减少设计时间并简化总体系统设计的完成。

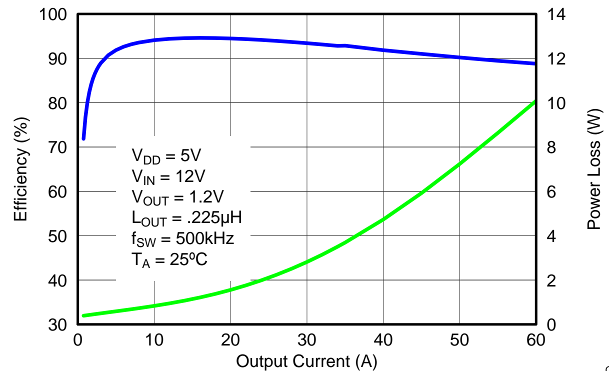
器件信息

| 器件 | 介质 | 数量 | 封装 | 出货 |
|---|---|---|---|---|
| CSD95372BQ5M | 13 英寸卷带 | 2500 | SON 5mm x 6mm 封装 | 卷带封装 |
| CSD95372BQ5MT | 7 英寸卷带 | 250 | SON 5mm x 6mm 封装 | 卷带封装 |

应用图表




典型功率级效率与功率损耗



PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

目录

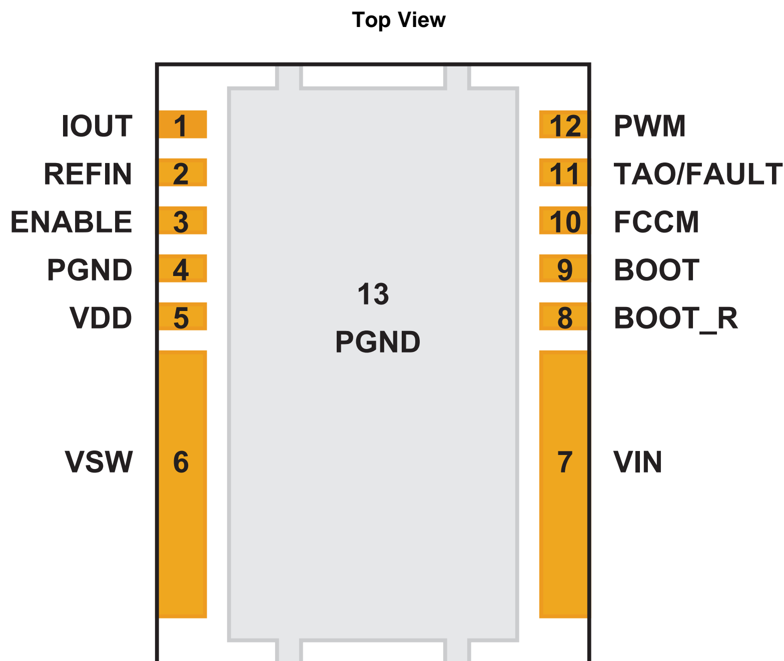
1 特性 ... 1
2 应用范围 ... 1
3 说明 ... 1
4 修订历史记录 ... 2
5 **Terminal Configuration and Functions** ... 3
6 **Specifications** ... 4
  6.1 Absolute Maximum Ratings ... 4
  6.2 Handling Ratings ... 4
  6.3 Recommended Operating Conditions ... 4
  6.4 Thermal Information ... 4
7 **Application Schematic** ... 5
8 器件和文档支持 ... 6
  8.1 Trademarks ... 6
  8.2 Electrostatic Discharge Caution ... 6
  8.3 Glossary ... 6
9 机械封装和可订购信息 ... 7
  9.1 机械制图 ... 8
  9.2 建议印刷电路板 (PCB) 焊盘图案 ... 9
  9.3 建议模板开口 ... 9

# 4 修订历史记录

| 日期 | 修订版本 | 注释 |
| --- | --- | --- |
| 2014 年 3 月 | * | 最初发布版本。 |


Copyright © 2014, Texas Instruments Incorporated

## 5 Terminal Configuration and Functions




**Terminal Functions**

| TERMINAL | | DESCRIPTION |
|---|---|---|
| NAME | NUMBER | |
| BOOT | 9 | Bootstrap capacitor connection. Connect a minimum of 0.1-µF 16-V X7R ceramic capacitor from BOOT to BOOT_R pins. The bootstrap capacitor provides the charge to turn on the control FET. The bootstrap diode is integrated. |
| BOOT_R | 8 | Return path for HS gate driver, connected to $V_{SW}$ internally. |
| ENABLE | 3 | Enables device operation. If ENABLE = logic HIGH, turns on device. If ENABLE = logic LOW, the device is turned off and both MOSFET gates are actively pulled low. An internal 100kΩ pull down resistor will pull the ENABLE pin LOW if left floating. |
| FCCM | 10 | This pin enables the Diode Emulation function. When this pin is held LOW, Diode Emulation Mode is enabled for sync FET. When FCCM is HIGH, the device is operated in Forced Continuous Conduction Mode. An internal 5-µA current source will pull the FCCM pin to 3.3 V if left floating. |
| IOUT | 1 | Output of current sensing amplifier. V(IOUT) – V(REFIN) is proportional to the phase current. |
| $P_{GND}$ | 4 | Power ground, connected directly to terminal 13. |
| $P_{GND}$ | 13 | Power ground |
| PWM | 12 | Pulse width modulated 3-state input from external controller. Logic LOW sets control FET gate low and sync FET gate high. Logic HIGH sets control FET gate high and sync FET gate low. Open or High Z sets both MOSFET gates low if greater than the 3-state shutdown hold-off time ($t_{3HT}$). |
| REFIN | 2 | External reference voltage input for current sensing amplifier |
| TAO/ FAULT | 11 | Temperature Analog Output. Reports a voltage proportional to the die temperature. An ORing diode is integrated in the IC. When used in multiphase application, a single wire can be used to connect the TAO pins of all the IC's. Only the highest temperature will be reported. TAO will be pulled up to 3 V if thermal shutdown occurs. TAO should be bypassed to $P_{GND}$ with a 1nF 16V X6R ceramic capacitor. |
| $V_{DD}$ | 5 | Supply voltage to gate driver and internal circuitry |
| $V_{IN}$ | 7 | Input voltage pin. Connect input capacitors close to this pin. |
| $V_{SW}$ | 6 | Phase node connecting the HS MOSFET source and LS MOSFET drain – pin connection to the output inductor. |

Copyright © 2014, Texas Instruments Incorporated

# 6 Specifications

## 6.1 Absolute Maximum Ratings

$T_A$ = 25°C (unless otherwise noted)(1)

| PARAMETER | MIN | MAX | UNIT |
|---|---|---|---|
| $V_{IN}$ to $P_{GND}$ | –0.3 | 25 | V |
| $V_{IN}$ to $V_{SW}$ | –0.3 | 25 | V |
| $V_{IN}$ to $V_{SW}$ (10 ns) | –7 | 27 | V |
| $V_{SW}$ to $P_{GND}$ | –0.3 | 20 | V |
| $V_{SW}$ to $P_{GND}$ (10 ns) | –7 | 23 | V |
| $V_{DD}$ to $P_{GND}$ | –0.3 | 7 | V |
| ENABLE, PWM, FCCM. TAO, IOUT, REFIN to $P_{GND}$ | –0.3 | $V_{DD}$ + 0.3 V | V |
| BOOT to BOOT_R(2) | –0.3 | $V_{DD}$ + 0.3 V | V |
| $P_D$, Power Dissipation | | 12 | W |
| $T_J$, Operating Junction | –55 | 150 | °C |

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) Should not exceed 7 V

## 6.2 Handling Ratings

| PARAMETER | | MIN | MAX | UNIT |
|---|---|---|---|---|
| $T_{stg}$ | Storage Temperature Range | –55 | 150 | °C |
| ESD Rating | Human Body Model (HBM) | | 2000 | V |
| | Charged Device Model (CDM) | | 500 | |

## 6.3 Recommended Operating Conditions

$T_A$ = 25° (unless otherwise noted)

| PARAMETER | CONDITIONS | MIN | MAX | UNIT |
|---|---|---|---|---|
| $V_{DD}$, Gate Drive Voltage | | 4.5 | 5.5 | V |
| $V_{IN}$, Input Supply Voltage | | | 14.5 | V |
| $V_{OUT}$, Output Voltage | | | 5.5 | V |
| $I_{OUT}$, Continuous Output Current | $V_{IN}$ = 12 V, $V_{DD}$ = 5 V, $V_{OUT}$ = 1.2 V, $f_{SW}$ = 500 kHz, $L_{OUT}$ = 0.225 µH(1) | | 60 | A |
| $I_{OUT-PK}$, Peak Output Current(2) | | | 90 | A |
| $f_{SW}$, Switching Frequency | $C_{BST}$ = 0.1 µF (min) | | 1250 | kHz |
| On Time Duty Cycle | $f_{SW}$ = 1MHz | | 85 | % |
| Minimum PWM On Time | | 40 | | ns |
| Operating Temperature | | –40 | 125 | °C |

(1) Measurement made with six 10-µF (TDK C3216X5R1C106KT or equivalent) ceramic capacitors placed across $V_{IN}$ to $P_{GND}$ pins.
(2) System conditions as defined in Note 1. Peak Output Current is applied for $t_p$ = 50 µs.

## 6.4 Thermal Information

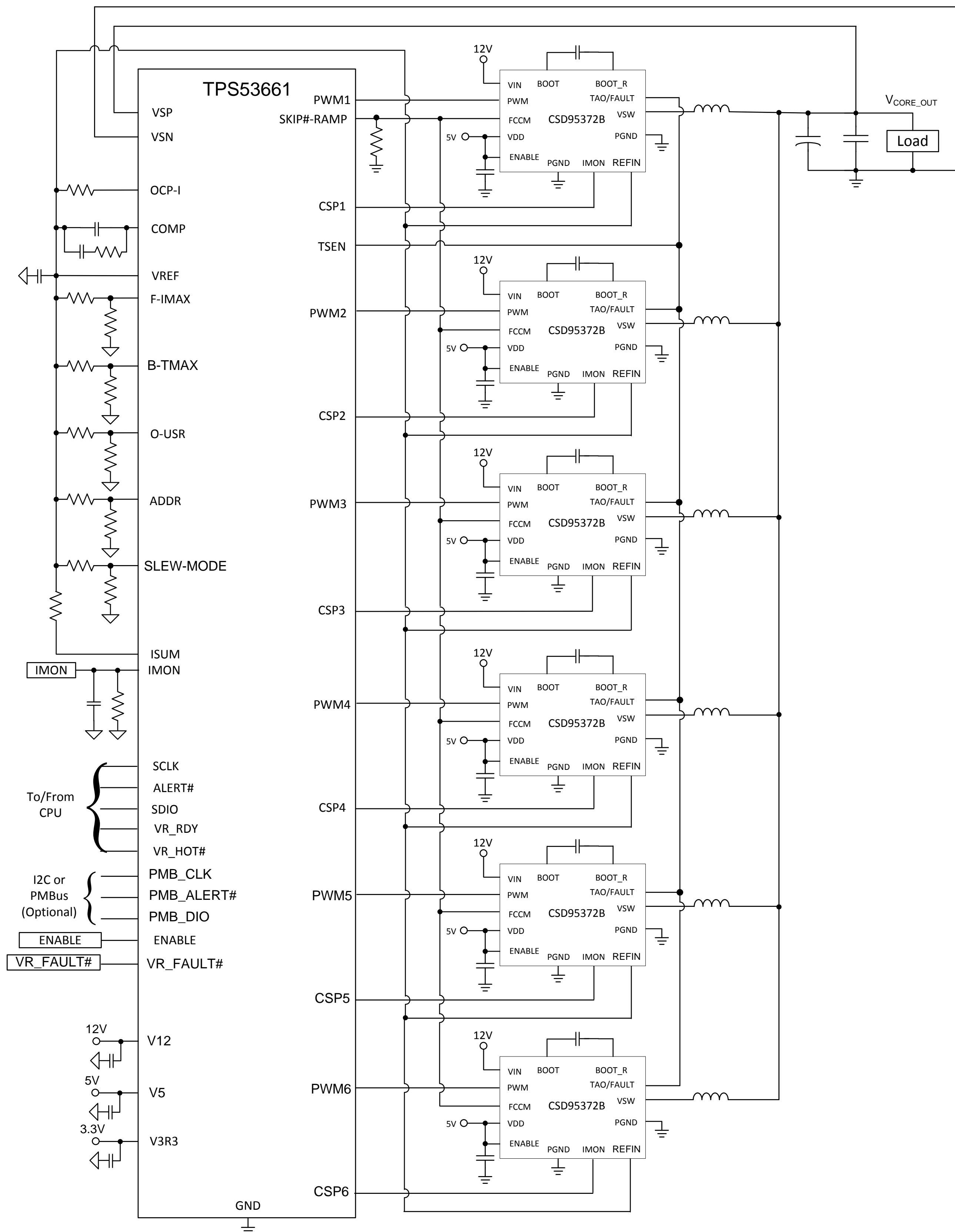
$T_A$ = 25°C (unless otherwise noted)

| PARAMETER | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case (Top of package)(1) | | | 15 | °C/W |
| $R_{\theta JB}$ | Thermal Resistance, Junction-to-Board(2) | | | 1.5 | |

(1) $R_{\theta JC}$ is determined with the device mounted on a 1-inch² (6.45 -cm²), 2-oz (.071-mm thick) Cu pad on a 1.5-inch x 1.5-inch, 0.06-inch (1.52-mm) thick FR4 board.
(2) $R_{\theta JB}$ value based on hottest board temperature within 1 mm of the package.


Copyright © 2014, Texas Instruments Incorporated

# 7 Application Schematic



# 8 器件和文档支持

## 8.1 Trademarks

NexFET is a trademark of Texas Instruments.

## 8.2 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## 8.3 Glossary

SLYZ022 — *TI Glossary*.

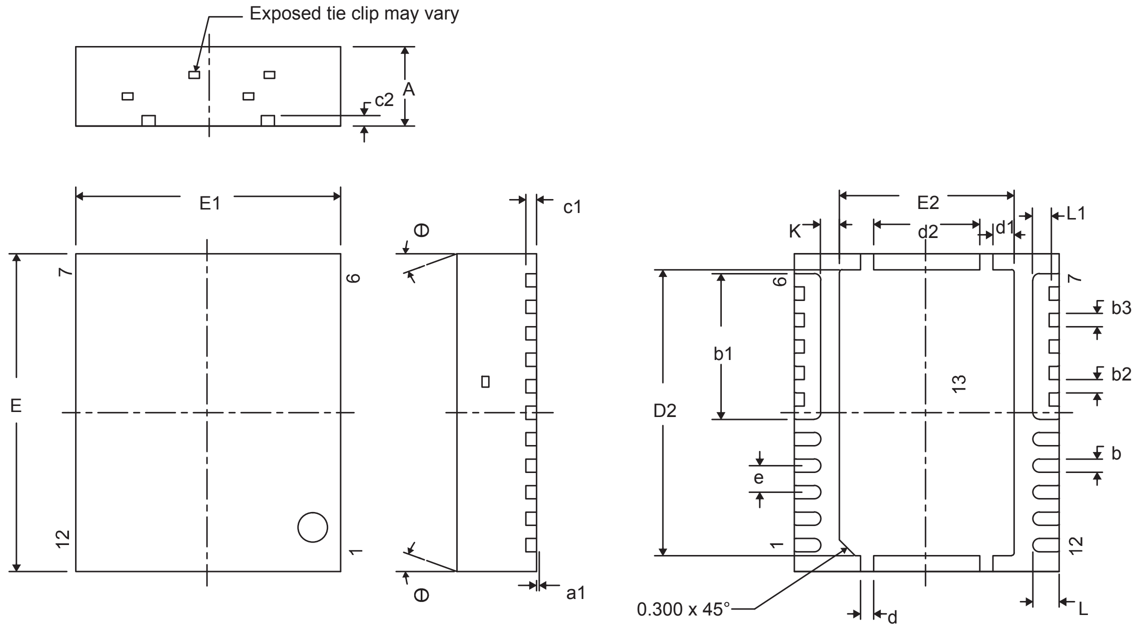
This glossary lists and explains terms, acronyms and definitions.


Copyright © 2014, Texas Instruments Incorporated

## 9 机械封装和可订购信息

以下页中包括机械封装和可订购信息。 这些信息是针对指定器件可提供的最新数据。 这些数据会在无通知且不对本文档进行修订的情况下发生改变。 要获得这份数据表的浏览器版本，请查阅左侧的导航栏。

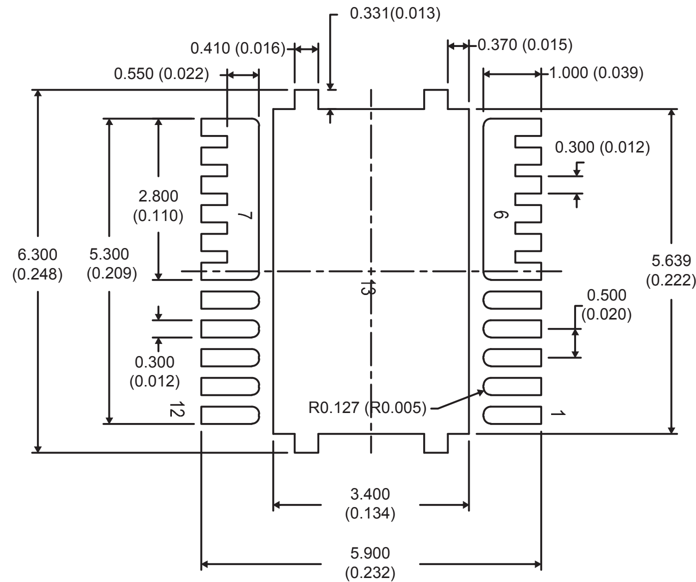
## 9.1 机械制图




| DIM | 毫米 | | | 英寸 | | |
|---|---|---|---|---|---|---|
| | 最小值 | 标称值 | 最大值 | 最小值 | 标称值 | 最大值 |
| A | 1.400 | 1.450 | 1.500 | 0.057 | 0.059 | 0.061 |
| a1 | 0.000 | 0.000 | 0.050 | 0.000 | 0.000 | 0.002 |
| b | 0.200 | 0.250 | 0.320 | 0.008 | 0.010 | 0.013 |
| b1 | 2.750 典型值 | | | 0.108 典型值 | | |
| b2 | 0.200 | 0.250 | 0.320 | 0.008 | 0.010 | 0.013 |
| b3 | 0.250 典型值 | | | 0.010 典型值 | | |
| c1 | 0.150 | 0.200 | 0.250 | 0.006 | 0.008 | 0.010 |
| c2 | 0.200 | 0.250 | 0.300 | 0.008 | 0.010 | 0.012 |
| D2 | 5.300 | 5.400 | 5.500 | 0.209 | 0.213 | 0.217 |
| d | 0.200 | 0.250 | 0.300 | 0.008 | 0.010 | 0.012 |
| d1 | 0.350 | 0.400 | 0.450 | 0.014 | 0.016 | 0.018 |
| d2 | 1.900 | 2.000 | 2.100 | 0.075 | 0.079 | 0.083 |
| E | 5.900 | 6.000 | 6.100 | 0.232 | 0.236 | 0.240 |
| E1 | 4.900 | 5.000 | 5.100 | 0.193 | 0.197 | 0.201 |
| E2 | 3.200 | 3.300 | 3.400 | 0.126 | 0.130 | 0.134 |
| e | 0.500 典型值 | | | 0.020 典型值 | | |
| K | 0.350 典型值 | | | 0.014 典型值 | | |
| L | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| L1 | 0.210 | 0.310 | 0.410 | 0.008 | 0.012 | 0.016 |
| θ | 0.00 | — | — | 0.00 | — | — |

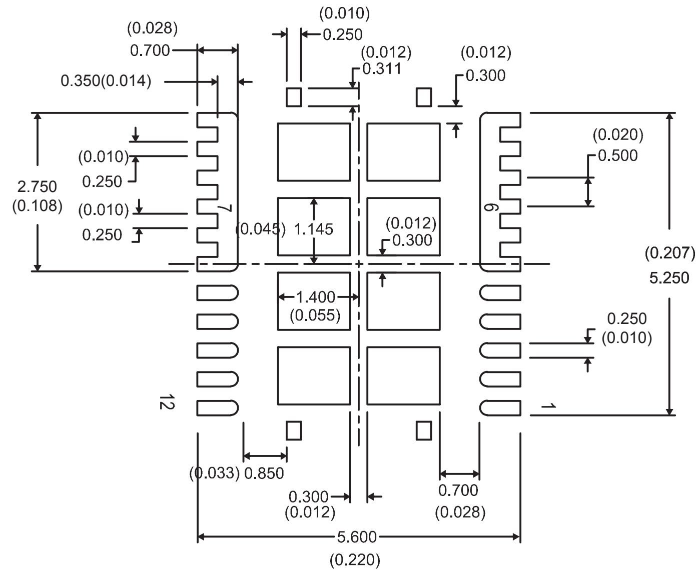

Copyright © 2014, Texas Instruments Incorporated

## 9.2 建议印刷电路板 (PCB) 焊盘图案




1. 尺寸单位为 mm（英寸）。

## 9.3 建议模板开口




1. 尺寸单位为 mm（英寸）。
2. 模板厚度 100μm

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CSD95372BQ5M | ACTIVE | LSON-CLIP | DQP | 12 | 2500 | RoHS-Exempt & Green | NIPDAU | Level-2-260C-1 YEAR | -55 to 150 | 95372BM | Samples |
| CSD95372BQ5MT | ACTIVE | LSON-CLIP | DQP | 12 | 250 | RoHS-Exempt & Green | NIPDAU \| SN | Level-2-260C-1 YEAR | -55 to 150 | 95372BM | 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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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

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

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

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

## 重要声明和免责声明

TI"按原样"提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做出任何明示或暗示的担保，包括但不限于对适销性、某特定用途方面的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他功能安全、信息安全、监管或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的应用。严禁对这些资源进行其他复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。您应全额赔偿因在这些资源的使用中对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，TI 对此概不负责。

TI 提供的产品受 TI 的销售条款或 ti.com 上其他适用条款/TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。

TI 反对并拒绝您可能提出的任何其他或不同的条款。



邮寄地址：Texas Instruments, Post Office Box 655303, Dallas, Texas 75265


Copyright © 2024，德州仪器 (TI) 公司