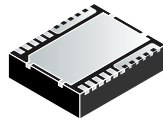


CSD95372BQ5MC 同步降压NexFET™ 智能功率级

1 特性

- 60A 持续运行电流能力
- 电流 30A 时，系统效率为 93.4%
- 电流 30A 时，2.8W 低功率损耗
- 高频工作（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
- 3.3V 和 5V 脉宽调制 (PWM) 信号兼容
- 三态 PWM 输入
- 集成型自举二极管
- 优化了击穿保护死区时间
- 高密度小外形尺寸无引线 (SON) 5mm x 6mm 封装
- 超低电感封装
- 系统优化的 PCB 封装
- DualCool™ 封装
- 符合 RoHS 环保标准-无铅引脚镀层
- 无卤素



2 应用

- 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

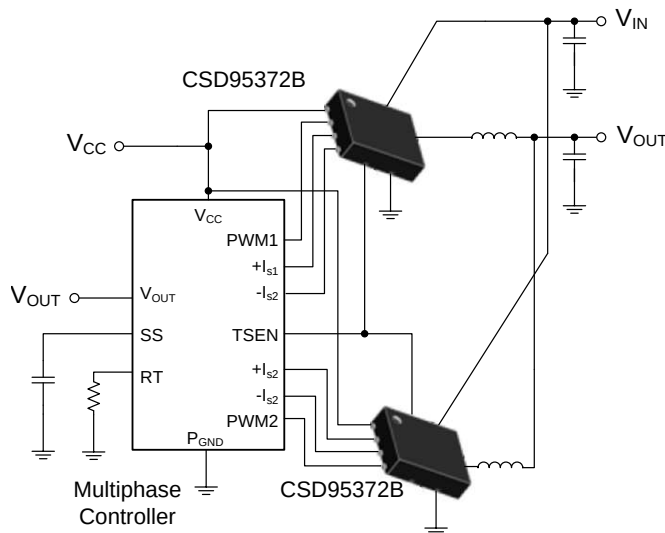
CSD95372BQ5MC NexFET™智能功率级的设计针对高功率、高密度同步降压转换器中的使用进行了高度优化。这个产品集成了驱动器集成电路 (IC) 和功率金属氧化物半导体场效应晶体管 (MOSFET) 来完善功率级开关功能。该组合可在 5mm x 6mm 小型封装中实现高电流、高效率以及高速切换功能。它还集成了准确电流感测和温度感测功能，以简化系统设计并提高准确度。此外，PCB 封装已经过优化，可帮助减少设计时间并简化总体系统设计的完成。

器件信息⁽¹⁾

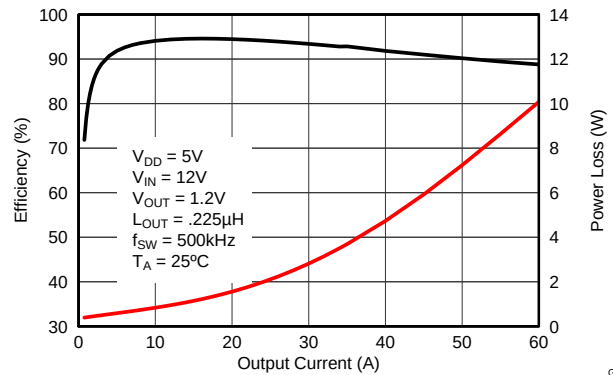
器件	介质	数量	封装	发货
CSD95372BQ5MC	13 英寸卷带	2500	SON 5mm x 6mm DualCool 封装	卷带封装
CSD95372BQ5MCT	7 英寸卷带	250		

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。

应用图表



典型功率级效率与功率损耗



目录

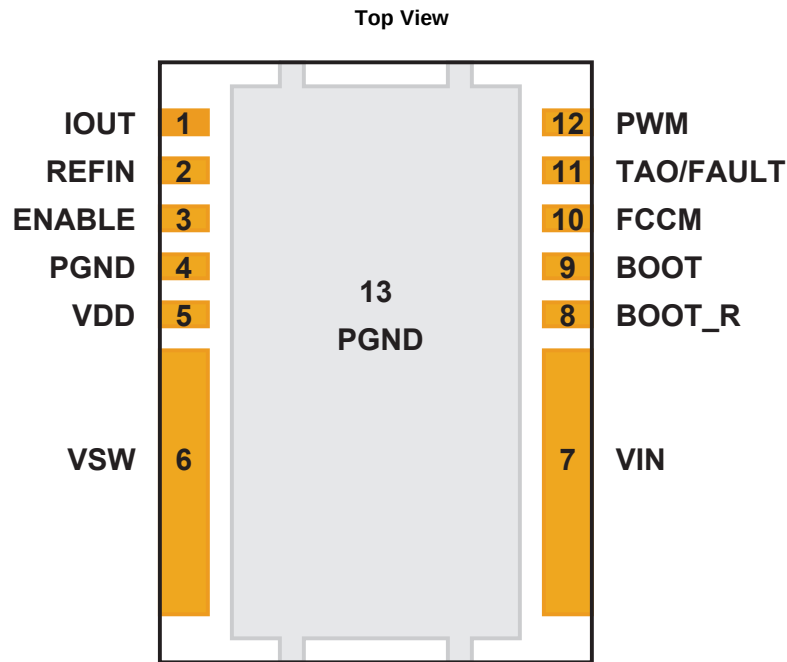
1	特性	1	7	Application Schematic	5
2	应用	1	8	器件和文档支持	6
3	说明	1	8.1	社区资源	6
4	修订历史记录	2	8.2	商标	6
5	Pin Configuration and Functions	3	8.3	静电放电警告	6
6	Specifications	4	8.4	Glossary	6
6.1	Absolute Maximum Ratings	4	9	机械、封装和可订购信息	7
6.2	ESD Ratings	4	9.1	机械制图	7
6.3	Recommended Operating Conditions	4	9.2	建议印刷电路板 (PCB) 焊盘图案	8
6.4	Thermal Information	4	9.3	建议模板开口	8

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 Original (April 2014) to Revision A	Page
• Updated Application Schematic to show I_{OUT} (not I_{MON}) for each CSD95372B	5
• 已将 机械制图 表中的 MAX A 尺寸更正为 1.050mm (0.041in.)	7

5 Pin Configuration and Functions



Pin Functions

PIN		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 100-kΩ pulldown 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 pin 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 tri-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 ICs. Only the highest temperature will be reported. TAO will be pulled up to 3.3 V if thermal shutdown occurs. TAO should be bypassed to P _{GND} with a 1 nF 16 V X7R 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.

6 Specifications

6.1 Absolute Maximum Ratings

 $T_A = 25^\circ\text{C}$ (unless otherwise noted)⁽¹⁾

	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	$V_{DD} + 0.3\text{ V}$	V
BOOT to BOOT_R ⁽²⁾	−0.3	$V_{DD} + 0.3\text{ V}$	V
P_D Power dissipation		12	W
T_J Operating junction	−55	150	°C
T_{stg} Storage temperature	−55	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) Should not exceed 7 V.

6.2 ESD Ratings

	VALUE	UNIT
$V_{(ESD)}$ Electrostatic discharge	Human body model (HBM)	±2000 V
	Charged device model (CDM)	±500 V

6.3 Recommended Operating Conditions

 $T_A = 25^\circ$ (unless otherwise noted)

	MIN	MAX	UNIT
V_{DD} Gate drive voltage	4.5	5.5	V
V_{IN} Input supply voltage ⁽¹⁾		16	V
V_{OUT} Output voltage		5.5	V
I_{OUT} Continuous output current	$V_{IN} = 12\text{ V}$, $V_{DD} = 5\text{ V}$, $V_{OUT} = 3.3\text{ V}$, $f_{SW} = 500\text{ kHz}$, $L_{OUT} = 0.47\text{ }\mu\text{H}$ ⁽²⁾		60 A
I_{OUT-PK} Peak output current ⁽³⁾			90 A
f_{SW} Switching frequency	$C_{BST} = 0.1\text{ }\mu\text{F}$ (min)	1250	kHz
On-time duty cycle	$f_{SW} = 1\text{ MHz}$	85%	
Minimum PWM on-time	40		ns
Operating temperature	−40	125	°C

- (1) Operating at high V_{IN} can create excessive AC voltage overshoots on the switch node (V_{SW}) during MOSFET switching transients. For reliable operation, the switch node (V_{SW}) to ground voltage must remain at or below the Absolute Maximum Ratings.
- (2) Measurement made with six 10- μF (TDK C3216X5R1C106KT or equivalent) ceramic capacitors placed across V_{IN} to P_{GND} pins.
- (3) System conditions as defined in Note 1. Peak Output Current is applied for $t_p = 50\text{ }\mu\text{s}$

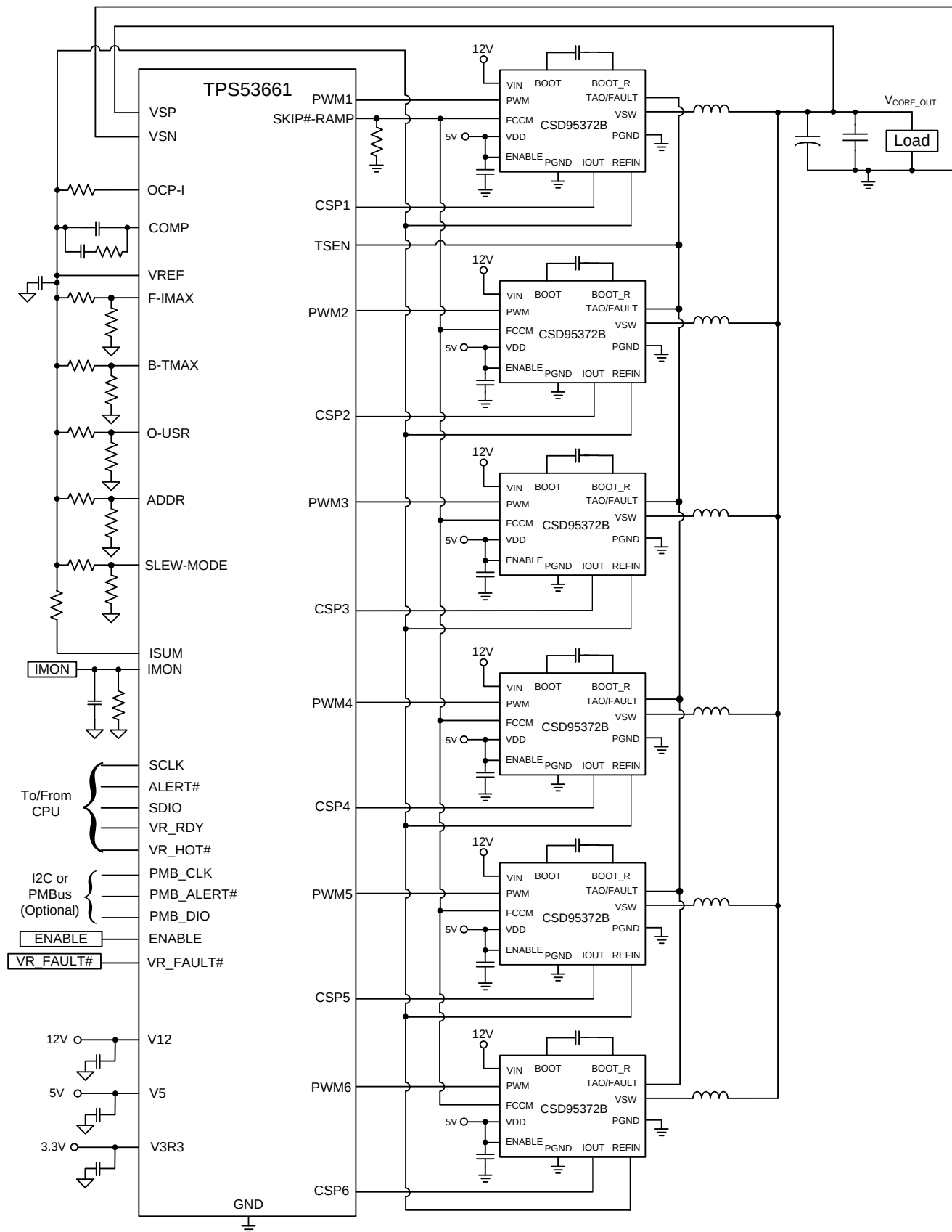
6.4 Thermal Information

 $T_A = 25^\circ\text{C}$ (unless otherwise noted)

THERMAL METRIC	MIN	TYP	MAX	UNIT
$R_{\theta JC(top)}$ Junction-to-case (top of package) thermal resistance ⁽¹⁾			5	°C/W
$R_{\theta JB}$ Junction-to-board thermal resistance ⁽²⁾			1.5	°C/W

- (1) $R_{\theta JC(top)}$ is determined with the device mounted on a 1-in² (6.45-cm²), 2-oz (0.071-mm) thick Cu pad on a 1.5-in x 1.5-in, 0.06-in (1.52-mm) thick FR4 board.
- (2) $R_{\theta JB}$ value based on hottest board temperature within 1 mm of the package.

7 Application Schematic



8 器件和文档支持

8.1 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》。

TI E2E™ 在线社区 **TI 的工程师对工程师 (E2E) 社区。**此社区的创建目的在于促进工程师之间的协作。在 e2e.ti.com 中，您可以咨询问题、分享知识、拓展思路并与同行工程师一道帮助解决问题。

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。

8.2 商标

DualCool, NexFET, E2E are trademarks of Texas Instruments.
All other trademarks are the property of their respective owners.

8.3 静电放电警告



ESD 可能会损坏该集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理措施和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

8.4 Glossary

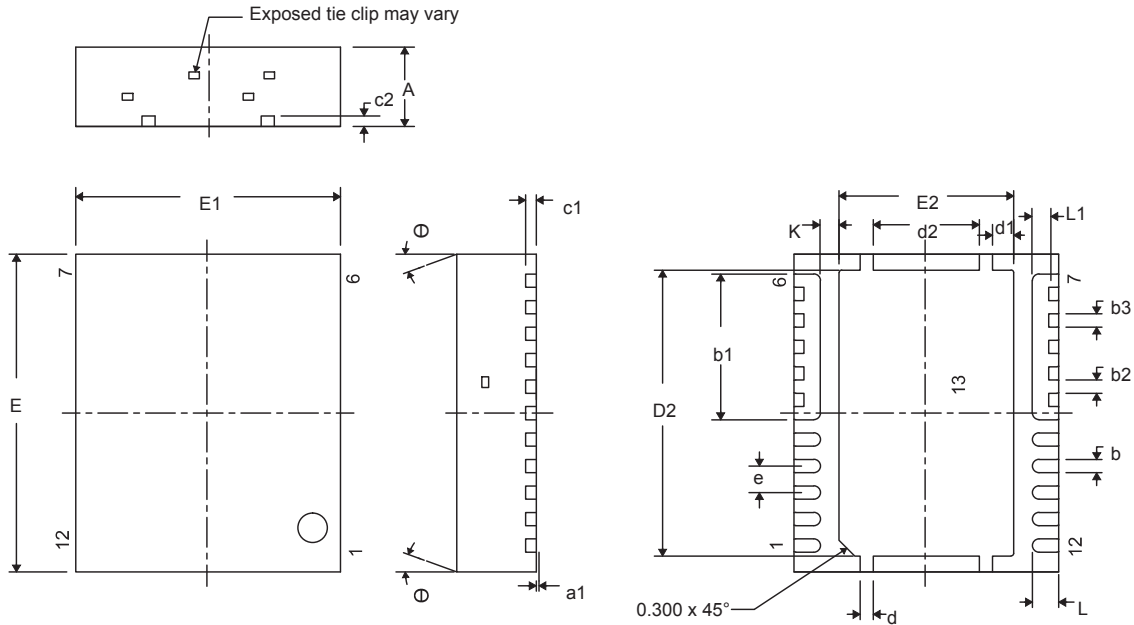
SLYZ022 — *TI Glossary*.

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

9 机械、封装和可订购信息

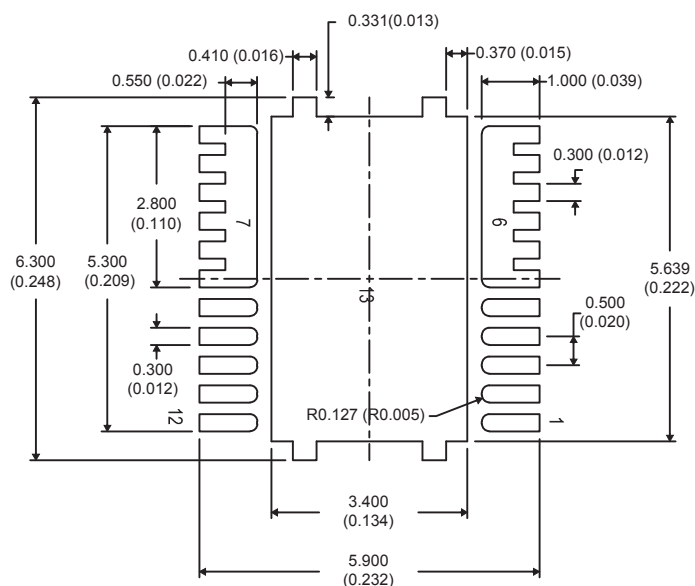
以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知和修订此文档。如欲获取此数据表的浏览器版本，请参阅左侧的导航。

9.1 机械制图



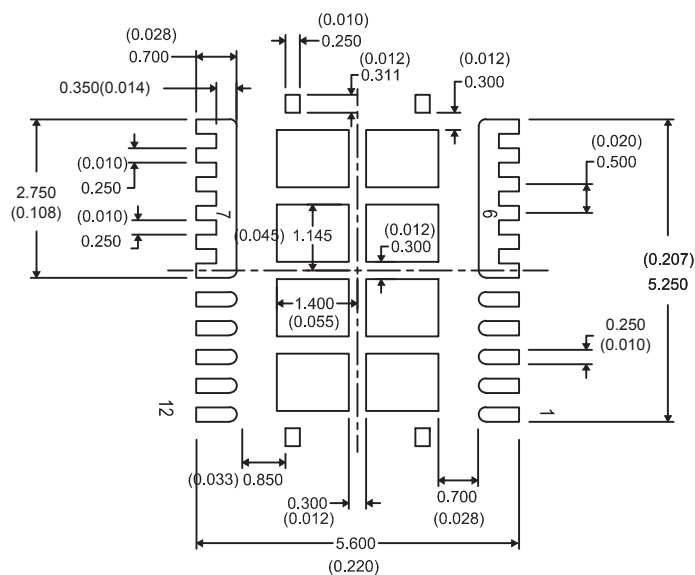
DIM	毫米			英寸		
	最小值	标称值	最大值	最小值	标称值	最大值
A	0.950	1.000	1.050	0.037	0.039	0.041
a1	0.000	0.000	0.050	0.000	0.000	0.002
b	0.200	0.250	0.320	0.008	0.010	0.013
b1	2.750 典型值			0.108 典型值		
b2	0.200	0.250	0.320	0.008	0.010	0.013
b3	0.250 典型值			0.010 典型值		
c1	0.150	0.200	0.250	0.006	0.008	0.010
c2	0.200	0.250	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	—	—

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. 模板厚度为 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
CSD95372BQ5MC	ACTIVE	VSON-CLIP	DMC	12	2500	RoHS-Exempt & Green	SN	Level-2-260C-1 YEAR	-55 to 150	95372BMC	Samples
CSD95372BQ5MCT	ACTIVE	VSON-CLIP	DMC	12	250	RoHS-Exempt & Green	SN	Level-2-260C-1 YEAR	-55 to 150	95372BMC	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.

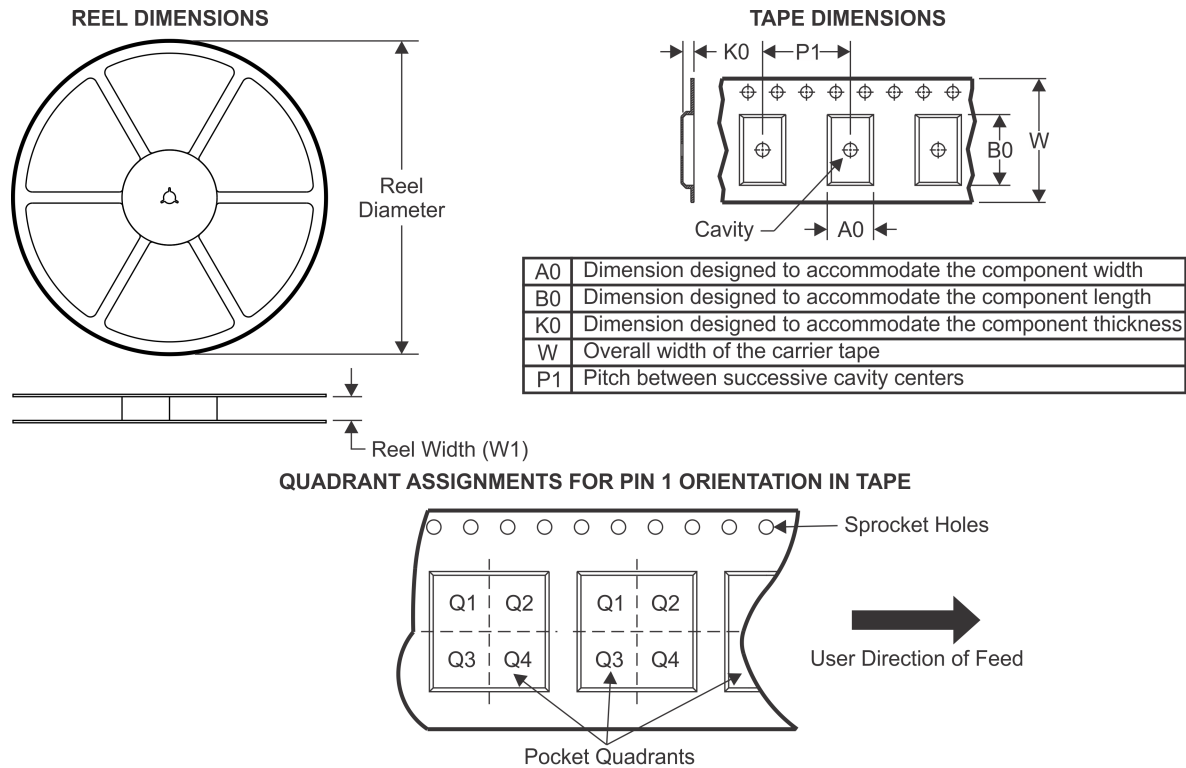
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

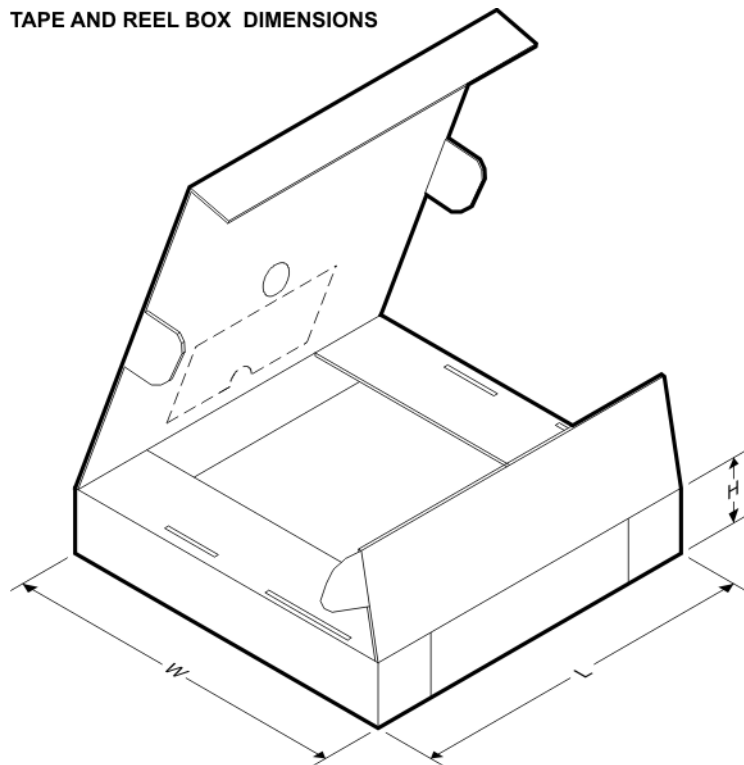
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION


*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
CSD95372BQ5MC	VSON-CLIP	DMC	12	2500	330.0	12.4	5.3	6.3	1.2	8.0	12.0	Q1
CSD95372BQ5MCT	VSON-CLIP	DMC	12	250	180.0	12.4	5.3	6.3	1.2	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CSD95372BQ5MC	VSON-CLIP	DMC	12	2500	367.0	367.0	38.0
CSD95372BQ5MCT	VSON-CLIP	DMC	12	250	213.0	191.0	35.0

重要声明和免责声明

TI 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安全、安保或其他要求。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 (<https://www.ti.com.cn/zh-cn/legal/termsofsale.html>) 或 [ti.com.cn](https://www.ti.com.cn) 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。

邮寄地址：上海市浦东新区世纪大道 1568 号中建大厦 32 楼，邮政编码：200122
Copyright © 2021 德州仪器半导体技术（上海）有限公司