

CSD25481F4 20V P 沟道 FemtoFET™ MOSFET

1 特性

- 超低导通电阻
- 超低 Q_g 和 Q_{gd}
- 高漏极工作电流
- 超小封装尺寸 (0402 外壳尺寸)
 - $1\text{mm} \times 0.6\text{mm}$
- 超薄型封装
 - 最大厚度为 0.36mm
- 集成型 ESD 保护二极管
 - 额定值 $> 4\text{kV}$ 人体放电模型 (HBM)
 - 额定值 $> 2\text{kV}$ 充电器件模型 (CDM)
- 无铅且无卤素
- 符合 RoHS

2 应用

- 针对负载开关应用进行了优化
- 针对通用开关应用进行了优化
- 电池应用
- 手持式和移动类应用

3 说明

该 $90\text{m}\Omega$ 、 20V P 沟道 FemtoFET™ MOSFET 经过设计和优化，能够最大限度地减小在许多手持式和移动应用中占用的空间。这项技术能够在替代标准小信号 MOSFET 的同时将封装尺寸减小至少 60%。

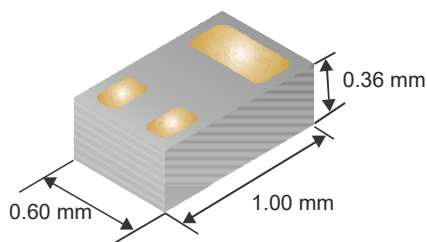


图 3-1. 典型器件尺寸

产品概要

$T_A = 25^\circ\text{C}$		典型值		单位
V_{DS}	漏源电压	-20		V
Q_g	栅极电荷总量 (-4.5V)	913		pC
Q_{gd}	栅极电荷 (栅极到漏极)	153		pC
$R_{DS(on)}$	漏源导通电阻	$V_{GS} = -1.8\text{V}$	395	$\text{m}\Omega$
		$V_{GS} = -2.5\text{V}$	145	$\text{m}\Omega$
		$V_{GS} = -4.5\text{V}$	90	$\text{m}\Omega$
$V_{GS(th)}$	阈值电压	-0.95		V

订购信息

器件 ⁽¹⁾	数量	介质	封装	出货
CSD25481F4	3000	7 英寸卷带	Femto (0402) $1.0\text{mm} \times 0.6\text{mm}$	卷带包装
CSD25481F4T	250	7 英寸卷带	基板栅格阵列 (LGA)	

(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。

绝对最大额定值

$T_A = 25^\circ\text{C}$ 时测得，除非另外注明		值	单位
V_{DS}	漏源电压	-20	V
V_{GS}	栅源电压	-12	V
I_D	持续漏极电流 ⁽¹⁾	-2.5	A
I_{DM}	脉冲漏极电流 ⁽²⁾	-13.1	A
I_G	持续栅极钳位电流	-35	mA
	脉冲栅极钳位电流 ⁽²⁾	-350	
P_D	功率耗散 ⁽¹⁾	500	mW
$V_{(ESD)}$	人体放电模型 (HBM)	4	kV
	充电器件模型 (CDM)	2	kV
T_J 、 T_{stg}	工作结温和贮存温度范围	-55 至 150	$^\circ\text{C}$

- (1) 典型 $R_{\theta JA} = 90^\circ\text{C/W}$ (在 0.06 英寸 (1.52mm) 厚的 FR4 PCB 上安装 1 平方英寸 (6.45cm^2)、 2oz 、 0.071mm 厚的铜焊盘时)。
- (2) 脉冲持续时间 $\leq 100\mu\text{s}$ ，占空比 $\leq 1\%$ 。

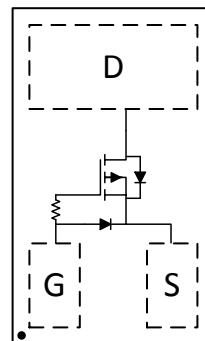


图 3-2. 顶视图



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4 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision E (December 2017) to Revision F (February 2022)	Page
• 将超薄型封装要点中的厚度从 0.35mm 更改为 0.36mm.....	1
• 将超薄型封装图片中的厚度从 0.35mm 更新为 0.36mm.....	1
• Changed ultra-low profile image height from 0.35 mm to 0.36 mm.....	8
• Added FemtoFET Surface Mount Guide note.....	9

Changes from Revision D (October 2014) to Revision E (December 2017)	Page
• 将“脉冲漏极电流”值从-10A 更改为-13.1A (位于绝对最大额定值表中).....	1
• 将“注释 1”从“典型 $R_{\theta JA} = 85^{\circ}\text{C/W}$ ”更改为“典型 $R_{\theta JA} = 90^{\circ}\text{C/W}$ ”.....	1
• 将“注释 2”从“脉冲持续时间 $\leq 300 \mu\text{s}$, 占空比 $\leq 2\%$ ”更改为“脉冲持续时间 $\leq 100 \mu\text{s}$, 占空比 $\leq 1\%$ ”.....	1
• Changed the typical $R_{\theta JA}$ values in the <i>Thermal Information</i> table.....	3
• Updated 图 5-1.	4
• Updated 图 5-10 with newly measured data.	4
• Updated all mechanical drawings, increased the size of the pads in the 节 7.3 section.	8

5 Specifications

5.1 Electrical Characteristics

(T_A = 25°C unless otherwise stated)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	
STATIC CHARACTERISTICS							
BV _{DSS}	Drain-to-Source Voltage	V _{GS} = 0 V, I _{DS} = - 250 μ A	- 20			V	
I _{DSS}	Drain-to-Source Leakage Current	V _{GS} = 0 V, V _{DS} = - 16 V	- 100			nA	
I _{GSS}	Gate-to-Source Leakage Current	V _{DS} = 0 V, V _{GS} = - 12 V	- 50			nA	
V _{GS(th)}	Gate-to-Source Threshold Voltage	V _{DS} = V _{GS} , I _{DS} = - 250 μ A	- 0.7	- 0.95	- 1.2	V	
R _{DS(on)}	Drain-to-Source On-Resistance	V _{GS} = - 1.8 V, I _{DS} = - 0.1 A	395			800	mΩ
		V _{GS} = - 2.5 V, I _{DS} = - 0.5 A	145			174	mΩ
		V _{GS} = - 4.5 V, I _{DS} = - 0.5 A	90			105	mΩ
		V _{GS} = - 8 V, I _{DS} = - 0.5 A	75			88	mΩ
g _{fs}	Transconductance	V _{DS} = - 10 V, I _{DS} = - 0.5 A	3.3			S	
DYNAMIC CHARACTERISTICS							
C _{iss}	Input Capacitance	V _{GS} = 0 V, V _{DS} = - 10 V, f = 1 MHz	189			pF	
C _{oss}	Output Capacitance		78			pF	
C _{rss}	Reverse Transfer Capacitance		5.5			pF	
R _G	Series Gate Resistance		20			Ω	
Q _g	Gate Charge Total (4.5 V)	V _{DS} = - 10 V, I _{DS} = - 0.5 A	913			pC	
Q _{gd}	Gate Charge Gate-to-Drain		153			pC	
Q _{gs}	Gate Charge Gate-to-Source		240			pC	
Q _{g(th)}	Gate Charge at V _{th}		116			pC	
Q _{oss}	Output Charge	V _{DS} = - 10 V, V _{GS} = 0 V	1030			pC	
t _{d(on)}	Turn On Delay Time	V _{DS} = - 10 V, V _{GS} = - 4.5 V, I _{DS} = - 0.5 A, R _G = 2 Ω	4.1			ns	
t _r	Rise Time		3.6			ns	
t _{d(off)}	Turn Off Delay Time		16.9			ns	
t _f	Fall Time		6.7			ns	
DIODE CHARACTERISTICS							
V _{SD}	Diode Forward Voltage	I _{SD} = - 0.5 A, V _{GS} = 0 V	- 0.75			V	
Q _{rr}	Reverse Recovery Charge	V _{DS} = - 10 V, I _F = - 0.5 A, di/dt = 100 A/ μ s	1010			pC	
t _{rr}	Reverse Recovery Time		7.5			ns	

5.2 Thermal Information

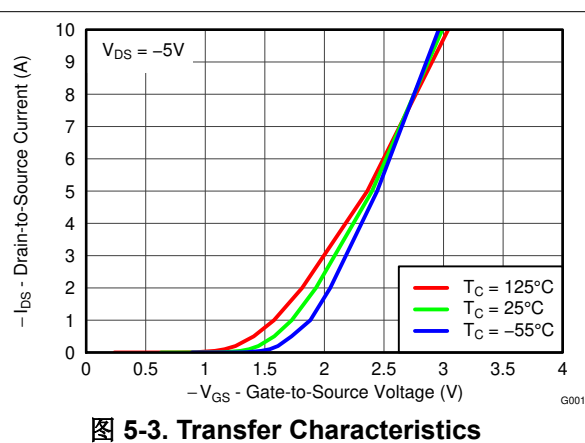
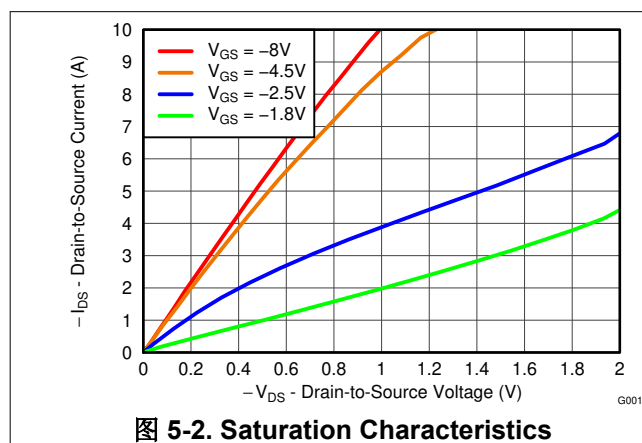
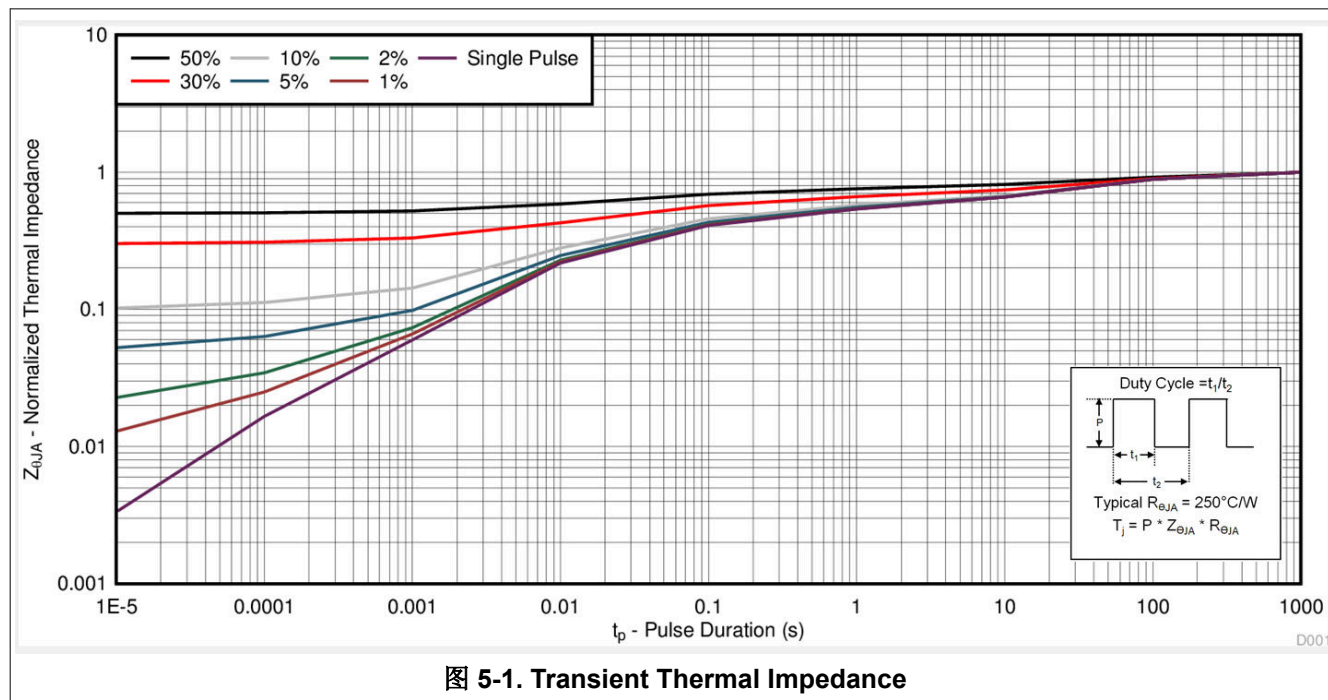
(T_A = 25°C unless otherwise stated)

THERMAL METRIC		TYPICAL VALUES	UNIT
R _{θJA}	Junction-to-Ambient Thermal Resistance ⁽¹⁾	90	°C/W
	Junction-to-Ambient Thermal Resistance ⁽²⁾	250	

- (1) Device mounted on FR4 material with 1 inch² (6.45 cm²), 2 oz. (0.071 mm thick) Cu.
 (2) Device mounted on FR4 material with minimum Cu mounting area.

5.3 Typical MOSFET Characteristics

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



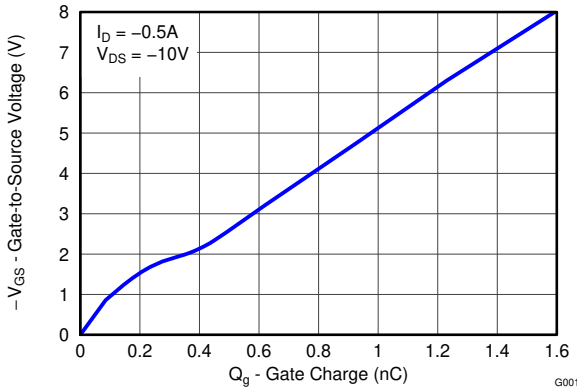


图 5-4. Gate Charge

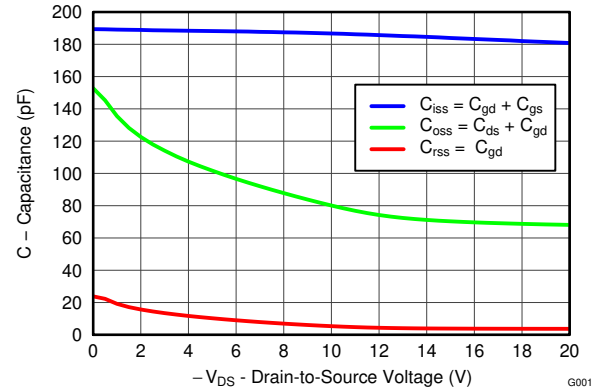


图 5-5. Capacitance

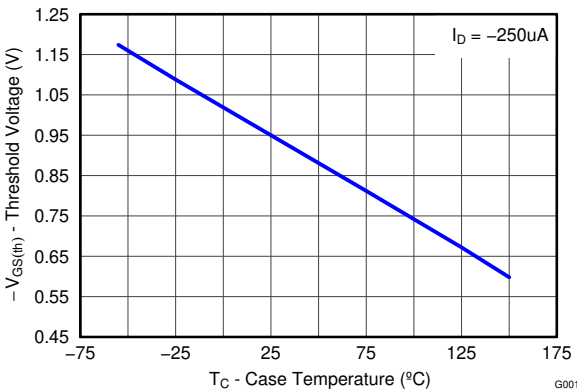


图 5-6. Threshold Voltage vs Temperature

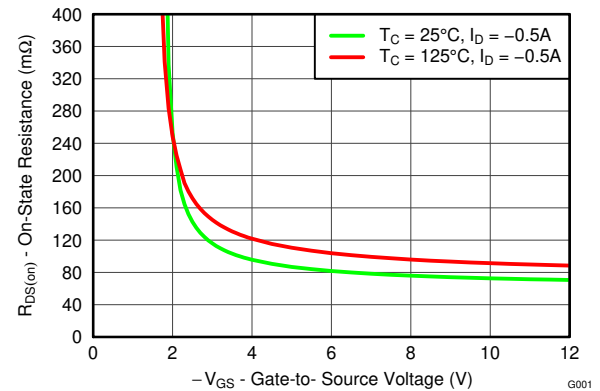


图 5-7. On-State Resistance vs Gate-to-Source Voltage

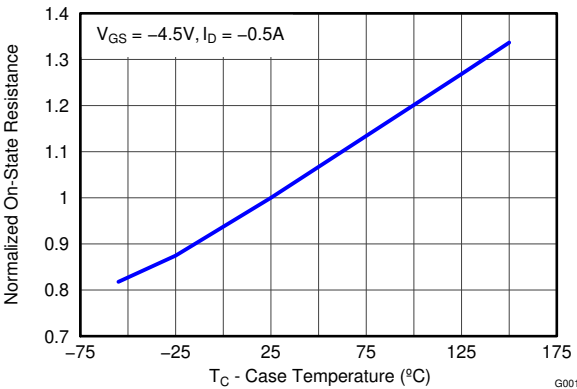


图 5-8. Normalized On-State Resistance vs Temperature

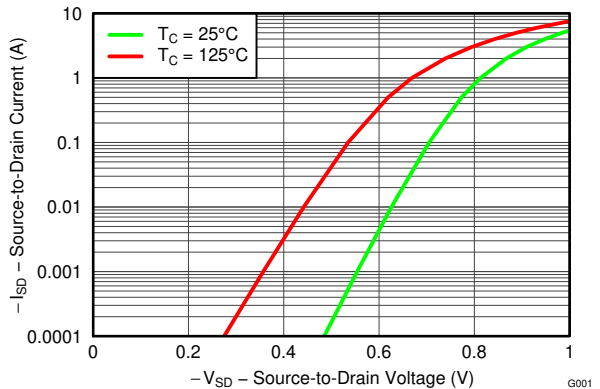


图 5-9. Typical Diode Forward Voltage

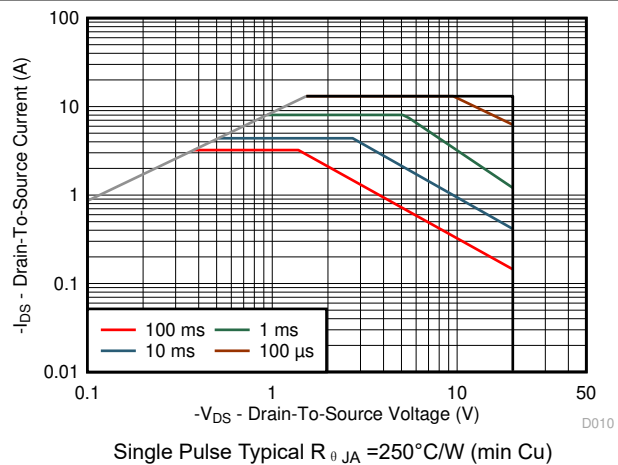


图 5-10. Maximum Safe Operating Area

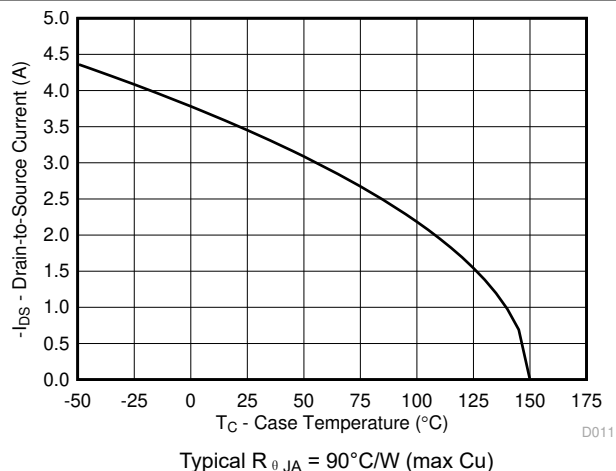


图 5-11. Maximum Drain Current vs Temperature

6 Device and Documentation Support

6.1 支持资源

[TI E2E™ 支持论坛](#)是工程师的重要参考资料，可直接从专家获得快速、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可获得所需的快速设计帮助。

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6.3 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

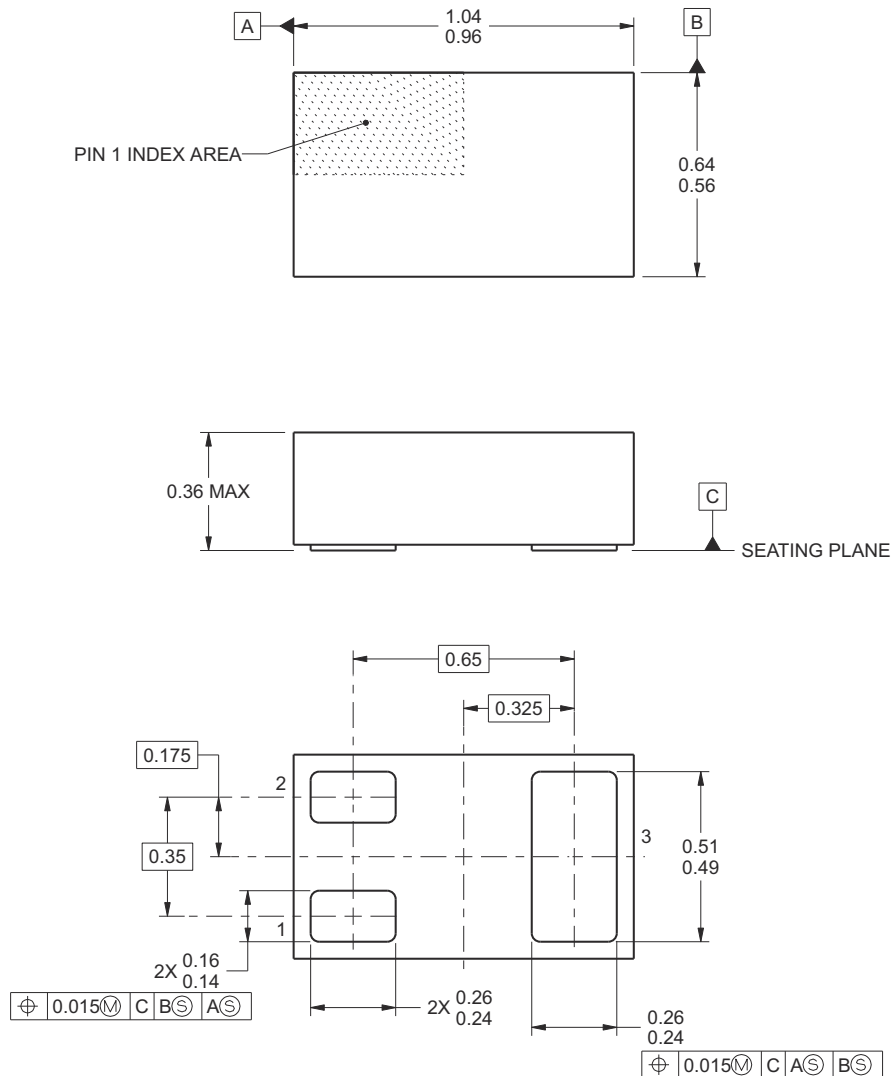
6.4 术语表

[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。

7 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

7.1 Mechanical Dimensions

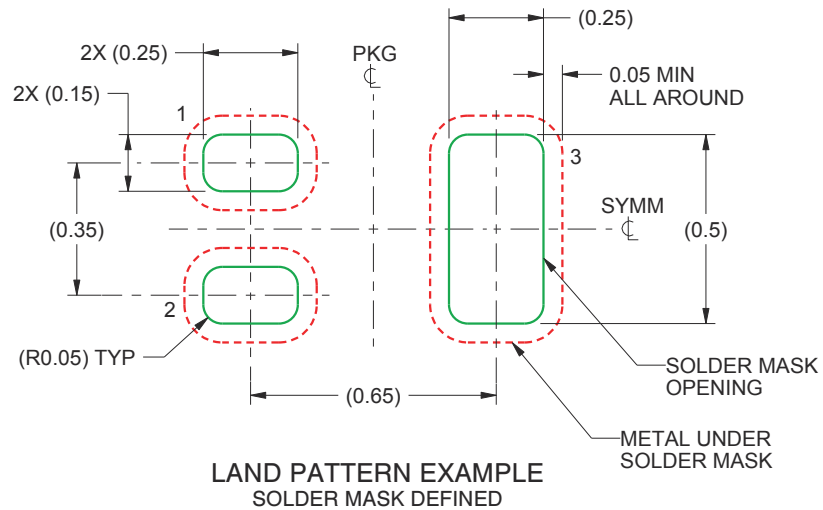


- A. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- B. This drawing is subject to change without notice.
- C. This package is a Pb-free bump design. Bump finish may vary. To determine the exact finish, refer to the device data sheet or contact a local TI representative.

表 7-1. Pin Configuration

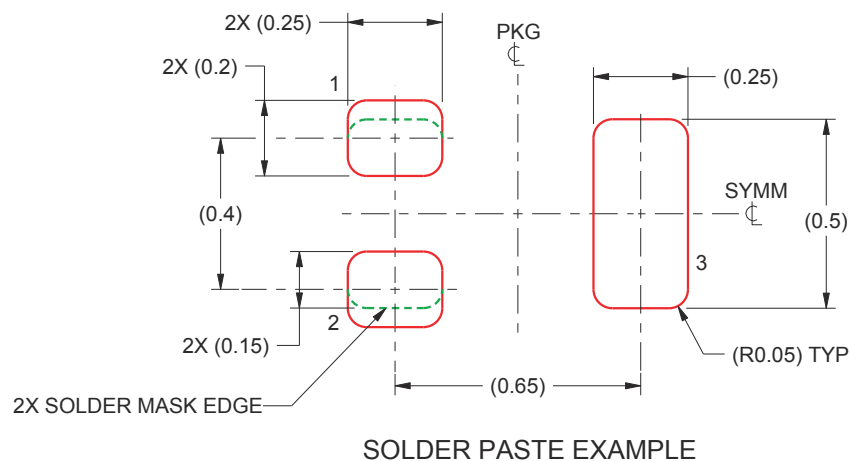
Position	Designation
Pin 1	Gate
Pin 2	Source
Pin 3	Drain

7.2 Recommended Minimum PCB Layout



- A. All dimensions are in millimeters.
- B. For more information, see [FemtoFET Surface Mount Guide](#) (SLRA003D).

7.3 Recommended Stencil Pattern



- A. All dimensions are in millimeters.
- B. 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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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)
CSD25481F4	Active	Production	PICOSTAR (YJC) 3	3000 LARGE T&R	Yes	NIAU	Level-1-260C-UNLIM	-55 to 150	CS
CSD25481F4.B	Active	Production	PICOSTAR (YJC) 3	3000 LARGE T&R	Yes	NIAU	Level-1-260C-UNLIM	-55 to 150	CS
CSD25481F4T	Active	Production	PICOSTAR (YJC) 3	250 SMALL T&R	Yes	NIAU	Level-1-260C-UNLIM	-55 to 150	CS
CSD25481F4T.B	Active	Production	PICOSTAR (YJC) 3	250 SMALL T&R	Yes	NIAU	Level-1-260C-UNLIM	-55 to 150	CS

⁽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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