

特性

- 先进工艺技术
- 超低导通电阻
- 工作温度 175°C
- 快速开关
- 允许达到 T_{jmax} 的重复雪崩
- 无铅，符合 RoHS 要求
- 汽车认证 *

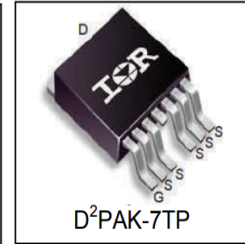
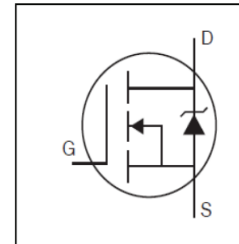
描述

这款 HEXFET® 功率 MOSFET 专为汽车应用而设计，采用最新的工艺技术实现单位硅面积极低的导通电阻。该设计的特点包括 175°C 工作结温、开关速度快和提高重复雪崩额定值。通过结合以上特点，使该设计成为一种极其高效和可靠的器件，可用于汽车应用和各种其他应用。

应用

- 电动助力转向 (EPS)
- 电池开关
- 启停微混
- 高负载
- DC-DC 应用

V_{DS}	40V
$R_{DS(on)}$ typ.	0.50mΩ
max.	0.69mΩ
I_D (Silicon Limited)	523A①
I_D (Package Limited)	360A



G	D	S
Gate	Drain	Source

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRFSA8409-7P	D²PAK-7TP	Tube	50	AUIRFSA8409-7P
		Tape and Reel Left	800	AUIRFSA8409-7TRL

绝对最大额定值

超过“绝对最大额定值”所列值的应力可能会对器件造成永久性损坏。这些仅仅是应力额定值，并不意味着器件在这些或任何其他超过该规范所示的条件下能够正常运行。延长暴露在绝对最大额定值条件的时间可能会影响器件的可靠性。热阻和功率耗散额定值是在装板和静止空气条件下测得的。环境温度 (T_A) 为 25°C，除非另有规定。

Symbol	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	523①	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	370①	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Wire Bond Limited)	360	
I_{DM}	Pulsed Drain Current ②	1440*	
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	375	W
	Linear Derating Factor	2.5	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	

雪崩特性

E_{AS} (Thermally Limited)	Single Pulse Avalanche Energy ③	743	mJ
E_{AS} (Thermally Limited)	Single Pulse Avalanche Energy ④	1450	
I_{AR}	Avalanche Current ②	See Fig. 14, 15, 24a, 24b	A
E_{AR}	Repetitive Avalanche Energy ②		mJ

HEXFET® 是英飞凌的注册商标。

*认证标准可在 www.infineon.com 上找到

本数据手册的原文使用英文撰写。为方便起见，英飞凌提供了译文；由于翻译过程中可能使用了自动化工具，英飞凌不保证译文的准确性。为确认准确性，请务必访问 infineon.com 参考最新的英文版本（控制文档）。

热阻抗

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑨	---	0.4	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ⑧	---	40	

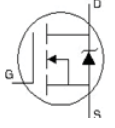
静态电气特性@T_J = 25°C (除非另有说明)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	---	---	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	---	0.038	---	V/°C	Reference to 25°C, $I_D = 2.0mA$ ②
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	---	0.50	0.69	mΩ	$V_{GS} = 10V, I_D = 100A$ ⑤
$V_{GS(th)}$	Gate Threshold Voltage	2.2	3.0	3.9	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
I_{DSS}	Drain-to-Source Leakage Current	---	---	1.0	μA	$V_{DS} = 40V, V_{GS} = 0V$
		---	---	150		$V_{DS} = 40V, V_{GS} = 0V, T_J = 125^\circ C$
I_{GSS}	Gate-to-Source Forward Leakage	---	---	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	---	---	-100		$V_{GS} = -20V$
R_G	Internal Gate Resistance	---	2.3	---	Ω	

动态电气特性在 T_J = 25°C时测得 (除非另有规定)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	180	---	---	S	$V_{DS} = 10V, I_D = 100A$
Q_g	Total Gate Charge	---	305	460	nC	$I_D = 100A, V_{DS} = 20V, V_{GS} = 10V$ ⑤
Q_{gs}	Gate-to-Source Charge	---	84	---		
Q_{gd}	Gate-to-Drain ("Miller") Charge	---	96	---		
Q_{sync}	Total Gate Charge Sync. ($Q_g - Q_{gd}$)	---	209	---		
$t_{d(on)}$	Turn-On Delay Time	---	21	---	ns	$V_{DD} = 20V, I_D = 100A, R_G = 2.7\Omega, V_{GS} = 10V$ ⑤
t_r	Rise Time	---	94	---		
$t_{d(off)}$	Turn-Off Delay Time	---	150	---		
t_f	Fall Time	---	90	---		
C_{iss}	Input Capacitance	---	13975	---	pF	$V_{GS} = 0V, V_{DS} = 25V, f = 1.0 MHz$ $V_{GS} = 0V, V_{DS} = 0V$ to 32V ⑦ $V_{GS} = 0V, V_{DS} = 0V$ to 32V ⑥
C_{oss}	Output Capacitance	---	2140	---		
C_{rss}	Reverse Transfer Capacitance	---	1438	---		
$C_{oss \text{ eff. (ER)}}$	Effective Output Capacitance (Energy Related) ⑦	---	2620	---		
$C_{oss \text{ eff. (TR)}}$	Effective Output Capacitance (Time Related) ⑥	---	3306	---		

二极管特性

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	---	---	523①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ②	---	---	1440*	A	
V_{SD}	Diode Forward Voltage	---	0.8	1.3	V	$T_J = 25^\circ C, I_S = 100A, V_{GS} = 0V$ ⑤
dv/dt	Peak Diode Recovery ④	---	3.1	---	V/ns	$T_J = 175^\circ C, I_S = 100A, V_{GS} = 40V$
t_{rr}	Reverse Recovery Time	---	59	---	ns	$T_J = 25^\circ C$
		---	60	---		$T_J = 125^\circ C$
Q_{rr}	Reverse Recovery Charge	---	96	---	nC	$T_J = 25^\circ C$
		---	98	---		$T_J = 125^\circ C$
I_{RRM}	Reverse Recovery Current	---	2.7	---	A	$T_J = 25^\circ C$

注:

- ① 根据最大允许结温计算连续电流。键合线电流限制为360A。请注意，若引脚发热，某些引脚安装布置会引起电流限制。（参见 AN-1140）
- ② 重复额定值；脉冲宽度受最高结温限制。
- ③ 受 T_{Jmax} 限制，起始 $T_J = 25^\circ C$ 、 $L = 0.15mH$ $R_G = 50\Omega$ 、 $I_{AS} = 100A$ 、 $V_{GS} = 10V$ 。
- ④ $I_{SD} \leq 100A$ ， $di/dt \leq 1070A/\mu s$ ， $V_{DD} \leq V_{(BR)DSS}$ ， $T_J \leq 175^\circ C$ 。
- ⑤ 脉冲宽度 $\leq 400\mu s$ ；占空比 $\leq 2\%$ 。

- ⑥ $C_{oss \text{ eff. (TR)}}$ 是一个固定电容值，当 V_{DS} 从 0 上升至 80% V_{DSS} 时，其充电时间与 C_{oss} 相同。
 - ⑦ $C_{oss \text{ eff. (ER)}}$ 是一个固定电容值，当 V_{DS} 从 0 上升至 80% V_{DSS} 时，其产生与 C_{oss} 相同的热量。
 - ⑧ 安装在 1 英寸见方 PCB（FR-4 或 G-10 材料）上时。有关建议的封装和焊接技术，请参阅应用注释 #AN-994。
 - ⑨ R_{θ} 在 T_J 约为 90°C 时测得。
 - ⑩ 受 T_{Jmax} 限制，起始 $T_J = 25^\circ C$ 、 $L = 1mH$ 、 $R_G = 50\Omega$ 、 $I_{AS} = 53A$ 、 $V_{GS} = 10V$ 。
- *通过源极键合技术将脉冲漏极电流限制在 1440A

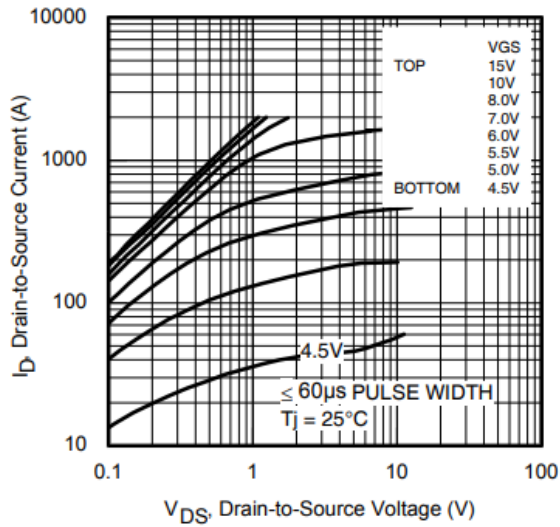


Fig. 1 Typical Output Characteristics

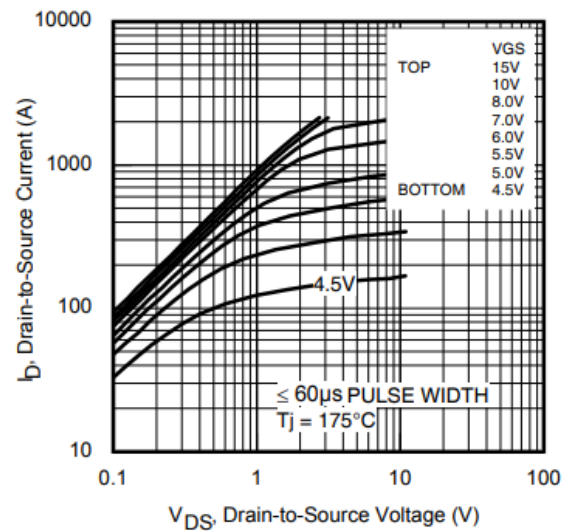


Fig. 2 Typical Output Characteristics

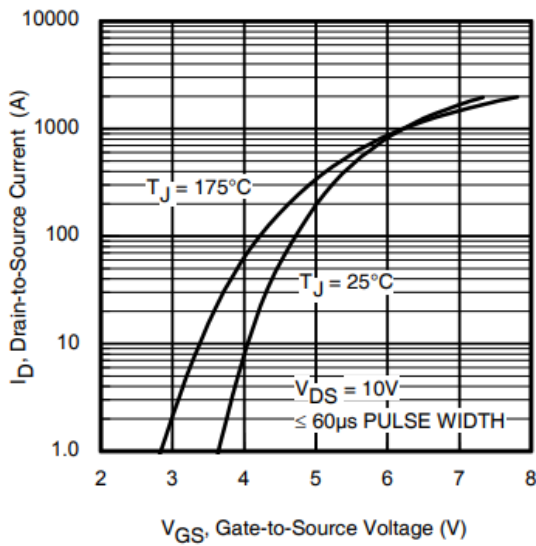


Fig. 3 Typical Transfer Characteristics

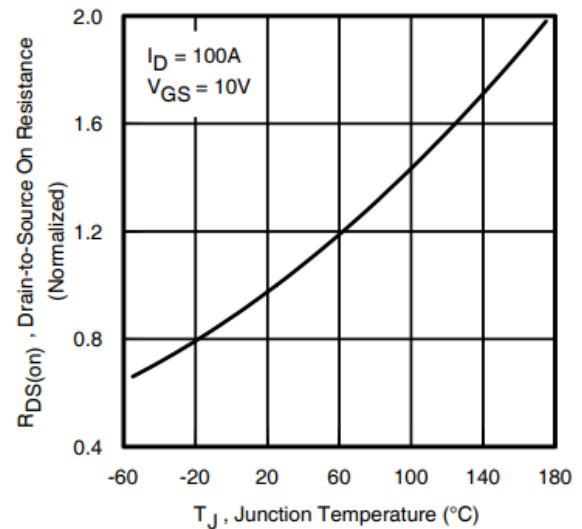


Fig. 4 Normalized On-Resistance vs. Temperature

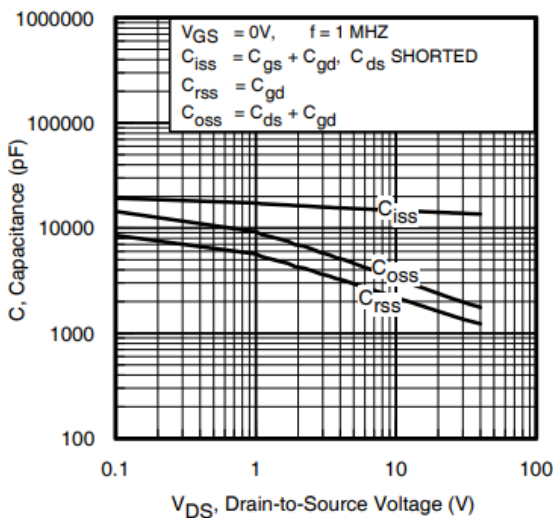


Fig. 5. Typical Capacitance vs. Drain-to-Source Voltage

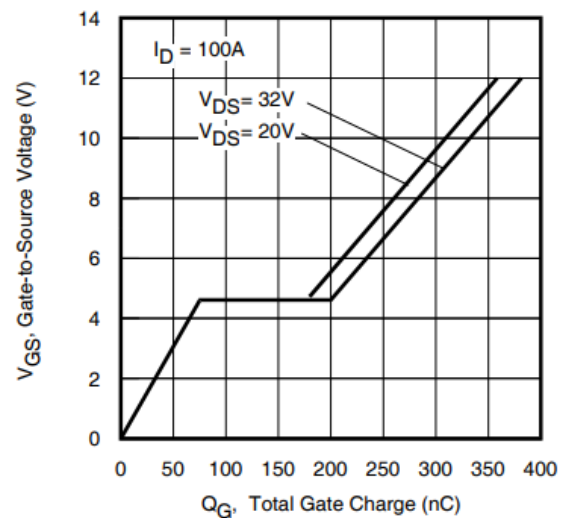
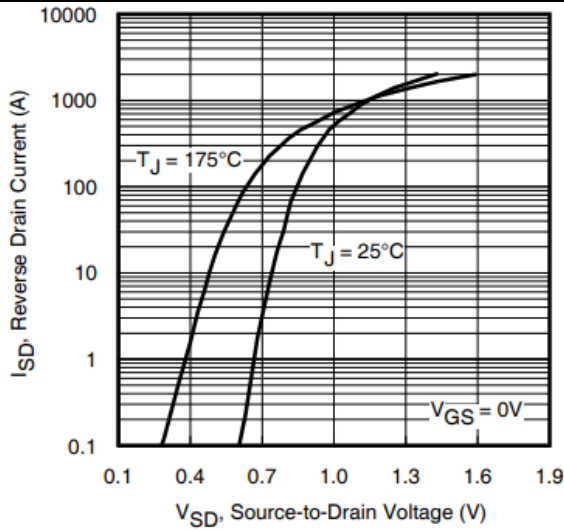
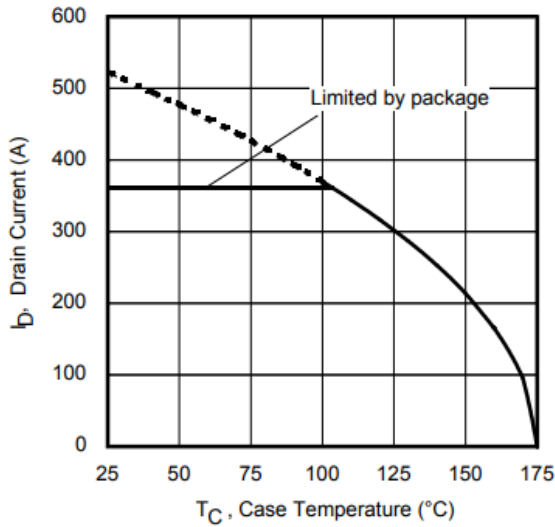
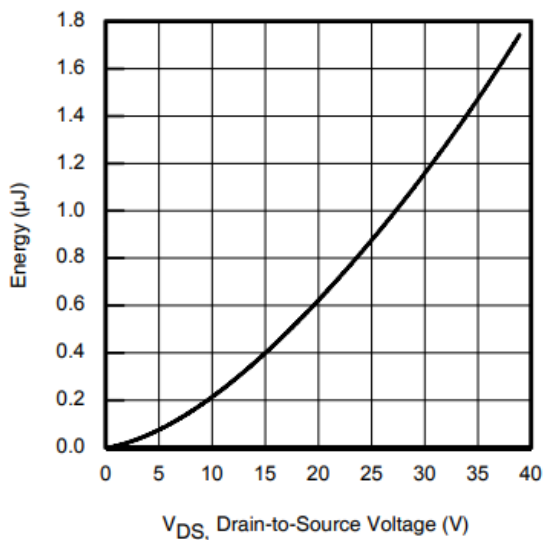
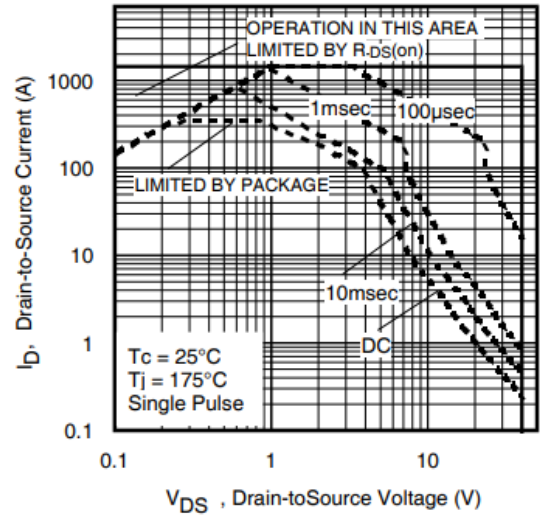
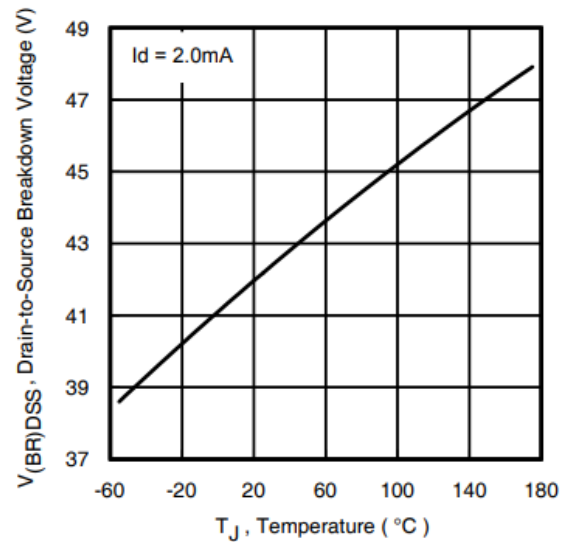
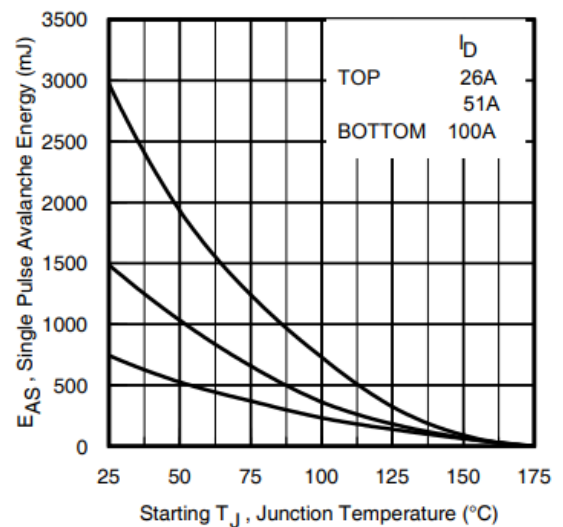


Fig. 6. Typical Gate Charge vs. Gate-to-Source Voltage


Fig. 7 Typical Source-to-Drain Diode Forward Voltage

Fig 9. Maximum Drain Current vs. Case Temperature

Fig 11. Typical Coss Stored Energy

Fig 8. Maximum Safe Operating Area

Fig 10. Drain-to-Source Breakdown Voltage

Fig 12. Maximum Avalanche Energy vs. Drain Current

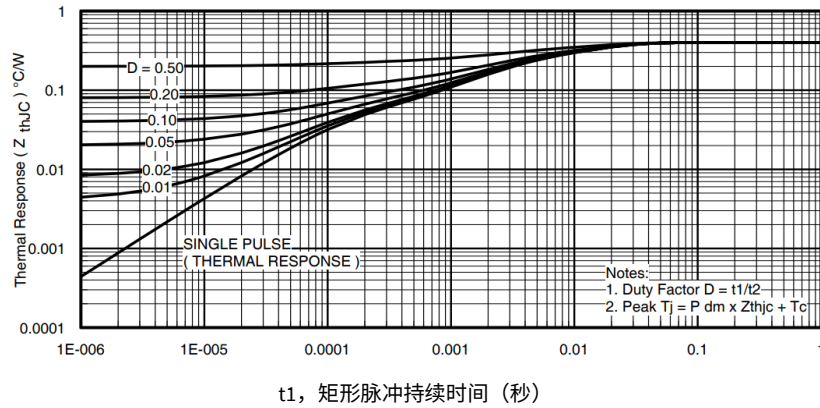


图 13.最大有效瞬态热阻，结到壳

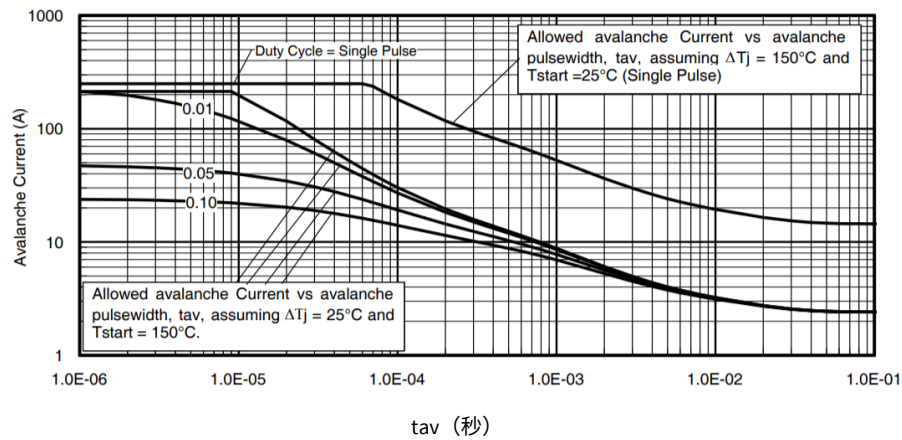


图 14.典型雪崩电流与脉冲宽度

关于重复的雪崩曲线的注释，图 14、15：（有关详细信息，请参阅www.irf.com 上的 AN-1005）

1. 雪崩失效假设：
纯粹的热现象和失效发生在结温远超 T_{jmax} 的情况下。这对每种零件类型都是有效的。
2. 只要不超过 T_{jmax} ，就可以在雪崩中安全运行。
3. 如下公式基于图 24a、24b 所示的电路和波形。
4. $P_{D(ave)}$ = 每个雪崩脉冲的平均功率耗散。
5. BV = 额定击穿电压（1.3 倍系数，考虑雪崩期间的电压增加）。
6. I_{av} = 可允许的雪崩电流。
7. ΔT = 可允许的结温上升，不得超过 T_{jmax} （图 13、14 中假设为 25°C）。

t_{av} = 雪崩的平均时间。

D = 雪崩占空比 = $t_{av} \cdot f$

$Z_{thJC}(D, t_{av})$ = 瞬态热阻抗，见图 13。

$$P_{D(ave)} = \frac{1}{2} (1.3 \cdot BV \cdot I_{av}) = \frac{\Delta T}{Z_{thJC} I_{av}} = \frac{2\Delta T}{[1.3 \cdot BV \cdot Z_{th}]}$$

$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$

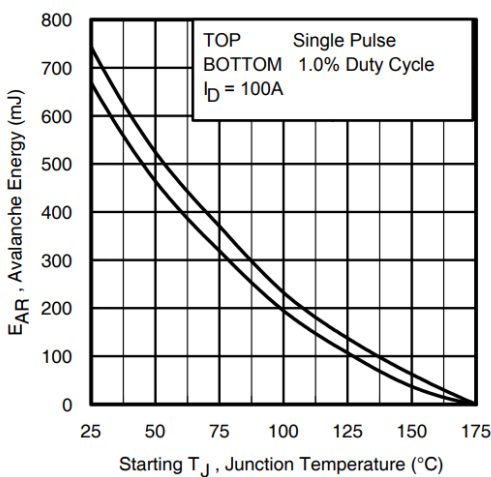
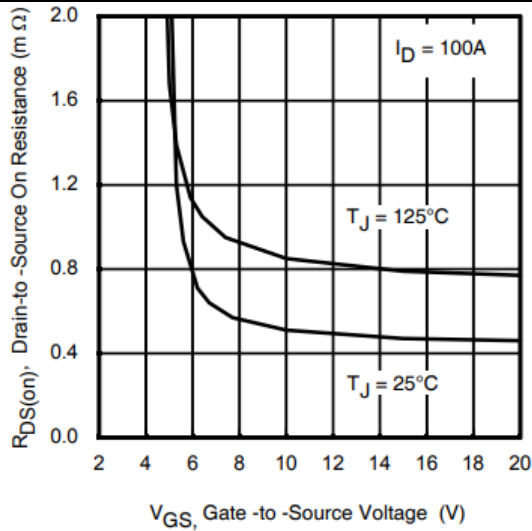
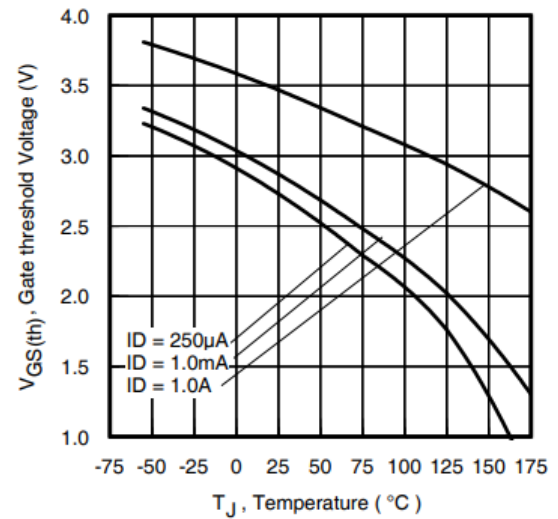
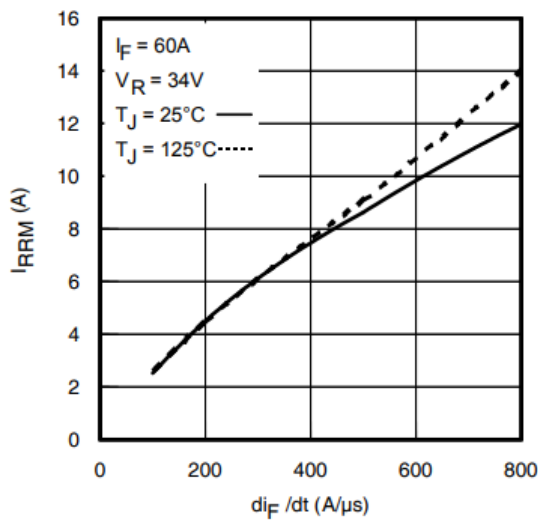
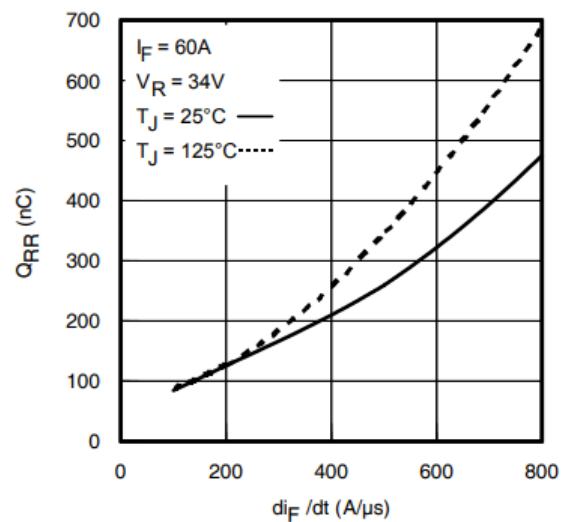
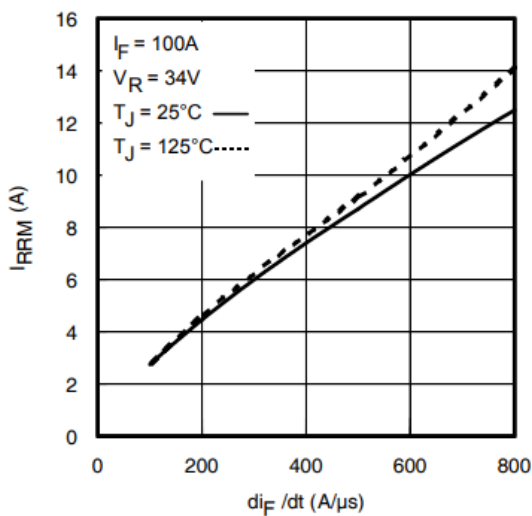
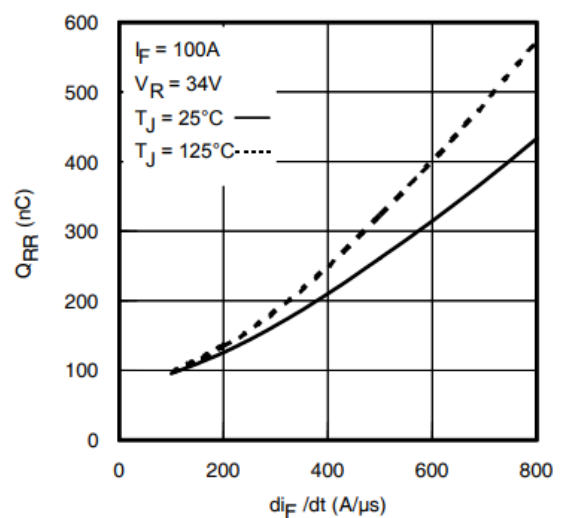


图 15.最大雪崩能量与温度的关系曲线


Fig 16. Typical On-Resistance vs. Gate Voltage

Fig 17. Threshold Voltage vs. Temperature

Fig. 18 - Typical Recovery Current vs. di_F/dt

Fig. 19 - Typical Stored Charge vs. di_F/dt

Fig. 20 - Typical Recovery Current vs. di_F/dt

Fig. 21 - Typical Stored Charge vs. di_F/dt

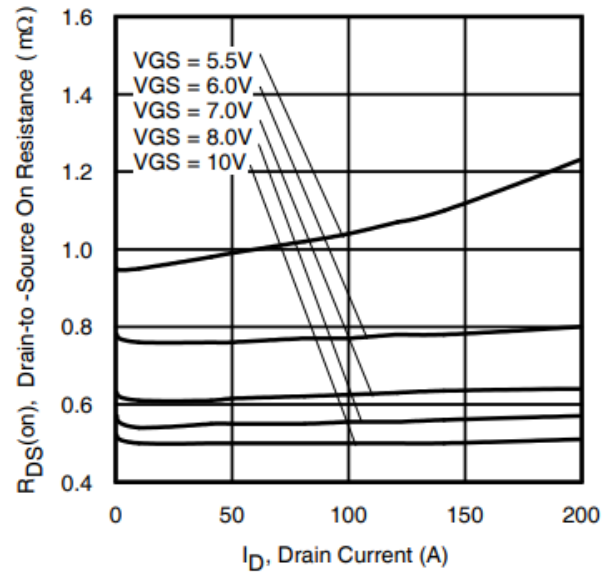
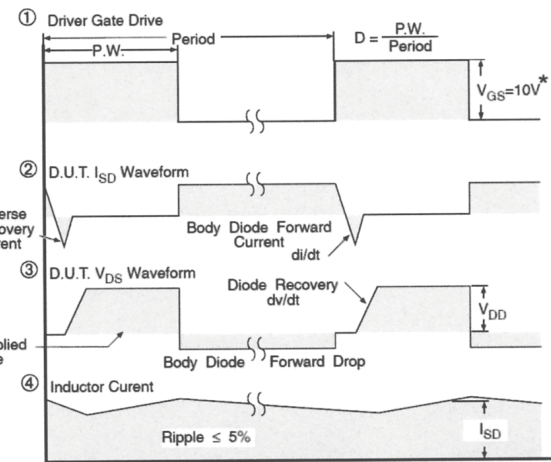
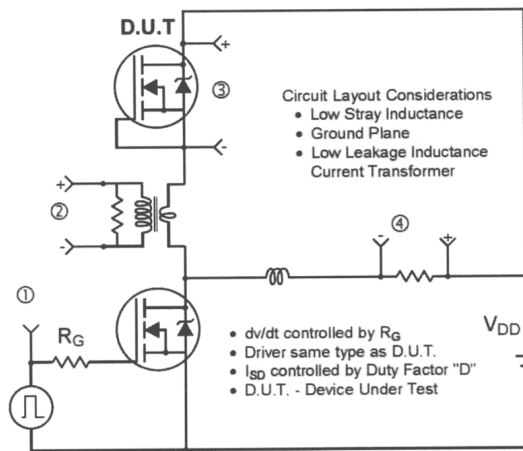


Fig 22. Typical On-Resistance vs. Drain Current



* $V_{GS} = 5V$ for Logic Level Devices

图 23. N 沟道 HEXFET® 功率 MOSFET 二极管峰值恢复 dv/dt 测试电路

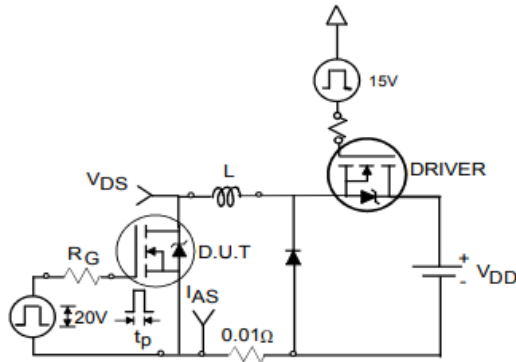


Fig 24a. Unclamped Inductive Test Circuit

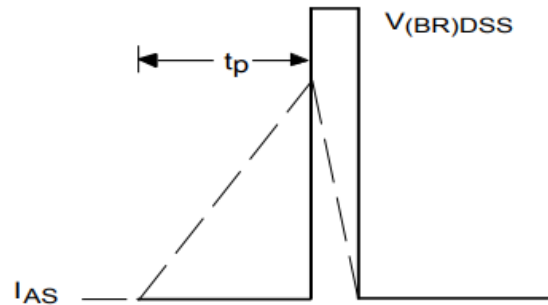


Fig 24b. Unclamped Inductive Waveforms

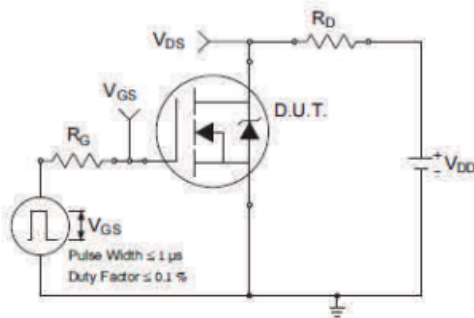


Fig 25a. Switching Time Test Circuit

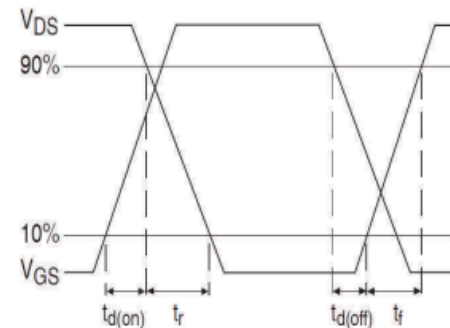


Fig 25b. Switching Time Waveforms

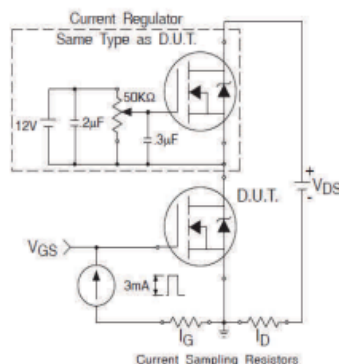


Fig 26a. Gate Charge Test Circuit

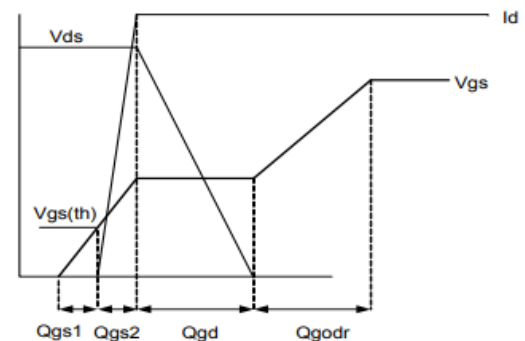
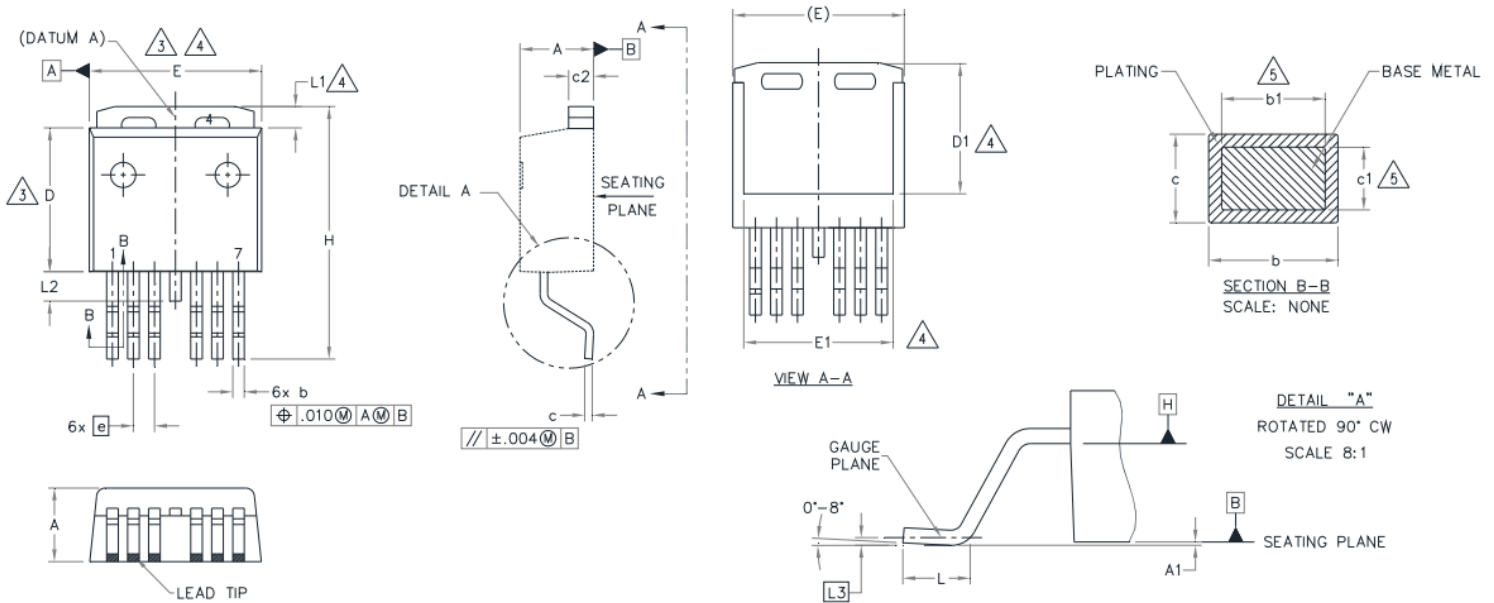


Fig 26b. Gate Charge Waveform

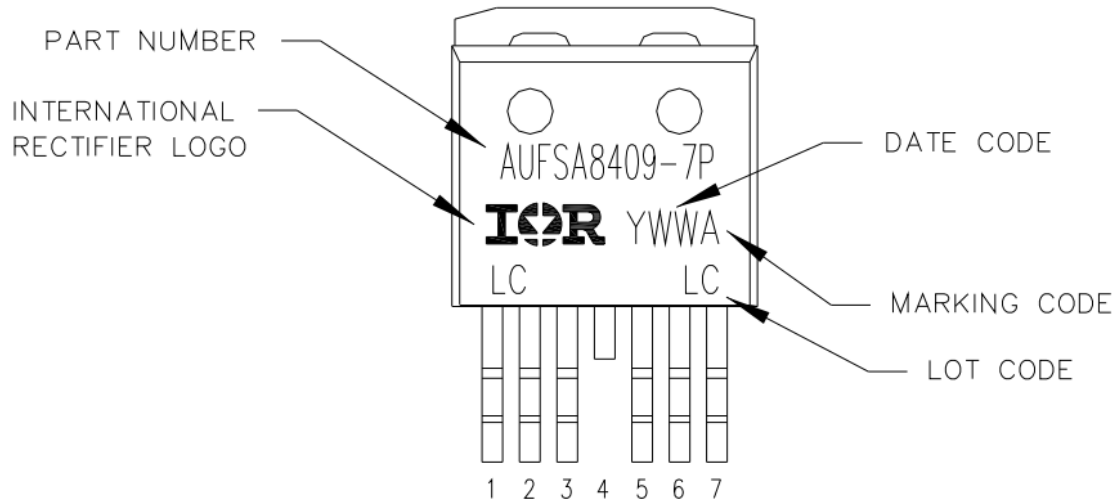
D² PAK-7TP 封装外形 (尺寸以毫米 (英寸) 为单位)


SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	5
A1	—	0.254	—	.010	
b	0.51	0.91	.020	.036	
b1	0.51	0.81	.020	.032	
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	3
D	8.38	9.65	.330	.380	
D1	6.86	7.42	.270	.292	4
E	9.65	10.54	.380	.415	3,4
E1	8.00	9.00	.315	.354	4
e	1.27 BSC		.050 BSC		4
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	—	1.68	—	.066	
L2	—	1.78	—	.070	
L3	0.25 BSC		.010 BSC		

NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263CB, EXCEPT FOR DIMS. E, E1 & D1.

Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

D² PAK-7TP 零件标识信息

D² PAK-7TP 盘带信息

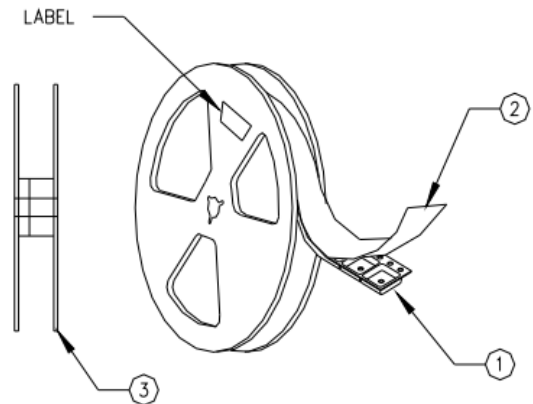
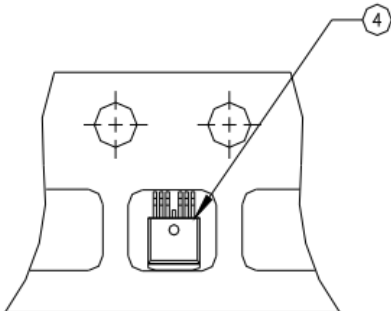
NOTES, TAPE & REEL, LABELLING:

1. TAPE AND REEL.

- 1.1 REEL SIZE 13 INCH DIAMETER.
- 1.2 EACH REEL CONTAINING 800 DEVICES.
- 1.3 THERE SHALL BE A MINIMUM OF 42 SEALED POCKETS CONTAINED IN THE LEADER AND A MINIMUM OF 15 SEALED POCKETS IN THE TRAILER.
- 1.4 PEEL STRENGTH MUST CONFORM TO THE SPEC. NO. 71-9667.
- 1.5 PART ORIENTATION SHALL BE AS SHOWN BELOW.
- 1.6 REEL MAY CONTAIN A MAXIMUM OF TWO UNIQUE LOT CODE/DATE CODE COMBINATIONS. REWORKED REELS MAY CONTAIN A MAXIMUM OF THREE UNIQUE LOT CODE/DATE CODE COMBINATIONS. HOWEVER, THE LOT CODES AND DATE CODES WITH THEIR RESPECTIVE QUANTITIES SHALL APPEAR ON THE BAR CODE LABEL FOR THE AFFECTED REEL.

2. LABELLING (REEL AND SHIPPING BAG).

- 2.1 CUST. PART NUMBER (BAR CODE): IRFXXXXSTRL-7P
- 2.2 CUST. PART NUMBER (TEXT CODE): IRFXXXXSTRL-7P
- 2.3 I.R. PART NUMBER: IRFXXXXSTRL-7P
- 2.4 QUANTITY:
- 2.5 VENDOR CODE: IR
- 2.6 LOT CODE:
- 2.7 DATE CODE:



Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

Qualification Information[†]

Qualification Level		Automotive (per AEC-Q101)	
		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
		D ² PAK-7TP	MSL1
ESD	Human Body Model	Class H3A ($\pm 8000V$) [†] AEC-Q101-001	
	Charged Device Model	Class C5 ($\pm 2000V$) [†] AEC-Q101-005	
RoHS Compliant		Yes	

[†] 最高通过电压。

Published by
Infineon Technologies AG 81726
München, Germany
© Infineon Technologies AG 2015
All Rights Reserved.

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie"). With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.



免责声明

请注意，本文件的原文使用英文撰写，为方便客户浏览英飞凌提供了中文译文。该中文译文仅供参考，并不可作为任何论点之依据。

由于翻译过程中可能使用了自动化程序，以及语言翻译和转换过程中的差异，最后的中文译文与最新的英文版本原文含义可能存在不尽相同之处。

因此，我们同时提供该中文译文版本的最新英文原文供您阅读，请参见 <http://www.infineon.com>

英文原文和中文译文版本之间若存有任何歧异，以最新的英文版本为准，并且仅认可英文版本为正式文件。

您如果使用本文件，即表示您同意并理解上述说明。英飞凌不对因翻译过程中可能存在的任何不完整或不准确信息而产生的任何直接或间接损失或损害负责。英飞凌不承担中文译文版本的完整性和准确性责任。如果您不同意上述说明，请不要使用本文件。

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

重要通知

版本 2025-10-30

Infineon Technologies AG 出版，
德国 Neubiberg 85579

版权 © 2025 Infineon Technologies AG
及其关联公司。
保留所有权利。

Do you have a question about this
document?

Email:
erratum@infineon.com

Infineon Technologies AG 及其关联公司（以下简称“英飞凌”）销售或提供和交付的产品（可能也包括样品，且可能由硬件或软件或两者组成）（以下简称“产品”），应遵守客户与英飞凌签订的框架供应合同或其他书面协议的条款和条件，如无上述合同或其他书面协议，则应遵守适用的英飞凌销售条件。只有在英飞凌明确书面同意的情况下，客户的一般条款和条件或对适用的英飞凌销售条件的偏离才对英飞凌具有约束力。

为避免疑义，英飞凌不承担不侵犯第三方权利的所有保证和默示保证，例如对特定用途/目的的适用性或适销性的保证。

英飞凌对与样品、应用或客户对任何产品的具体使用有关的任何信息或本文件中给出的任何示例或典型值概不负责。

本文件中包含的数据仅供具有技术资格和技能的客户代表使用。客户有责任评估产品对预期应用和客户特定用途的适用性，并在预期应用和客户特定用途中验证本文件中包含的所有相关技术数据。客户有责任正确设计、编程和测试预期应用的功能性和安全性，并遵守与其使用相关的法律要求。

除非英飞凌另行明确批准，否则产品不得用于任何因产品故障或使用产品的任何后果可合理预期会导致人身伤害的应用。但是，上述规定并不妨碍客户在英飞凌明确设计和销售的使用领域中使用任何产品，但是客户对应用负有全部责任。

英飞凌明确保留根据适用法律，如《德国版权法》（UrhG）第 44b 条，将其内容用于商业资料和数据勘探（TDM）的权利。

如果产品包含安全功能：

由于任何计算设备都不可能绝对安全，尽管产品采取了安全措施，但英飞凌不保证产品不会被入侵、数据不会被盗或遗失，或不会发生其他漏洞（以下简称“安全漏洞”），英飞凌对任何安全漏洞不承担任何责任。

如果本文件包含或引用软件：

根据美国、德国和世界其他国家的知识产权法律和条约，该软件归英飞凌所有。英飞凌保留所有权利。因此，您只能按照软件附带的软件授权协议的规定使用本软件。

如果没有适用的软件授权协议，英飞凌特此授予您个人的、非排他性的、不可转让的软件知识产权授权（无权转授权）：(a) 对于以源代码形式提供的软件，仅在贵组织内部修改和复制该软件用于英飞凌硬件产品；及 (b) 对于以二进制代码 (binary code) 形式对外向终端用户分发该软件，仅得用于英飞凌硬件产品。禁止对本软件进行任何其他使用、复制、修改、翻译或编译。有关产品、技术、交货条款和条件以及价格的详细信息，请联系离您最近的英飞凌办公室或访问 <https://www.infineon.com>。