

TPS6288x-Q1 具有 I²C 接口的 2.8V 至 6V 输入、12A、20A、24A 和 30A 汽车级快速瞬态可堆叠双相降压转换器

1 特性

- 符合面向汽车应用的 AEC-Q100 标准
 - 温度等级 1：-40°C 至 125°C T_A
 - 40°C 至 150°C 的结温范围
- 符合功能安全标准
 - 专为功能安全应用开发
 - 提供文档以支持 ISO 26262 系统设计，最高可达 ASIL D (SEooC) 要求
- 输入电压范围：2.8V 至 6V
- 适用于 AVS/DVS 的可选输出电压范围
 - 3 个范围；V_{out} 为 0.4V 至 1.2V
- 输出电压精度：±0.5%
- 7mΩ 和 4.5mΩ 内部功率 MOSFET
- 外部补偿
- 开关频率选项：1.5MHz、2.25MHz、2.5MHz 或 3MHz
- 强制 PWM 或省电模式运行
- 具有 CRC 功能的 3.4MHz I²C 兼容接口
- 输出电压由 I²C i/f 或 VSELx 引脚选择
- 可选堆叠运行
- 差分遥感
- 输入和输出过压保护
- 热预警和热关断
- 输出放电
- 可选展频时钟
- 具有窗口比较器和可调阈值的电源正常输出
- 封装具有可湿性侧面

2 应用

- ADAS 摄像头、ADAS 传感器融合
- 环视 ECU
- 混合和可重新配置仪表组
- 音响主机、远程信息处理控制单元

3 说明

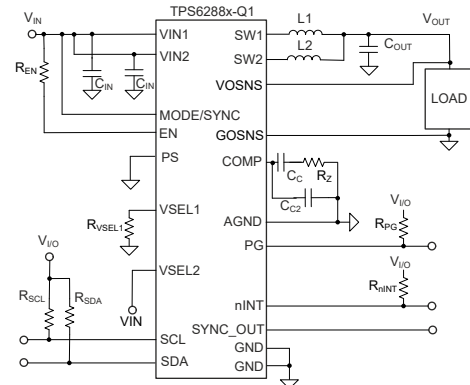
TPS62880-Q1、TPS62881-Q1、TPS62882-Q1 和 TPS62883-Q1 是引脚对引脚 12A、20A、24A 和 30A 同步双相直流/直流降压转换器系列。TPS6288x-Q1 实现了增强型 DCS-Control 方案，该方案将快速瞬态响应与固定频率运行相结合。双相运行不仅可降低输入和输出电压纹波，还支持每个相位使用更小的电感器。这些器件在中高负载条件下以脉宽调制 (PWM) 模式运行，并在轻负载时自动切换至不连续导通模式，以在整个负载电流范围内保持高效率。这些器件还可强制进入 PWM 模式运行，实现最小的输出电压纹波。这些器件在建议的输入电压和温度范围内提供 0.5% 的直流输出

电压精度。差分遥感可直接在负载处实现精确的电压控制。只要电源电压高于 UVLO 阈值，兼容 I²C 的接口就可正常工作。该接口提供多种控制、监测和警告功能，例如电压监测和温度警告。动态电压调节让负载功耗可以根据应用的性能需求进行调整。默认启动电压可通过 VSELx 引脚进行选择。开关频率在出厂时已编程为 2.25MHz，并提供了 1.5MHz、2.5MHz 或 3MHz 选项。TPS6288x-Q1 可与外部时钟同步。通过堆叠，最多可并联运行五个器件，从而支持高达 150A 的总输出电流。PS 引脚与 SYNC_OUT 引脚一起将器件定义为主器件或辅助器件。辅助器件的相移由 VSEL1 和 VSEL2 引脚定义为 30°、60°、90° 或 120°。请参阅 [器件选项](#) 表以了解详细信息。

器件信息

器件型号	电流额定值 ⁽¹⁾	封装尺寸 (标称值)
TPS62880-Q1	12A	4mm × 5mm
TPS62881-Q1	20A	
TPS62882-Q1	24A	
TPS62883-Q1	30A	

(1) 请参阅 [器件选项](#) 表。



简化版原理图



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4 器件选项

器件型号	输出电流	主器件的启动电压和 I ² C 器件地址	辅助器件的 I ² C 器件地址/相移	软启动时间/默认开关频率和其他配置设置
TPS62880QFWRADQ1	12A	Vo1 = 0.850V ; I2C1 = 0x38 Vo2 = 0.750V ; I2C2 = 0x39 Vo3 = 0.875V ; I2C3 = 0x3A Vo4 = 0.800V ; I2C4 = 0x3B	I2C1 = 0x3C/30° I2C2 = 0x3D/60° I2C3 = 0x3E/90° I2C4 = 0x3F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1
TPS6288001QFWRADQ1 ⁽¹⁾	12A	Vo1 = 0.750V ; I2C1 = 0x18 Vo2 = 0.800V ; I2C2 = 0x19 Vo3 = 1.050V ; I2C3 = 0x1A Vo4 = 0.800V ; I2C4 = 0x1B	I2C1 = 0x1C/30° I2C2 = 0x1D/60° I2C3 = 0x1E/90° I2C4 = 0x1F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1
TPS62881QFWRADQ1	20A	Vo1 = 0.850V ; I2C1 = 0x38 Vo2 = 0.750V ; I2C2 = 0x39 Vo3 = 0.875V ; I2C3 = 0x3A Vo4 = 0.800V ; I2C4 = 0x3B	I2C1 = 0x3C/30° I2C2 = 0x3D/60° I2C3 = 0x3E/90° I2C4 = 0x3F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1
TPS6288101QFWRADQ1 ⁽¹⁾	20A	Vo1 = 0.750V ; I2C1 = 0x18 Vo2 = 0.800V ; I2C2 = 0x19 Vo3 = 1.050V ; I2C3 = 0x1A Vo4 = 0.800V ; I2C4 = 0x1B	I2C1 = 0x1C/30° I2C2 = 0x1D/60° I2C3 = 0x1E/90° I2C4 = 0x1F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1
TPS62882QFWRADQ1	24A	Vo1 = 0.850V ; I2C1 = 0x38 Vo2 = 0.750V ; I2C2 = 0x39 Vo3 = 0.875V ; I2C3 = 0x3A Vo4 = 0.800V ; I2C4 = 0x3B	I2C1 = 0x3C/30° I2C2 = 0x3D/60° I2C3 = 0x3E/90° I2C4 = 0x3F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1
TPS6288280QFWRADQ1	24A	Vo1 = 0.850V ; I2C1 = 0x38 Vo2 = 0.750V ; I2C2 = 0x39 Vo3 = 0.875V ; I2C3 = 0x3A Vo4 = 0.800V ; I2C4 = 0x3B	I2C1 = 0x3C/30° I2C2 = 0x3D/60° I2C3 = 0x3E/90° I2C4 = 0x3F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±8% REG_CRC_EN = 1
TPS62883QFWRADQ1	30A	Vo1 = 0.850V ; I2C1 = 0x38 Vo2 = 0.750V ; I2C2 = 0x39 Vo3 = 0.875V ; I2C3 = 0x3A Vo4 = 0.800V ; I2C4 = 0x3B	I2C1 = 0x3C/30° I2C2 = 0x3D/60° I2C3 = 0x3E/90° I2C4 = 0x3F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1
TPS6288301QFWRADQ1 ⁽¹⁾	30A	Vo1 = 0.750V ; I2C1 = 0x18 Vo2 = 0.800V ; I2C2 = 0x19 Vo3 = 1.050V ; I2C3 = 0x1A Vo4 = 0.800V ; I2C4 = 0x1B	I2C1 = 0x1C/30° I2C2 = 0x1D/60° I2C3 = 0x1E/90° I2C4 = 0x1F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1

器件型号	输出电流	主器件的启动电压和 I ² C 器件地址	辅助器件的 I ² C 器件地址/相移	软启动时间/默认开关频率和其他配置设置
TPS6288380QFWRADRQ1	30A	Vo1 = 0.850V ; I2C1 = 0x38 Vo2 = 0.750V ; I2C2 = 0x39 Vo3 = 0.875V ; I2C3 = 0x3A Vo4 = 0.800V ; I2C4 = 0x3B	I2C1 = 0x3C/30° I2C2 = 0x3D/60° I2C3 = 0x3E/90° I2C4 = 0x3F/120°	td(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±8% REG_CRC_EN = 1

(1) 预发布信息 (非量产数据)

5 器件和文档支持

5.1 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。点击 [通知](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

5.2 支持资源

[TI E2E™ 中文支持论坛](#) 是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”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](#)。

5.3 商标

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5.4 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。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。

5.5 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

6 修订历史记录

Changes from Revision A (December 2025) to Revision B (January 2026)	Page
• 删除了 器件选项表 中 TPS62880QFWRADRQ1、TPS62881QFWRADRQ1、TPS62882QFWRADRQ1、TPS6288280QFWRADRQ1 和 TPS6288380QFWRADRQ1 的预发布信息标签.....	3

Changes from Revision * (October 2024) to Revision A (December 2025)	Page
• 将文档状态从“预告信息”更改为“量产数据”	1
• 向器件选项表中添加了新的器件引脚.....	3

7 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可用的最新数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。有关此数据表的浏览器版本，请查阅左侧的导航栏。

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)
TPS62880QFWRDRQ1	Active	Production	VQFN-HR (RAD) 25	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TPS6288 0-Q1
TPS62881QFWRDRQ1	Active	Production	VQFN-HR (RAD) 25	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TPS6288 1-Q1
TPS6288280QWRDRQ1	Active	Production	VQFN-HR (RAD) 25	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TPS6288 280-Q1
TPS62882QFWRDRQ1	Active	Production	VQFN-HR (RAD) 25	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TPS6288 2-Q1
TPS6288380QWRDRQ1	Active	Production	VQFN-HR (RAD) 25	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TPS6288 380-Q1
TPS62883QFWRDRQ1	Active	Production	VQFN-HR (RAD) 25	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TPS6288 3-Q1

⁽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.

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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
TPS62880QFWRADRQ1	VQFN-HR	RAD	25	3000	330.0	12.4	4.3	5.3	1.3	8.0	12.0	Q1
TPS62881QFWRADRQ1	VQFN-HR	RAD	25	3000	330.0	12.4	4.3	5.3	1.3	8.0	12.0	Q1
TPS6288280QWRADRQ1	VQFN-HR	RAD	25	3000	330.0	12.4	4.3	5.3	1.3	8.0	12.0	Q1
TPS62882QFWRADRQ1	VQFN-HR	RAD	25	3000	330.0	12.4	4.3	5.3	1.3	8.0	12.0	Q1
TPS6288380QWRADRQ1	VQFN-HR	RAD	25	3000	330.0	12.4	4.3	5.3	1.3	8.0	12.0	Q1
TPS62883QFWRADRQ1	VQFN-HR	RAD	25	3000	330.0	12.4	4.3	5.3	1.3	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)
TPS62880QFWRADRQ1	VQFN-HR	RAD	25	3000	367.0	367.0	35.0
TPS62881QFWRADRQ1	VQFN-HR	RAD	25	3000	367.0	367.0	35.0
TPS6288280QWRADRQ1	VQFN-HR	RAD	25	3000	367.0	367.0	35.0
TPS62882QFWRADRQ1	VQFN-HR	RAD	25	3000	367.0	367.0	35.0
TPS6288380QWRADRQ1	VQFN-HR	RAD	25	3000	367.0	367.0	35.0
TPS62883QFWRADRQ1	VQFN-HR	RAD	25	3000	367.0	367.0	35.0



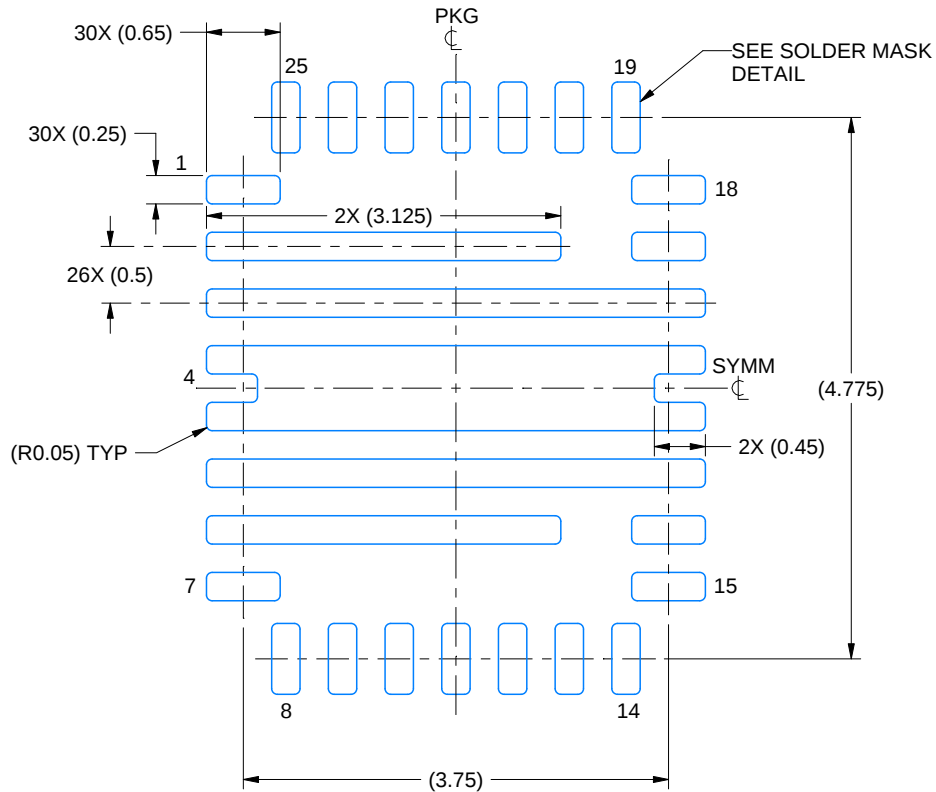
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

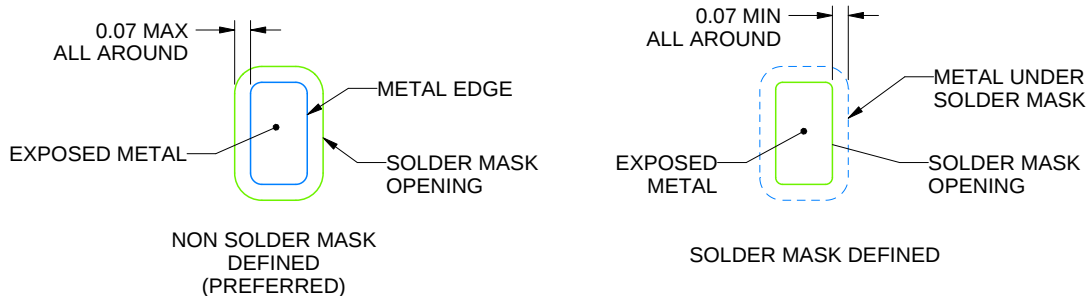
RAD0025A

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



SOLDER MASK DETAILS

4228993/C 08/2024

NOTES: (continued)

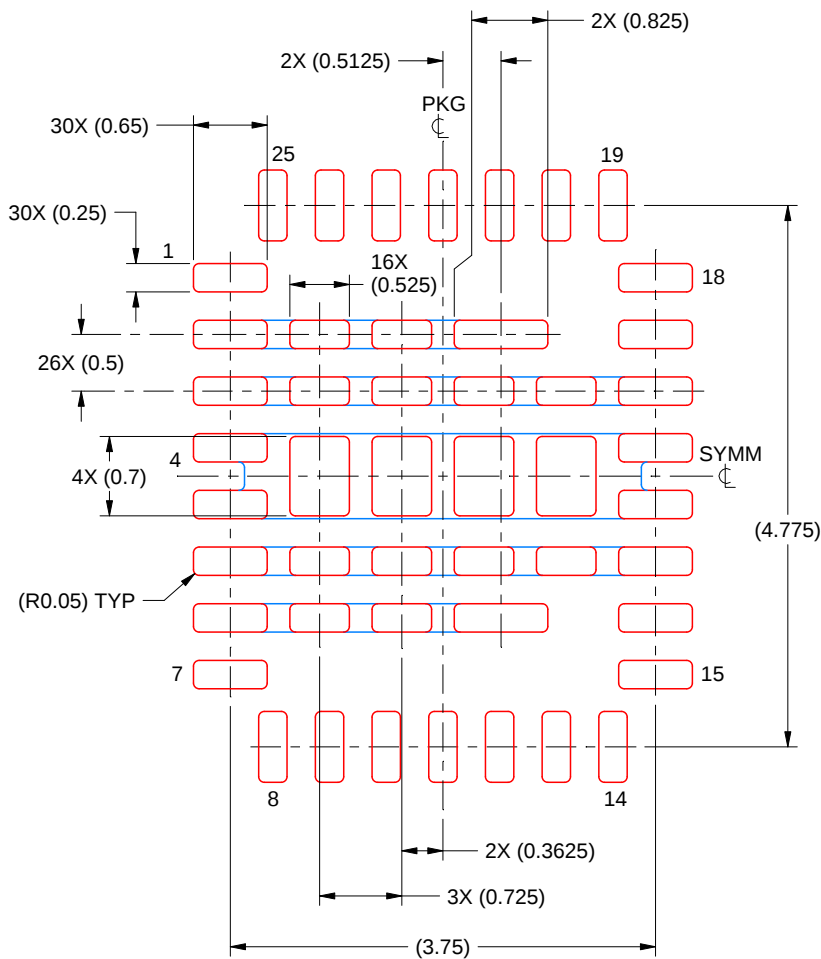
- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

RAD0025A

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 15X

PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
PADS 2 & 6: 80%
PADS 3 & 5: 77%
PAD 4: 69%

4228993/C 08/2024

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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