

最终数据手册

英飞凌 CoolSiC™ 1200 V 碳化硅沟道 MOSFET

特性

- $T_{vj} = -55 \dots 175^\circ\text{C}$ 时 $V_{DSS} = 1200\text{ V}$
- $T_C = 25^\circ\text{C}$ 时 $I_{DDC} = 198\text{ A}$
- 新的性能优化芯片技术 (Gen1p), 改善了 $R_{DS(on)} \cdot A$ FOM
- 提高了建议开启电压 ($V_{GS(on)} = 20\text{ V}$) 以降低 $R_{DS(on)}$
- 业界领先的开关能量特性, 可降低开关损耗并减少冷却需求
- 最低的器件电容值, 可实现更高的开关速度和更高的功率密度
- 低 C_{rSS}/C_{iSS} 电容比值和高 $V_{GS(th)}$ 的组合, 可避免寄生导通并实现单极性栅极驱动
- 降低了总栅极电荷 Q_{Gtot} , 可降低驱动功率和损耗
- .XT 芯片粘接技术, 实现业界领先的热性能
- 用于优化开关性能的检测引脚
- 最小爬电距离为 7.07 毫米, 以满足高压要求



潜在应用

- 车载充电器
- 直流/直流转换器
- 辅助驱动

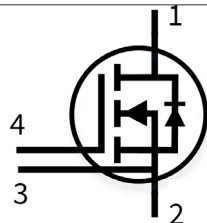
产品验证

- 适合汽车应用。根据 AEC-Q100/101 进行产品验证

描述

引脚定义:

- 1 - 漏极
- 2 - 来源
- 3 - 开尔文检测
- 4 - 栅极



| Type | Package | Marking |
|-----------------|----------------|-----------|
| AIMZH120R010M1T | PG-TO247-4-U03 | A12M1T010 |

目录

| | | |
|---|---------------------|----|
| | 描述..... | 1 |
| | 特性..... | 1 |
| | 潜在应用 | 1 |
| | 产品验证 | 1 |
| | 目录..... | 2 |
| 1 | 封装..... | 3 |
| 2 | MOSFET | 3 |
| 3 | 体二极管 (MOSFET) | 5 |
| 4 | 特性图 | 7 |
| 5 | 封装外形 | 13 |
| 6 | 测试条件 | 14 |
| | 修订记录 | 15 |
| | 免责声明 | 16 |

1 封装

1 封装

表 1 特征值

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---------------|------------------------|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Storage temperature | T_{stg} | | -55 | | 150 | °C |
| Soldering temperature | T_{sold} | | | | 260 | °C |
| MOSFET/body diode thermal resistance, junction-case ¹⁾ | $R_{th(j-c)}$ | | | 0.15 | 0.19 | K/W |

1) 未经过生产测试。该参数已通过设计/特性验证。

2 MOSFET

表 2 最大额定值

| Parameter | Symbol | Note or test condition | Values | Unit | |
|--|-----------|---|-----------------------|------|---|
| Drain-source voltage ¹⁾ | V_{DSS} | $T_{vj} = -55...175\text{ °C}$ | 1200 | V | |
| Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$ ²⁾ | I_{DCC} | $V_{GS} = 20\text{ V}$ | $T_c = 25\text{ °C}$ | 198 | A |
| | | | $T_c = 100\text{ °C}$ | 142 | |
| Peak drain current, t_p limited by $T_{vj(max)}$ ²⁾ | I_{DM} | $V_{GS} = 20\text{ V}$ | 511 | A | |
| Gate-source voltage, max. transient voltage ³⁾ | V_{GS} | $t_p \leq 0.5\ \mu\text{s}, D < 0.01$ | -10...25 | V | |
| Gate-source voltage, max. static voltage ³⁾ | V_{GS} | | -5...23 | V | |
| Avalanche energy, single pulse | E_{AS} | $I_D = 70\text{ A}, V_{DD} = 50\text{ V}, L = 0.26\text{ mH}$ | 625 | mJ | |
| Power dissipation, limited by $T_{vj(max)}$ ²⁾ | P_{tot} | | $T_c = 25\text{ °C}$ | 790 | W |
| | | | $T_c = 100\text{ °C}$ | 394 | |

1) 在 $T_{vj}=25\text{ °C}$ 下进行测试，并通过全温度范围内的设计/特性验证

2) 未经过生产测试。该参数已通过设计/特性验证

3) **重要注释：** 正负栅极源电压的选择会影响器件的长期行为。为了确保器件在计划使用寿命内的正常运行，必须考虑应用说明 AN2018-09 中描述的设计指南。

表 3 建议值

| Parameter | Symbol | Note or test condition | Values | Unit |
|-----------------------------------|---------------|------------------------|--------|------|
| Recommended turn-on gate voltage | $V_{GS(on)}$ | | 20 | V |
| Recommended turn-off gate voltage | $V_{GS(off)}$ | | 0 | V |

表 4 特征值

| Parameter | Symbol | Note or test condition | Values | | | Unit | |
|--|--------------|--|--|------|------|------|----|
| | | | Min. | Typ. | Max. | | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $I_D = 93\text{ A}$ | $T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 20\text{ V}$ | | 8.7 | 11.3 | mΩ |
| | | | $T_{vj} = 100\text{ °C}$, $V_{GS(on)} = 20\text{ V}$ | | 12.2 | | |
| | | | $T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 20\text{ V}$ | | 17.3 | | |
| | | | $T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$ | | 9.5 | | |
| Gate-source threshold voltage | $V_{GS(th)}$ | $I_D = 30\text{ mA}$, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$) | $T_{vj} = 25\text{ °C}$ | 3.7 | 4.4 | 5.1 | V |
| | | | $T_{vj} = 175\text{ °C}$ | | 3.6 | | |
| Zero gate-voltage drain current | I_{DSS} | $V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$ | $T_{vj} = 25\text{ °C}$ | | 1 | 90 | μA |
| | | | $T_{vj} = 175\text{ °C}$ | | 50 | | |
| Gate leakage current | I_{GSS} | $V_{DS} = 0\text{ V}$ | $V_{GS} = 25\text{ V}$ | | | 100 | nA |
| | | | $V_{GS} = -10\text{ V}$ | | | -100 | |
| Forward transconductance | g_{fs} | $I_D = 93\text{ A}$, $V_{DS} = 20\text{ V}$ | | | 56.8 | | S |
| Short-circuit withstand time ¹⁾ | t_{SC} | $V_{DD} \leq 800\text{ V}$, $V_{DS,peak} < 1200\text{ V}$, $T_{vj(start)} = 25\text{ °C}$, $R_{G,ext} = 2\text{ } \Omega$ | $V_{GS(on)} = 20\text{ V}$ | | 1.5 | | μs |
| | | | $V_{GS(on)} = 18\text{ V}$ | | 2 | | |
| | | | $V_{GS(on)} = 15\text{ V}$ | | 2.5 | | |
| Internal gate resistance | $R_{G,int}$ | $f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$ | | | 2.4 | | Ω |
| Input capacitance | C_{iss} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$ | | | 5703 | | pF |
| Output capacitance | C_{oss} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$ | | | 268 | | pF |
| Reverse transfer capacitance | C_{rss} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$ | | | 16 | | pF |
| C_{oss} stored energy | E_{oss} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$ | | | 107 | | μJ |
| Total gate charge | Q_G | $V_{DD} = 800\text{ V}$, $I_D = 93\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse | | | 178 | | nC |
| Plateau gate charge | $Q_{GS(pl)}$ | $V_{DD} = 800\text{ V}$, $I_D = 93\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse | | | 44 | | nC |
| Gate-drain charge | Q_{GD} | $V_{DD} = 800\text{ V}$, $I_D = 93\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse | | | 30 | | nC |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 800\text{ V}$, $I_D = 93\text{ A}$, $V_{GS} = 0/20\text{ V}$, $R_{GS(on)} = 2\text{ } \Omega$, $R_{GS(off)} = 2\text{ } \Omega$, $L_\sigma = 33\text{ nH}$ | $T_{vj} = 25\text{ °C}$ | | 19 | | ns |
| | | | $T_{vj} = 175\text{ °C}$ | | 18 | | |

(表格续下页.....)

3 体二极管 (MOSFET)

表 4 (续) 特征值

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|------------------------------|--------------|---|---------------------------------------|------|------|------------------|
| | | | Min. | Typ. | Max. | |
| Rise time | t_r | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A},$ $V_{GS} = 0/20 \text{ V},$ $R_{GS(on)} = 2 \Omega,$ $R_{GS(off)} = 2 \Omega, L_\sigma = 33 \text{ nH}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 20 | | ns |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 27 | | |
| Turn-off delay time | $t_{d(off)}$ | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A},$ $V_{GS} = 0/20 \text{ V},$ $R_{GS(on)} = 2 \Omega,$ $R_{GS(off)} = 2 \Omega, L_\sigma = 33 \text{ nH}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 41 | | ns |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 55 | | |
| Fall time | t_f | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A},$ $V_{GS} = 0/20 \text{ V},$ $R_{GS(on)} = 2 \Omega,$ $R_{GS(off)} = 2 \Omega, L_\sigma = 33 \text{ nH}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 13 | | ns |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 15 | | |
| Turn-on energy | E_{on} | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A},$ $V_{GS} = 0/20 \text{ V},$ $R_{GS(on)} = 2 \Omega,$ $R_{GS(off)} = 2 \Omega, L_\sigma = 33 \text{ nH}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 941 | | μJ |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 1606 | | |
| Turn-off energy | E_{off} | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A},$ $V_{GS} = 0/20 \text{ V},$ $R_{GS(on)} = 2 \Omega,$ $R_{GS(off)} = 2 \Omega, L_\sigma = 33 \text{ nH}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 606 | | μJ |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 868 | | |
| Total switching energy | E_{tot} | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A},$ $V_{GS} = 0/20 \text{ V},$ $R_{GS(on)} = 2 \Omega,$ $R_{GS(off)} = 2 \Omega, L_\sigma = 33 \text{ nH}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 1547 | | μJ |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 2474 | | |
| Virtual junction temperature | T_{vj} | | -55 | | 175 | $^\circ\text{C}$ |

1) 通过设计/特性验证

注: 动态测试电路参见图F。

除非另有规定, 特性均为 $T_{vj} = 25^\circ\text{C}$ 。

3 体二极管 (MOSFET)

表 5 最大额定值

| Parameter | Symbol | Note or test condition | Values | Unit |
|---|-----------|---|--------|------|
| Drain-source voltage ¹⁾ | V_{DSS} | $T_{vj} = -55...175 \text{ }^\circ\text{C}$ | 1200 | V |
| Continuous reverse drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$ ²⁾ | I_{SDC} | $T_c = 25 \text{ }^\circ\text{C}$ | 162 | A |
| | | $T_c = 100 \text{ }^\circ\text{C}$ | 94 | |

(表格续下页.....)

3 体二极管 (MOSFET)

表 5 (续) 最大额定值

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|----------|------------------------|---|------|------|------|
| | | | Min. | Typ. | Max. | |
| Peak reverse drain current, t_p limited by $T_{vj(max)}$ ²⁾ | I_{SM} | | $V_{GS} = 0 V$ | 208 | | A |
| | | | $-5 V \leq V_{GS} \leq 0 V,$ $t_p = 0.3 \mu s$ | 277 | | |
| | | | $-5 \leq V_{GS} \leq 0 V, T_{vj} \leq 175^\circ C;$ $t_p \leq 0.3 ms$ for accumulated conduction time < 5 s or $t_p \leq 1 ms$ for accumulated conduction time < 2.5 s ³⁾ | 717 | | |

1) 在 $T_{vj}=25^\circ C$ 下测试, 通过设计/特性验证

2) 未经过生产测试。该参数已通过设计/特性验证

3) t_p 和 I_{sm} 的组合不应导致 $T_{vj(max)} > 175^\circ C$

表 6 特征值

| Parameter | Symbol | Note or test condition | Values | | | Unit | |
|--------------------------------------|-----------|--|------------------------|------|------|------------|----|
| | | | Min. | Typ. | Max. | | |
| Drain-source reverse voltage | V_{SD} | $I_{SD} = 93 A$ | $T_{vj} = 25^\circ C$ | | 3.9 | 5 | V |
| | | | $T_{vj} = 100^\circ C$ | | 3.8 | | |
| | | | $T_{vj} = 175^\circ C$ | | 3.7 | | |
| MOSFET forward recovery charge | Q_{fr} | $V_{DD} = 800 V,$ $I_{SD} = 93 A, V_{GS} = 0 V,$ $-di_{SD}/dt = 3000 A/\mu s, Q_{fr}$ includes also Q_c | $T_{vj} = 25^\circ C$ | | 441 | | nC |
| | | | $T_{vj} = 175^\circ C$ | | 1450 | | |
| MOSFET peak forward recovery current | I_{frm} | $V_{DD} = 800 V,$ $I_{SD} = 93 A, V_{GS} = 0 V,$ $-di_{SD}/dt = 3000 A/\mu s, Q_{fr}$ includes also Q_c | $T_{vj} = 25^\circ C$ | | 38 | | A |
| | | | $T_{vj} = 175^\circ C$ | | 61 | | |
| Virtual junction temperature | T_{vj} | | -55 | | 175 | $^\circ C$ | |

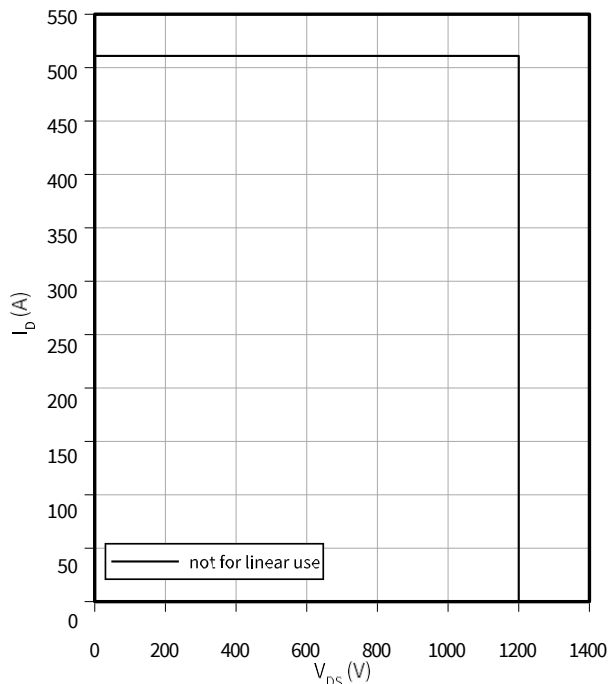
4 特性图

4 特性图

Reverse bias safe operating area (RBSOA)

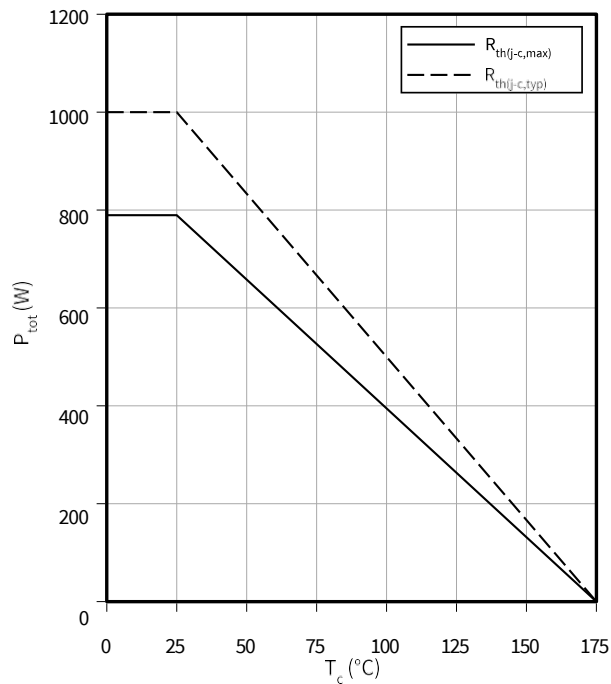
$I_D = f(V_{DS})$

$T_{vj} \leq 175\text{ }^\circ\text{C}$, $V_{GS} = 0/20\text{ V}$, $T_c = 25\text{ }^\circ\text{C}$



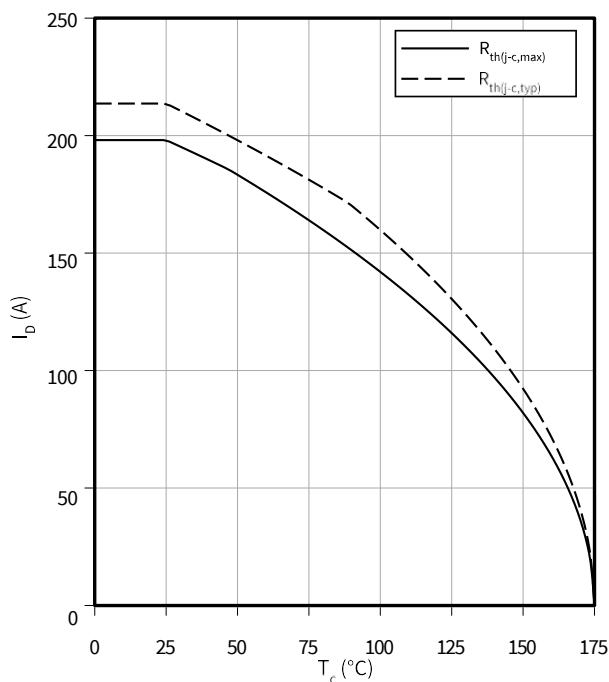
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$



Maximum DC drain to source current as a function of case temperature

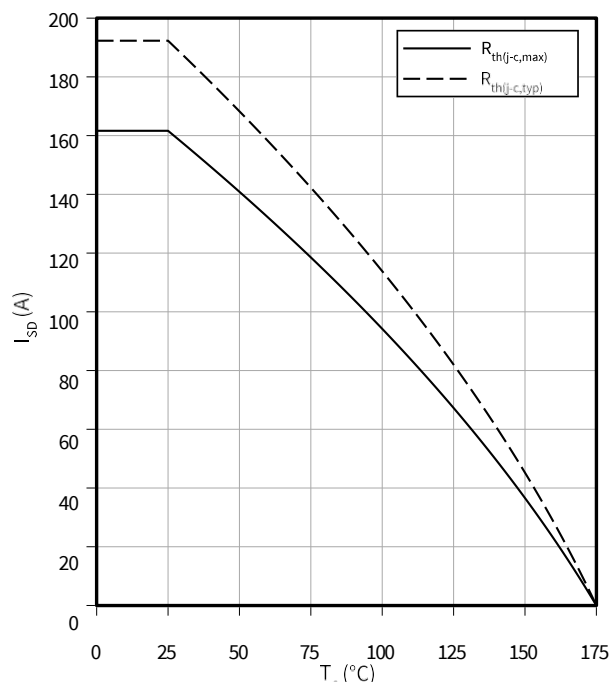
$I_D = f(T_c)$



Maximum source to drain current as a function of case temperature

$I_{SD} = f(T_c)$

$V_{GS} = 0\text{ V}$

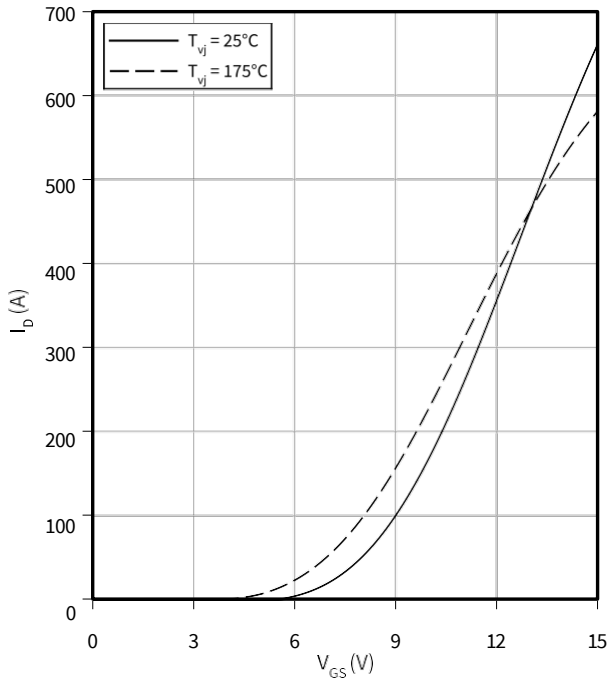


4 特性图

Typical transfer characteristic

$I_D = f(V_{GS})$

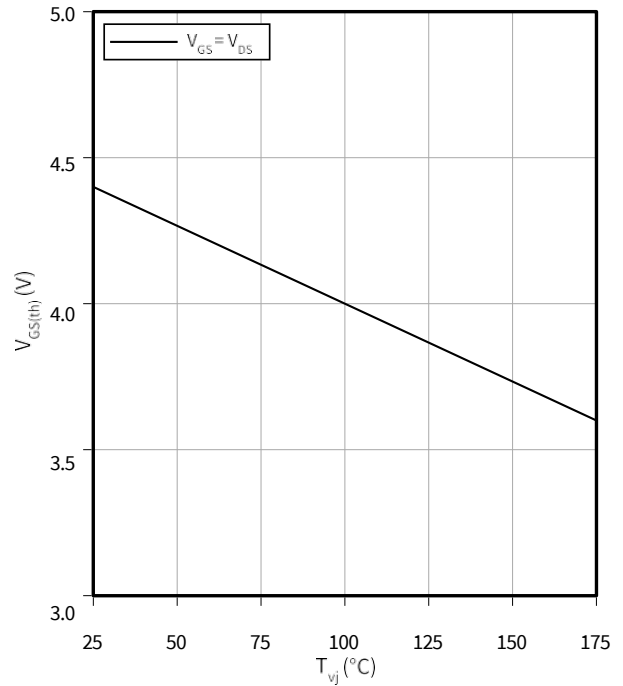
$V_{DS} = 20\text{ V}$, $t_p = 20\ \mu\text{s}$



Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$

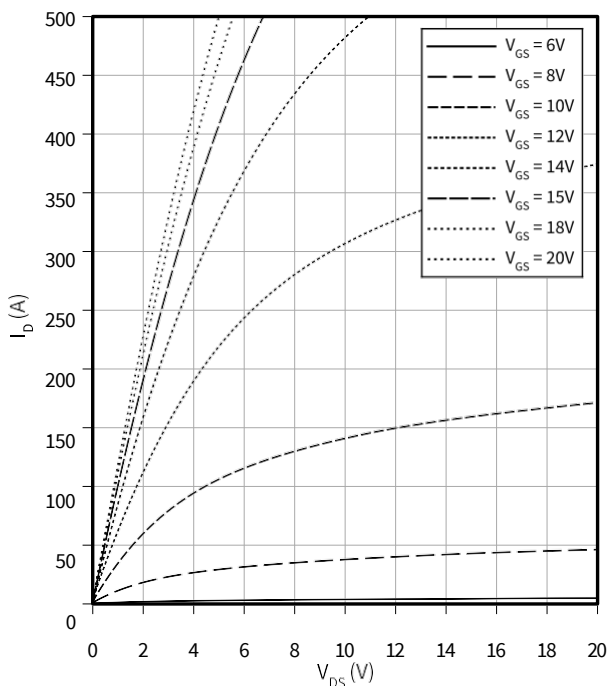
$I_D = 30\text{ mA}$



Typical output characteristic, V_{GS} as parameter

$I_D = f(V_{DS})$

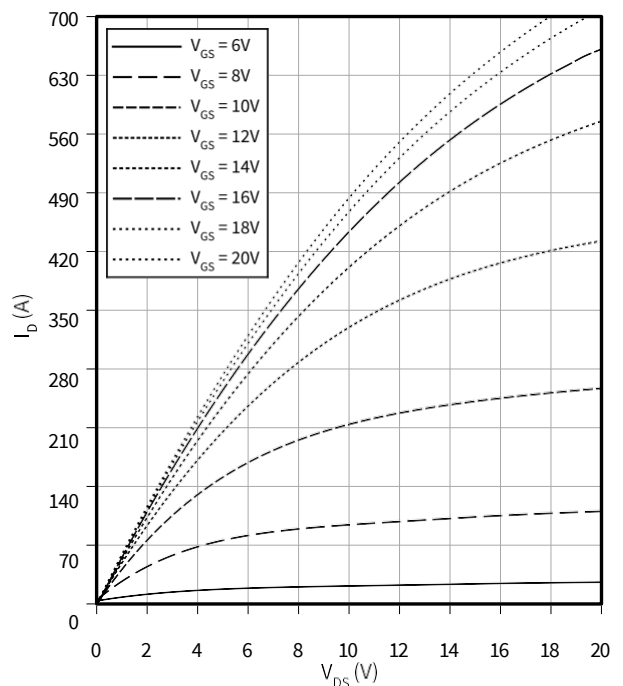
$T_{vj} = 25\ ^\circ\text{C}$, $t_p = 20\ \mu\text{s}$



Typical output characteristic, V_{GS} as parameter

$I_D = f(V_{DS})$

$T_{vj} = 175\ ^\circ\text{C}$, $t_p = 20\ \mu\text{s}$

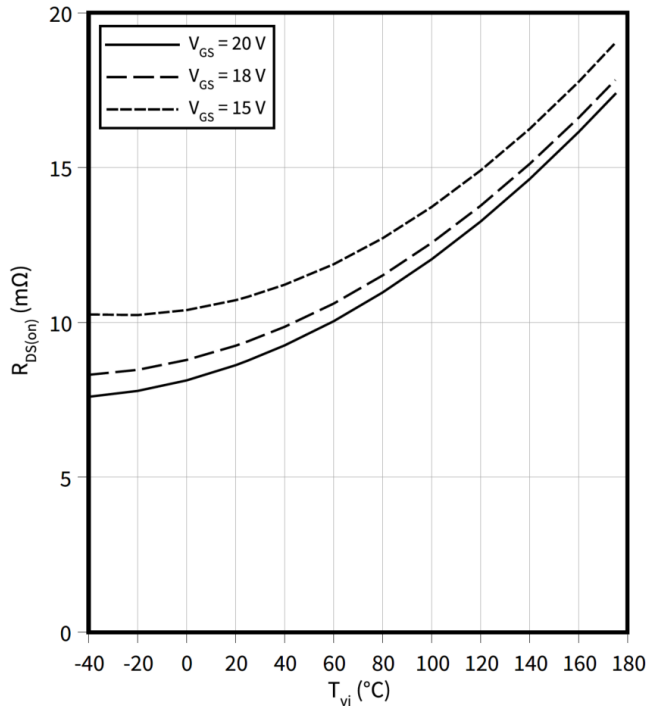


4 特性图

Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$

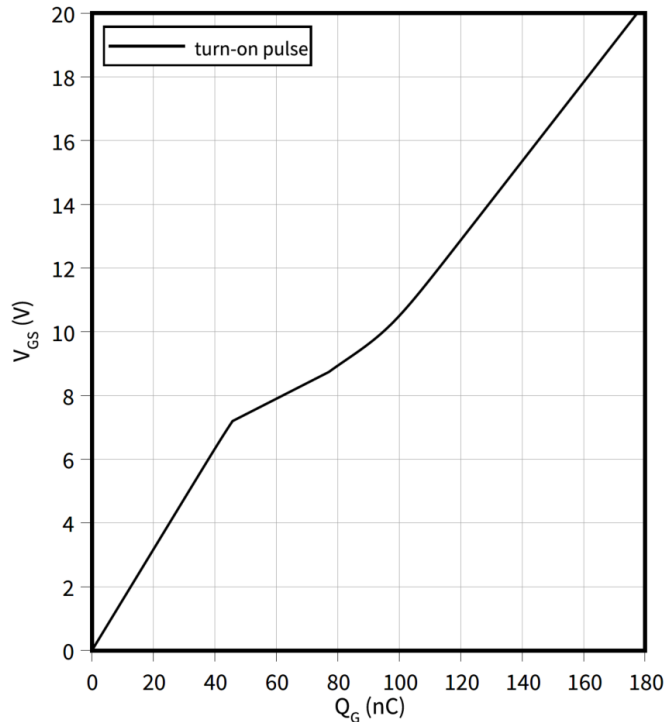
$I_D = 93 \text{ A}$



Typical gate charge

$V_{GS} = f(Q_G)$

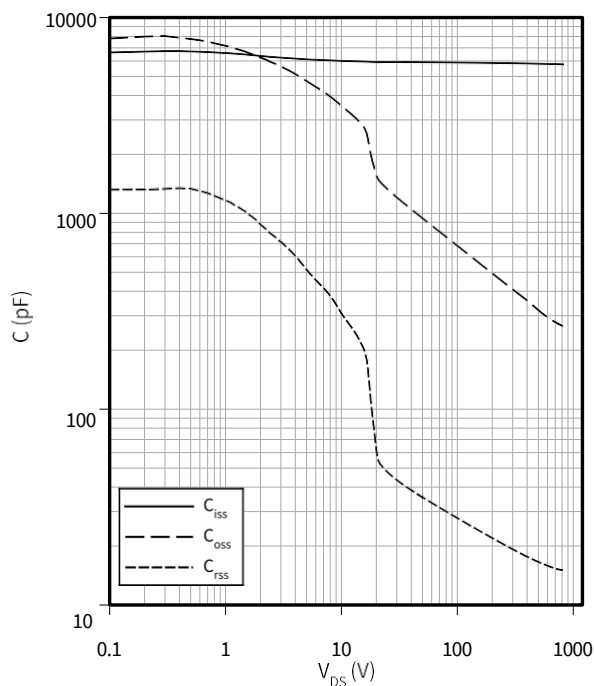
$I_D = 93 \text{ A}, V_{DS} = 800 \text{ V}$



Typical capacitance as a function of drain-source voltage

$C = f(V_{DS})$

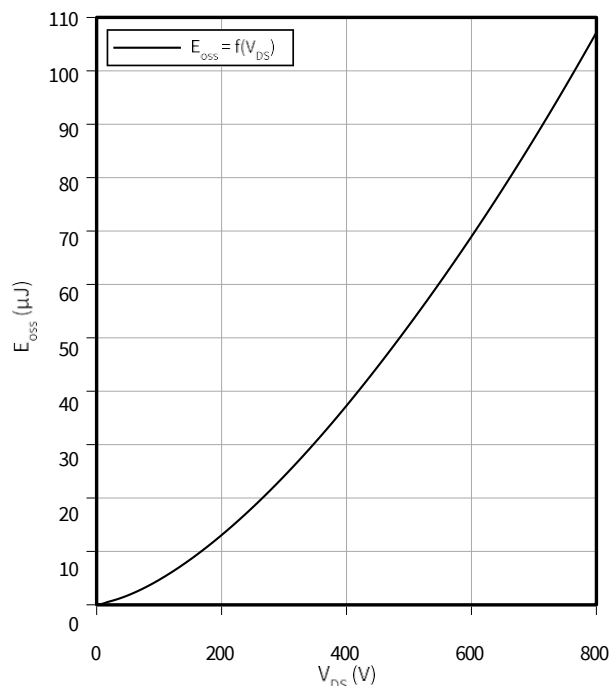
$f = 100 \text{ kHz}, V_{GS} = 0 \text{ V}$



Typical C_{oss} stored energy

$E_{oss} = f(V_{DS})$

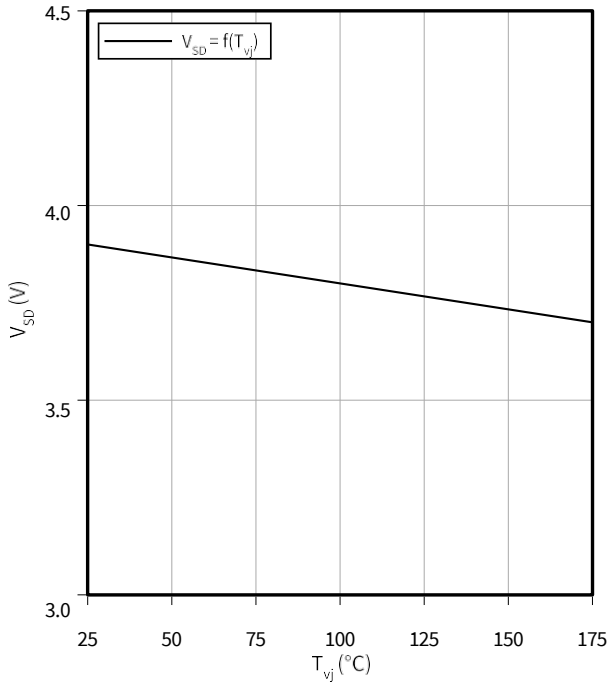
$f = 100 \text{ kHz}, V_{GS} = 0 \text{ V}$



4 特性图

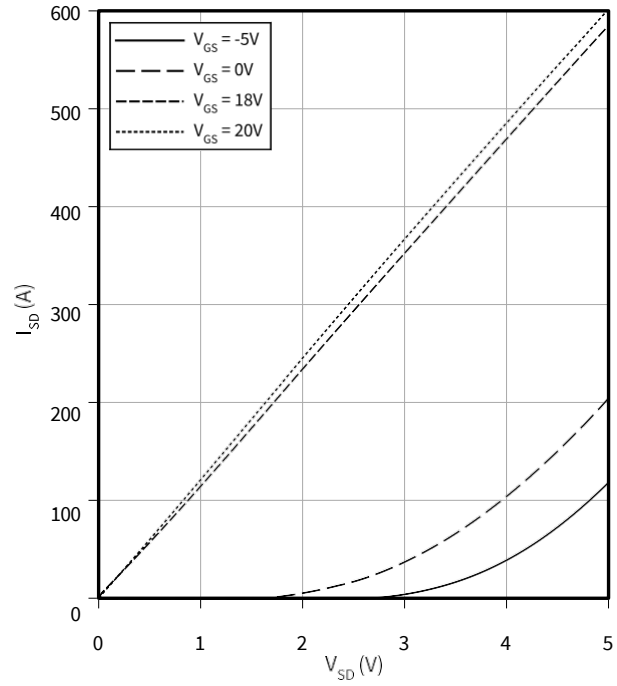
Typical reverse drain voltage as function of junction temperature

$V_{SD} = f(T_{vj})$
 $I_{SD} = 93 \text{ A}, V_{GS} = 0 \text{ V}$



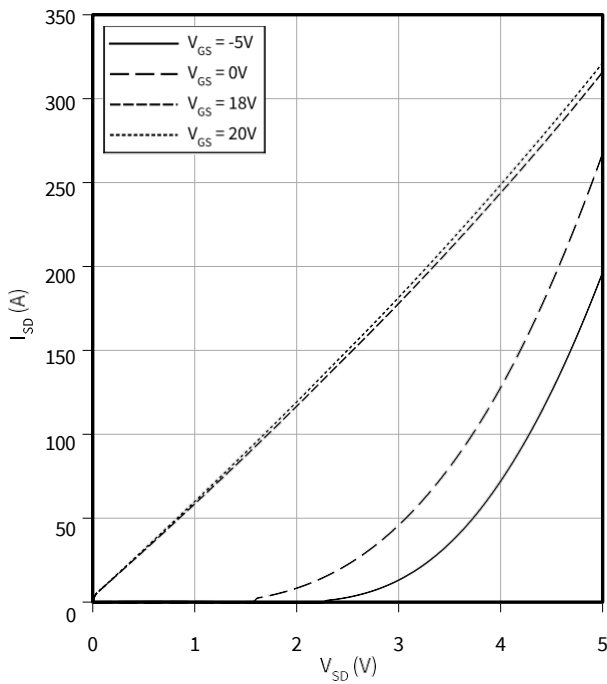
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{SD} = f(V_{SD})$
 $T_{vj} = 25 \text{ }^\circ\text{C}, t_p = 20 \text{ }\mu\text{s}$



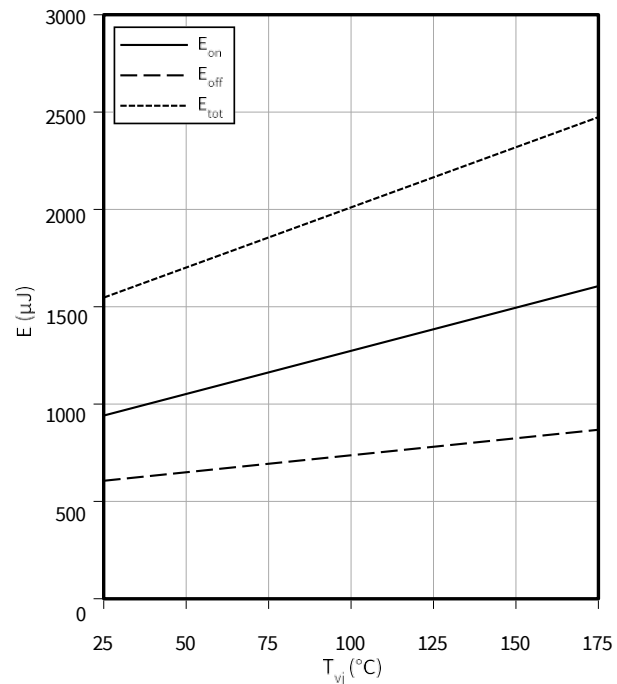
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{SD} = f(V_{SD})$
 $T_{vj} = 175 \text{ }^\circ\text{C}, t_p = 20 \text{ }\mu\text{s}$



Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0 \text{ V}$

$E = f(T_{vj})$
 $V_{GS} = 0/20 \text{ V}, I_D = 93 \text{ A}, R_{G,ext} = 2 \text{ }\Omega, V_{DD} = 800 \text{ V}$

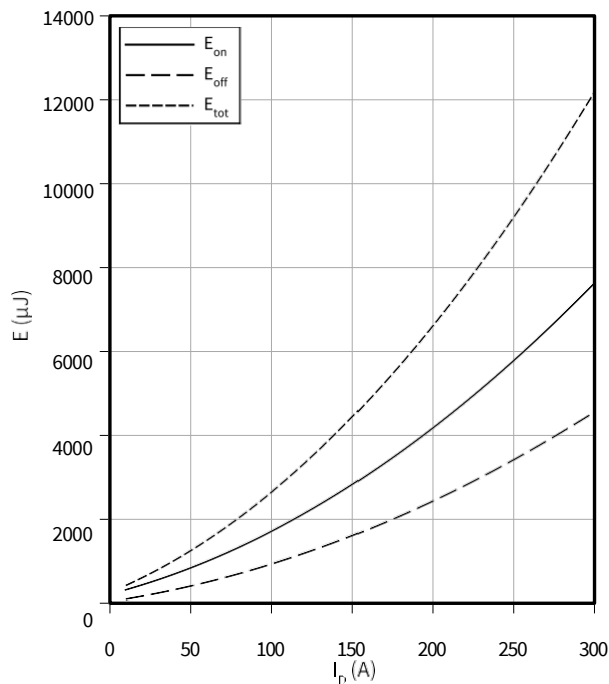


4 特性图

Typical switching energy as a function of drain current, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0$ V

$E = f(I_D)$

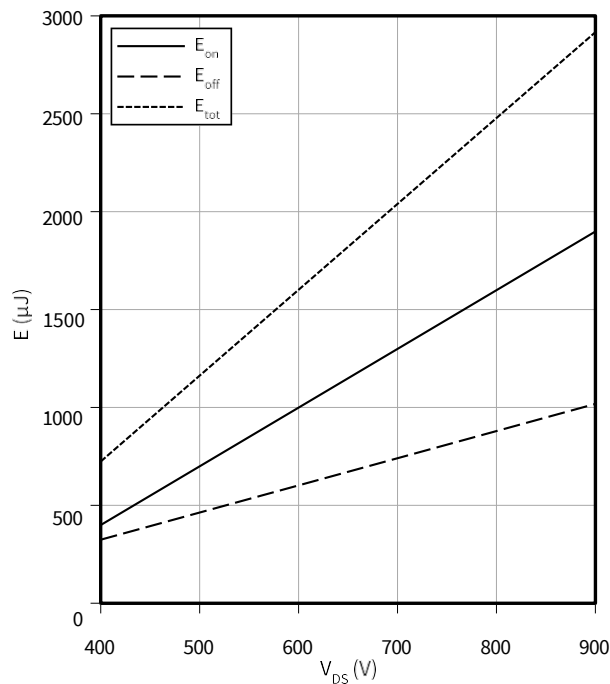
$V_{GS} = 0/20$ V, $T_{vj} = 175$ °C, $R_{G,ext} = 2$ Ω , $V_{DD} = 800$ V



Typical switching energy as a function of drain voltage, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0$ V

$E = f(V_{DS})$

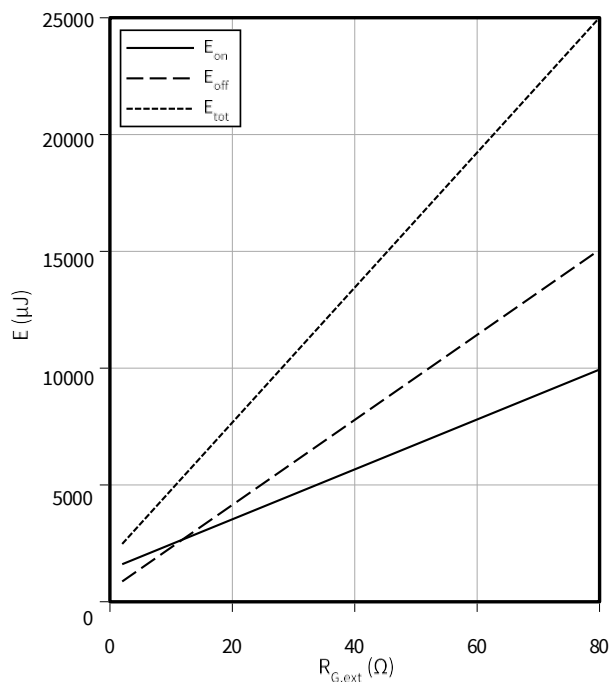
$V_{GS} = 0/20$ V, $I_D = 93$ A, $T_{vj} = 175$ °C, $R_{G,ext} = 2$ Ω



Typical switching energy as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0$ V

$E = f(R_{G,ext})$

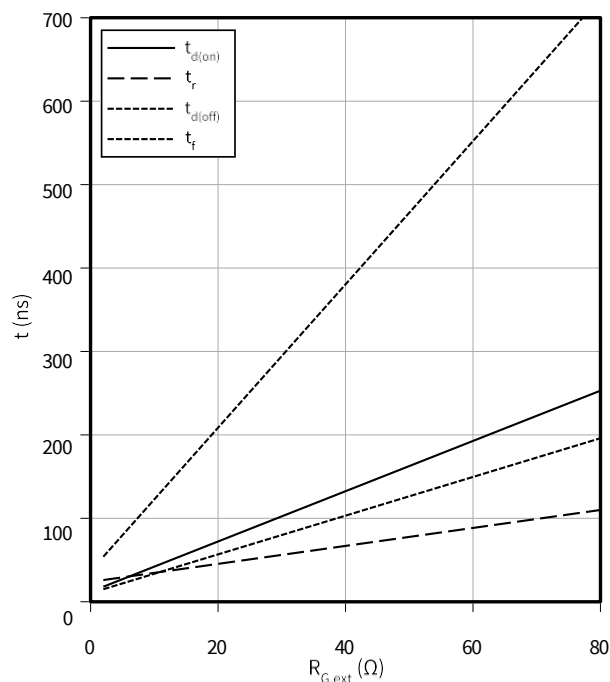
$V_{GS} = 0/20$ V, $I_D = 93$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



Typical switching times as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0$ V

$t = f(R_{G,ext})$

$V_{GS} = 0/20$ V, $I_D = 93$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V

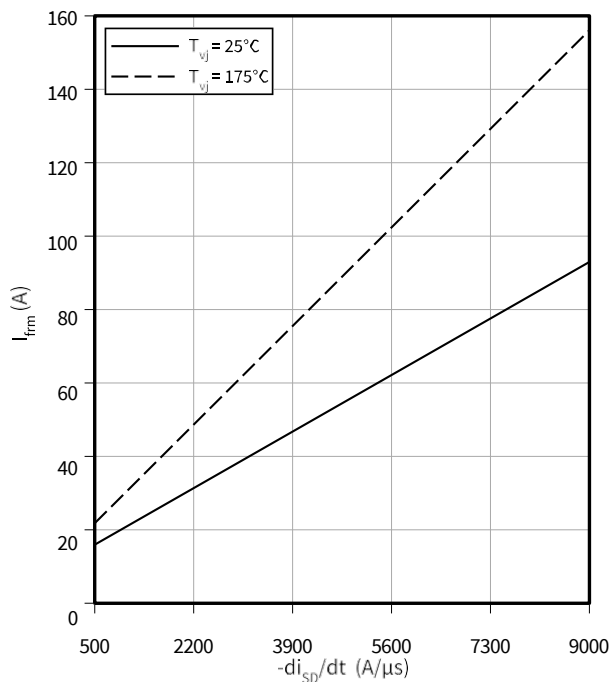


4 特性图

Typical reverse recovery current as a function of reverse drain current slope, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$$I_{frm} = f(-di_{SD}/dt)$$

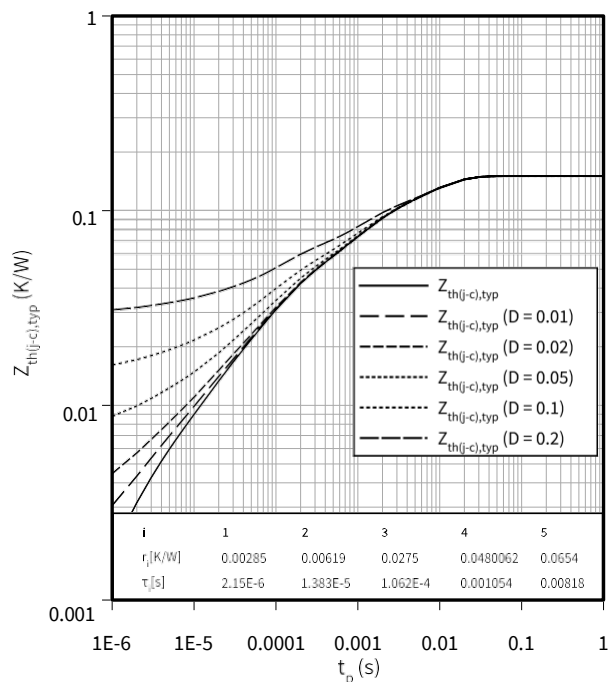
$V_{GS} = 0/18\text{ V}$, $I_{SD} = 93\text{ A}$, $V_{DD} = 800\text{ V}$



Typ. transient thermal impedance (MOSFET/diode)

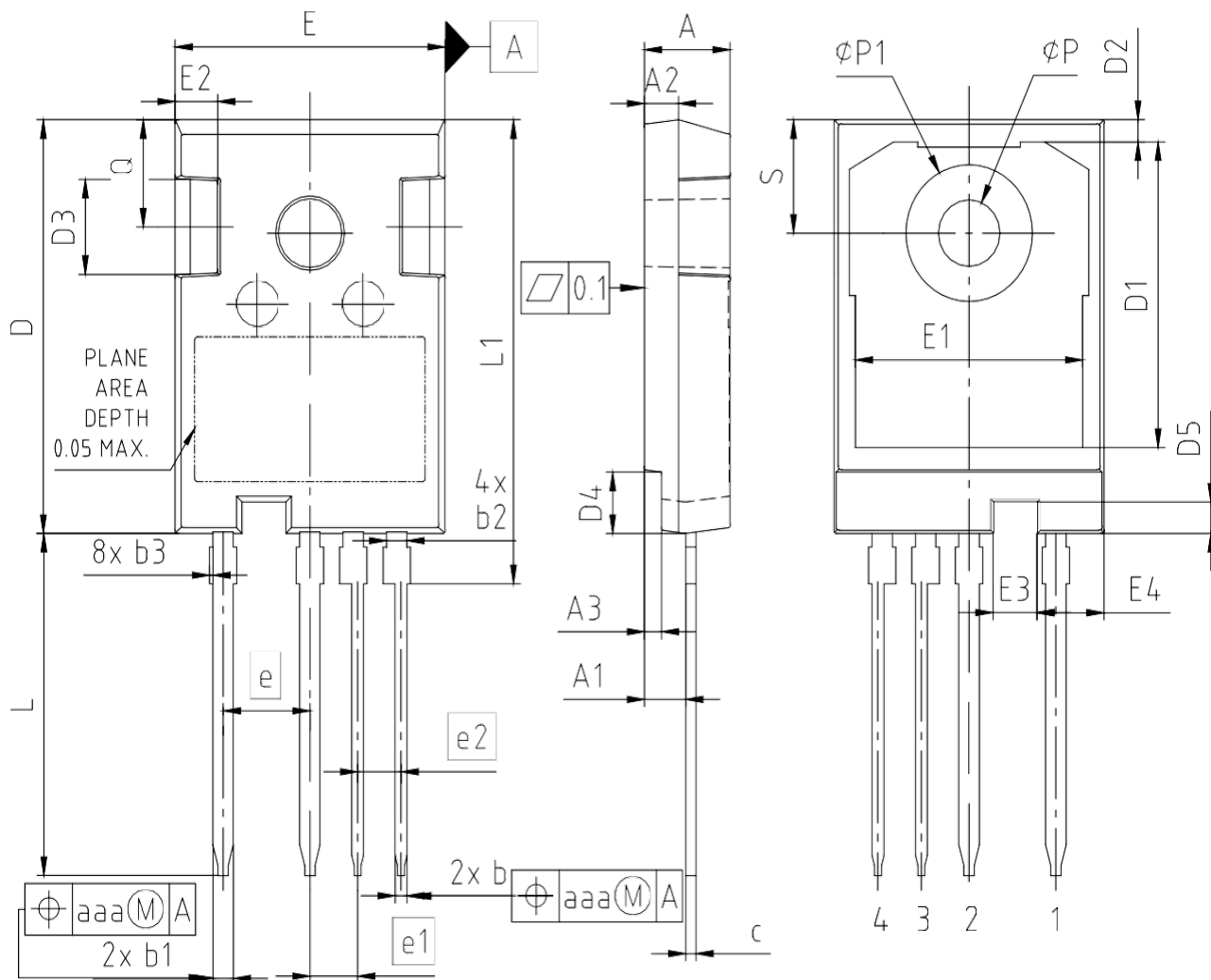
$$Z_{th(j-c),typ} = f(t_p)$$

$$D = t_p/T$$



5 封装外形

5 封装外形



PACKAGE - GROUP **PG-T0247-4-U03**
NUMBER:

| DIMENSIONS | MILLIMETERS | | DIMENSIONS | MILLIMETERS | |
|------------|-------------|-------|------------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 4.90 | 5.10 | E | 15.70 | 15.90 |
| A1 | 2.31 | 2.51 | E1 | 13.10 | 13.50 |
| A2 | 1.90 | 2.10 | E2 | 2.40 | 2.60 |
| A3 | 0.90 | 1.10 | E3 | 2.48 | 2.68 |
| b | 0.66 | 0.79 | E4 | 3.82 | 4.02 |
| b1 | 1.16 | 1.29 | e | 5.08 | |
| b2 | 1.16 | 1.29 | e1 | 2.79 | |
| b3 | | 0.20 | e2 | 2.54 | |
| c | 0.59 | 0.66 | N | 4 | |
| D | 22.30 | 22.50 | L | 18.40 | 18.70 |
| D1 | 16.25 | 16.85 | L1 | 24.97 | 25.27 |
| D2 | 1.05 | 1.35 | øP | 3.50 | 3.70 |
| D3 | 5.00 | 5.20 | øP1 | | 7.40 |
| D4 | 3.22 | 3.42 | Q | 5.60 | 6.00 |
| D5 | 1.60 | 1.80 | S | 6.00 | 6.30 |
| | | | aaa | 0.25 | |

NOTE: DIMENSIONS DO NOT INCLUDE MOLDFLASH; PROTRUSION OR GARE BURRS

图 1

6 测试条件

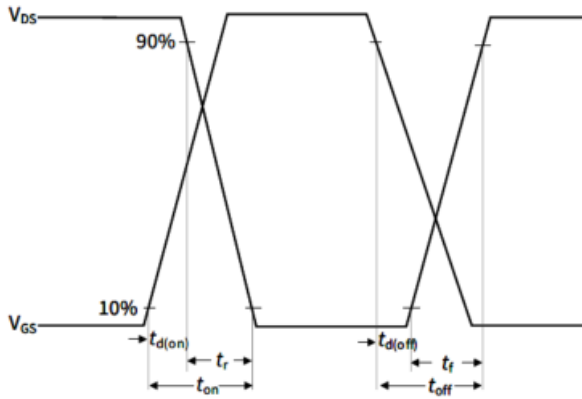


Figure A. Definition of switching times

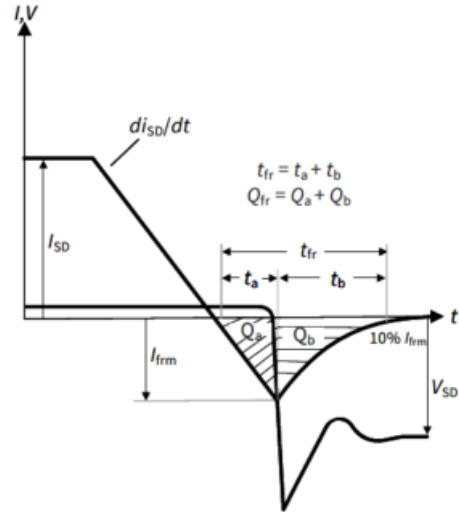


Figure B. Definition of body diode switching characteristics

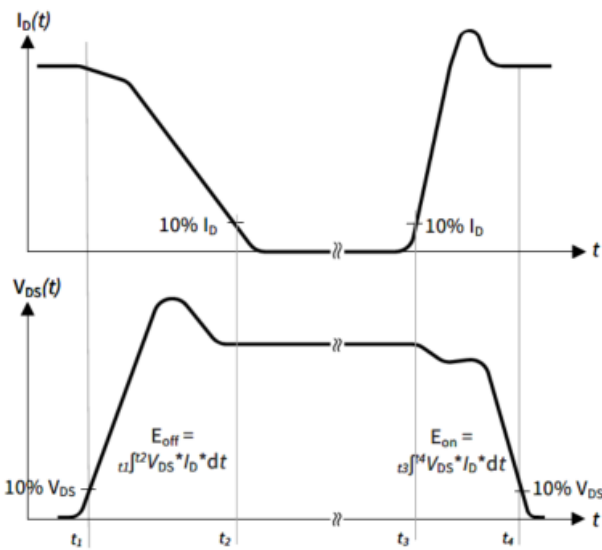


Figure C. Definition of switching losses

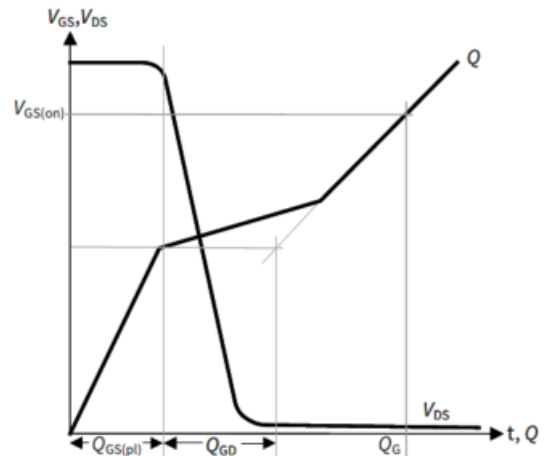


Figure D. Definition of QGD

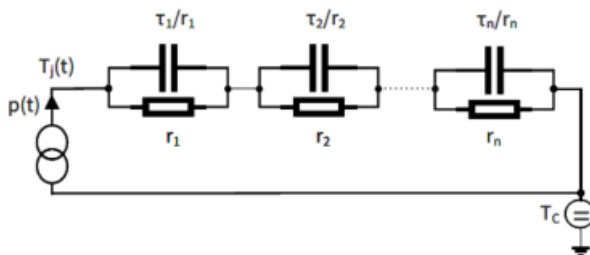


Figure E. Thermal equivalent circuit

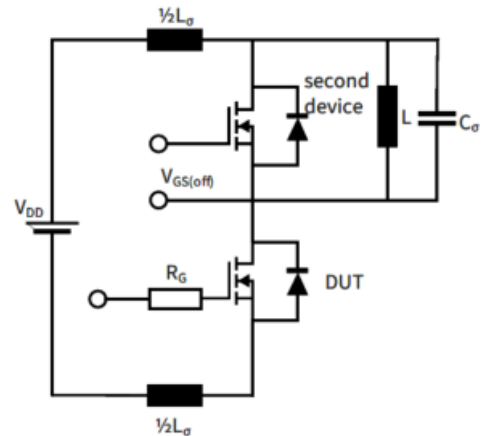


Figure F. Dynamic test circuit
Parasitic inductance L_{σ} ,
Parasitic capacitor C_{σ}

修订记录

| Document revision | Date of release | Description of changes |
|-------------------|-----------------|--|
| 0.10 | 2022-04-19 | Target datasheet |
| 0.20 | 2023-07-31 | Preliminary datasheet |
| 0.30 | 2023-08-03 | Correction of inductance unit (p. 3) |
| 1.00 | 2023-11-29 | Final datasheet |
| 1.10 | 2025-08-28 | <p>Updated table values: I_{DDC}, I_{DM}, P_{tot}, g_{fs}, L_{σ} for switching parameters, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f, E_{on}, E_{off}, E_{tot}, I_{SDC}, Q_{fr}, I_{frm}</p> <p>Added values: creepage distance value on p.1, I_{sm} values for limited t_p</p> <p>Updated graphs: $I_D = f(T_c)$, $P_{tot} = f(T_c)$, $I_{DS} = f(V_{DS})$, $R_{on}(T_{vj})$, $I_{DS}(V_{GS})$, $I_{SD} = f(V_{SD})$, $E = f(T_{vj})$, $E = f(RG_{ext})$, $E = f(I_D)$, $t_{sw} = f(RG_{ext})$, $Z_{th(j-c)} = f(t_p)$</p> <p>Added graphs: $E_{sw} = f(V_{DS})$, $I_{frm} = f(di/dt)$</p> <p>No change to the product, new/added values are based on additional assessments</p> |



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