# TM140PES65C0

## SiC MOSFET 芯片 SiC MOSFET Chip

初版 Preliminary

| 关键参数 | | Key Parameters | |
|---|---|---|---|
| $V_{DSmax}$ | | 1400 | V |
| $R_{DS(on)}$ | Typ. | 13.6 | mΩ |
| $I_D$ | Max. | 147 | A |
| Die Size | | 6.00*5.00 | $mm^2$ |

## 特点 Features

- 高开关频率 High Switching Frequency
- 低开关损耗 Low Switching Loss
- 软、快速开关 Soft, fast Switching
- 易并联使用 Easy Paralleling

## 电路结构 Circuit Configuration

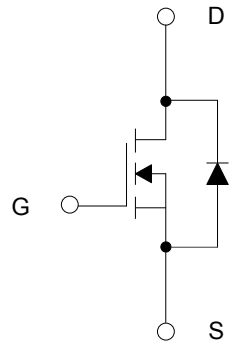



图 1. 电路结构

Fig. 1 Circuit configuration

## 最大额定值 Maximum Ratings

| 符号 Symbol | 参数名称 Parameter | 数值 Value | 单位 Unit |
|---|---|---|---|
| $V_{DSmax}$ | 漏源极电压 Drain-source voltage | 1400 | V |
| $V_{GSmax}$ | 栅源电压 Gate-source voltage | -8/+23 | V |
| $V_{GSop}$ | 栅源电压 Gate-source voltage | -4/+18 | V |
| $I_D$ | 持续正向电流，由 $T_{vj\,max}$ 限制 Continuous forward current, limited by $T_{vj\,max}$ | 147 | A |
| $I_{DM}$ | 最大重复正向电流，由 $T_{vj\,max}$ 限制 Maximum repetitive forward current, limited by $T_{vj\,max}$ | 294 | A |
| $T_{vj\,max}$ | 最大允许结温 Max. Junction temperature | 175 | °C |
| $T_{vj(op)}$ | 工作结温 Operation junction temperature | -40...+175 | °C |
| $T_{Proc}^{(*1)}$ | 最大加工温度 Maximum processing temperature | 400 | °C |

## 电特性值 Electrical Characteristics

除非特别声明，否则 $T_{vj}$= 25 °C　　$T_{vj}$= 25 °C unless otherwise stated

| 符号 Symbol | 参数名称 Parameter | 测试条件 Test Conditions | 最小值 Min. | 典型值 Typ. | 最大值 Max. | 单位 Unit |
|---|---|---|---|---|---|---|
| $I_{DSS}$ | 零栅压漏极电流 Zero gate voltage drain current | $V_{GS}$ = 0V, $V_{DS}$ = $V_{DSmax}$ | | | 20 | μA |
| | | $V_{GS}$ = 0V, $V_{DS}$ = $V_{DSmax}$, $T_{vj}$ = 175 °C | | | 20 | μA |
| $I_{GSS}$ | 栅极漏电流 Gate leakage current | $V_{GS}$ = $V_{GSmax}$, $V_{DS}$ = 0V | | | 250 | nA |
| $V_{GS(th)}$ (*2) | 栅极-源极阈值电压 Gate threshold voltage | $I_D$ = 25 mA, $V_{GS}$ = $V_{DS}$ | 2.4 | 3.0 | 3.6 | V |
| | | $I_D$ = 25 mA, $V_{GS}$ = $V_{DS}$, $T_{vj}$ = 175 °C | 1.8 | 2.4 | 3.0 | V |
| $R_{DS(ON)}$ | 漏极-源极通态电阻 Drain-source on-state resistance | $V_{GS}$ =18V, $I_D$ = 73.5A | | 13.6 | | mΩ |
| | | $V_{GS}$ =18V, $I_D$ = 73.5A, $T_{vj}$ = 175 °C | | 29.0 | | mΩ |
| $g_{fs}$ | 跨导 Forward transconductance | $V_{DS}$ =20V, $I_D$ = 73.5A | | 165 | | S |
| $C_{iss}$ | 输入电容 Input capacitance | $V_{DS}$ = 1000V, $V_{GS}$ = 0V, $f$ = 100kHz, $V_{AC}$ = 25mV | | 7425 | | pF |
| $C_{oss}$ | 输出电容 Output capacitance | | | 219 | | pF |
| $C_{rss}$ | 反向传输电容 Reverse transfer capacitance | | | 14 | | pF |
| $E_{oss}$ | 电容存储能量 $C_{oss}$ Stored Energy | | | 105 | | μJ |
| $R_{Gint}$ | 内部栅极电阻 Internal gate resistor | $V_{GS}$ =0V | | 7.2 | | Ω |
| $Q_{gs}$ | 栅源电荷 Gate to source charge | $V_{DS}$ =1000V, $I_D$ = 135A, $V_{GS}$ =-4V/+18V | | 81 | | nC |
| $Q_{gd}$ | 栅漏电荷 Gate to drain charge | | | 173 | | nC |
| $Q_g$ | 总栅极电荷 Total gate charge | | | 254 | | nC |
| $V_{SD}$ | 二极管正向电压 Diode forward voltage | $I_{SD}$ =73.5A, $V_{GS}$ = -4V | | 4.6 | | V |
| | | $I_{SD}$ =73.5A, $V_{GS}$ = -4V, $T_{vj}$ = 175 °C | | 4.2 | | V |

**注意：** 1.(*1) 表示最长持续时间 10min((*1) ) indicates 10min, maximum);

**Note:** 2.(*2) 表示做过预处理后的测试值((*2) indicates $V_{GS(th)}$ is preprocessed);

## 电特性值 Electrical Characteristics

| 符号 Symbol | 参数名称 Parameter | 测试条件 Test Conditions | | 最小值 Min. | 典型值 Typ. | 最大值 Max. | 单位 Unit |
|---|---|---|---|---|---|---|---|
| $t_{d(off)}$ | 关断延迟时间 Turn-off delay time | $I_D$ =140A, $V_{DS}$ = 1100V, $V_{GS}$ = -4/+18V, $R_{G(OFF)}$ =1.6Ω, d$v$/dt =39233V/μs ($T_{vj}$= 175 °C) | $T_{vj}$= 25 °C | | 59 | | ns |
| | | | $T_{vj}$= 175 °C | | 82 | | |
| $t_f$ | 下降时间 Fall time | | $T_{vj}$= 25 °C | | 36 | | ns |
| | | | $T_{vj}$= 175 °C | | 34 | | |
| $E_{OFF}$ | 关断损耗 Turn-off energy loss | | $T_{vj}$= 25 °C | | 225 | | μJ |
| | | | $T_{vj}$= 175 °C | | 233 | | |
| $t_{d(on)}$ | 开通延迟时间 Turn-on delay time | $I_D$ =140A, $V_{DS}$ = 1100V, $V_{GS}$ = -4/+18V, $R_{G(ON)}$ =1.8Ω, d$i$/dt =3442A/μs ($T_{vj}$= 175 °C) | $T_{vj}$= 25 °C | | 44 | | ns |
| | | | $T_{vj}$= 175 °C | | 46 | | |
| $t_r$ | 上升时间 Rise time | | $T_{vj}$= 25 °C | | 45 | | ns |
| | | | $T_{vj}$= 175 °C | | 38 | | |
| $E_{ON}$ | 开通损耗 Turn-on energy loss | | $T_{vj}$= 25 °C | | 742 | | μJ |
| | | | $T_{vj}$= 175 °C | | 892 | | |
| $Q_{rr}$ | 二极管反向恢复电荷 Diode reverse recovery charge | $I_D$ =140A, $V_{DS}$ = 1100V, - d$i_{SD}$/dt = 3442A/μs ($T_{vj}$= 175 °C) | $T_{vj}$= 25 °C | | 1000 | | nC |
| | | | $T_{vj}$= 175 °C | | 1000 | | |
| $I_{rr}$ | 二极管反向恢复电流 Diode reverse recovery current | | $T_{vj}$= 25 °C | | 28 | | A |
| | | | $T_{vj}$= 175 °C | | 56 | | |

**注意：**
**Note:**

1.(*1) d$v$/dt：定义为关断波形电压 $V_{DS}$ 上升段，40% $V_{CE}$ 至 60% $V_{DS}$ 区间段的斜率((*1) d$v$/dt：Defined as the slope of waveform of 40% $V_{DS}$ to 60% $V_{DS}$ during turn off )

2.(*2) d$i$/dt：定义为开通波形电流 $I_D$ 上升段，40% $I_D$ 至 60%$I_D$ 区间段的斜率((*2) d$i$/dt：Defined as the slope of waveform of 40% $I_D$ to 60% $I_D$ during turn on)

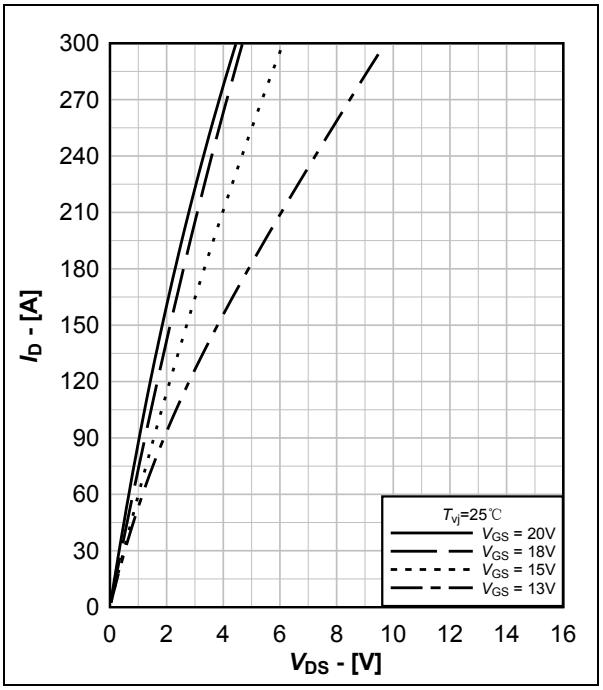



图 2. 输出特性典型曲线, $I_D$= f ($V_{DS}$), $T_{vj}$ = 25 °C

Fig.2 Typical output characteristics, $I_D$= f ($V_{DS}$), $T_{vj}$ = 25 °C

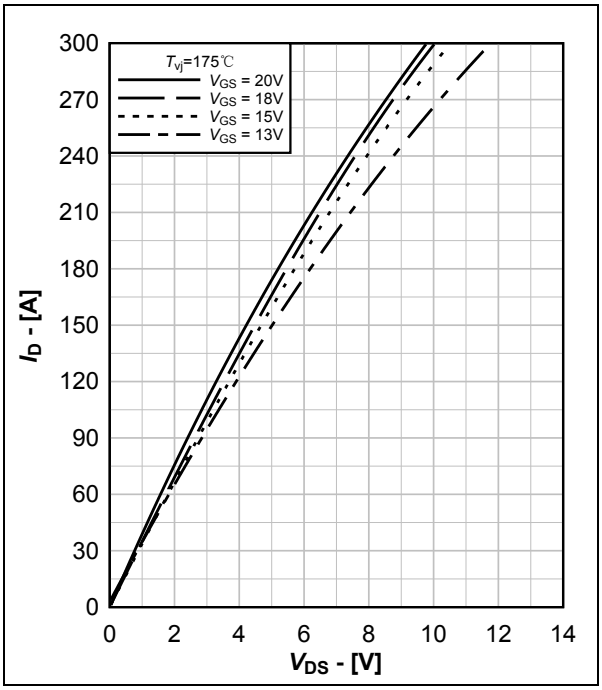



图 3. 输出特性典型曲线, $I_D$= f ($V_{DS}$), $T_{vj}$ = 175 °C

Fig.3 Typical output characteristics, $I_D$= f ($V_{DS}$), $T_{vj}$ = 175 °C

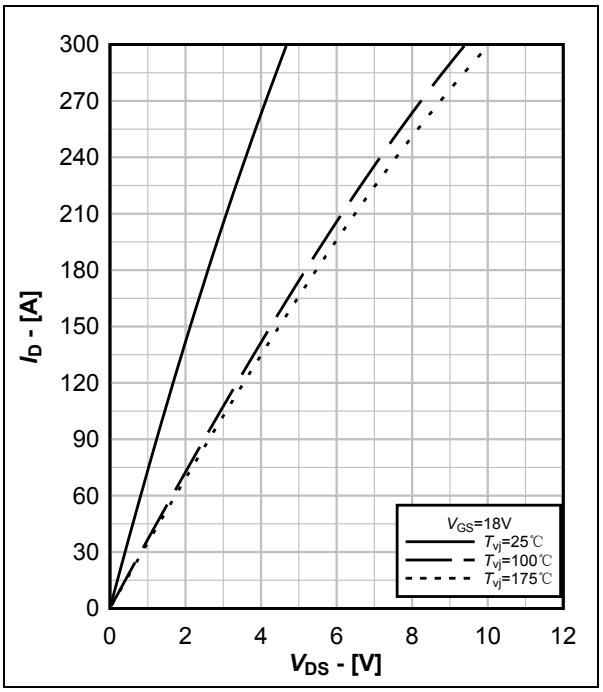



图 4. 输出特性典型曲线, $I_D$= f ($V_{DS}$)

Fig.4 Typical output characteristics, $I_D$= f ($V_{DS}$)

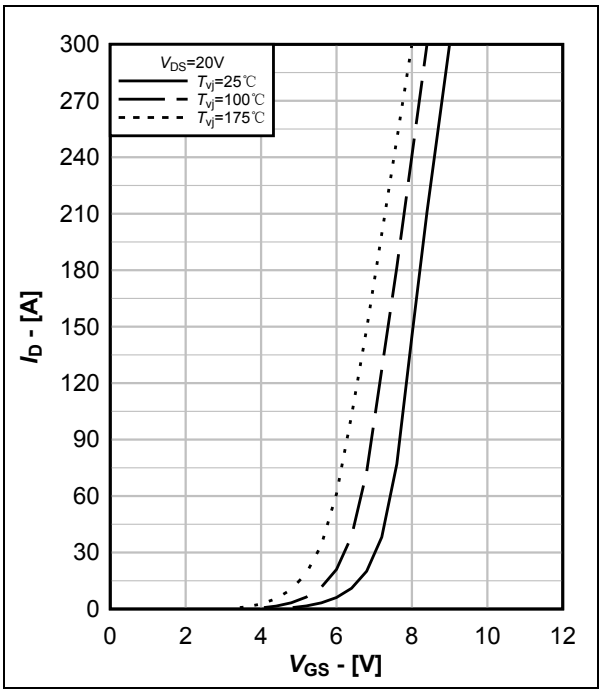



图 5.传输特性典型曲线,$I_D$= f ($V_{GS}$)

Fig.5 Typical transfer characteristics, $I_D$= f ($V_{GS}$)

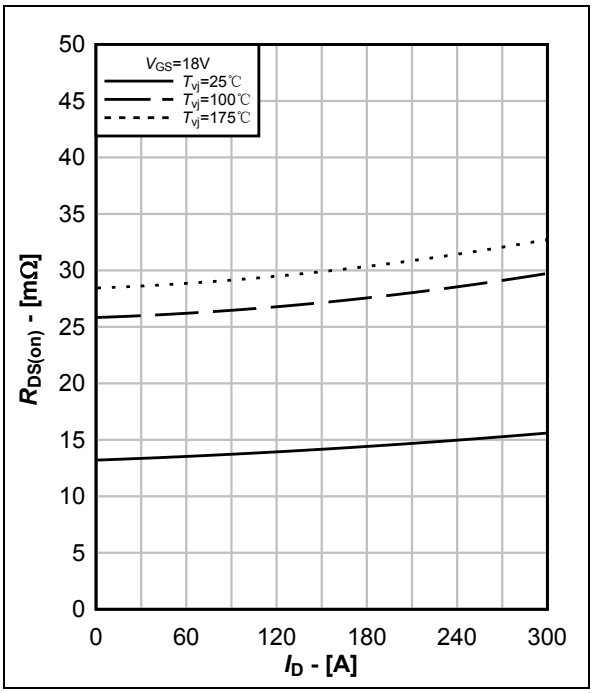



图 6. 导通电阻典型曲线, $R_{DS(on)}$ = f ($I_D$)

Fig.6 Typical On-Resistance characteristics, $R_{DS(on)}$ = f ($I_D$)

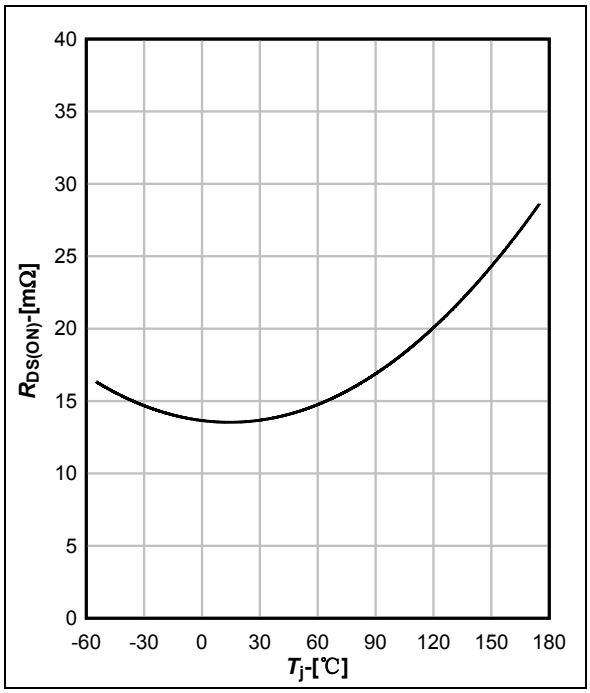



图 7. 导通电阻典型曲线, $R_{DS(ON)}$ = f ($T_j$)

Fig.7 Typical On-Resistance characteristics, $R_{DS(ON)}$ = f ($T_j$)

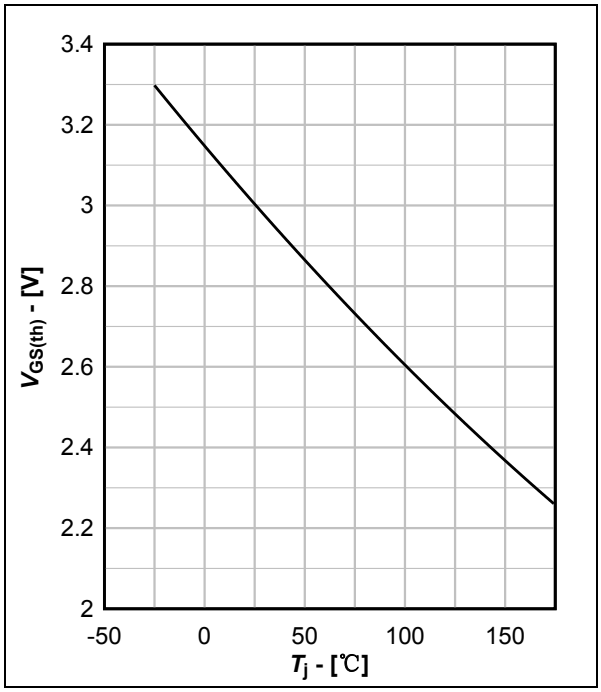



图 8. 阈值电压典型曲线, $V_{GS(th)}$ = f ($T_j$)

Fig.8 Typical $V_{GS(th)}$ characteristics, $V_{GS(th)}$ = f ($T_j$)

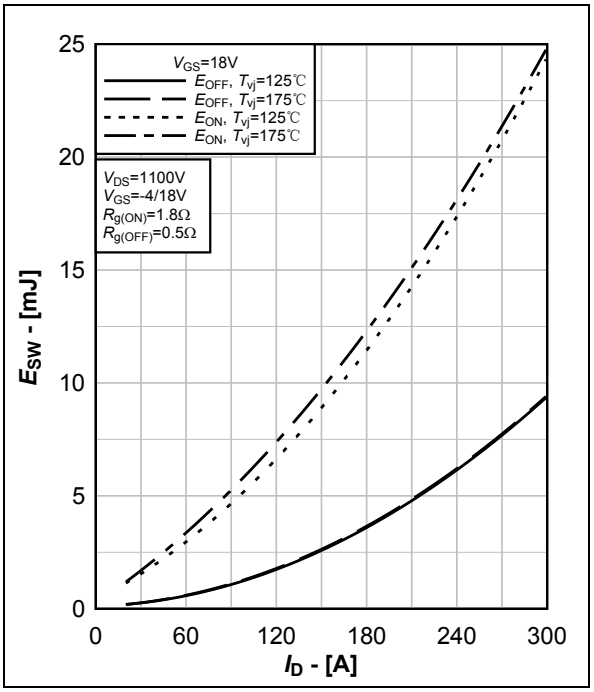



图 9. MOSFET 开关损耗典型曲线, $E_{off}$= f ($I_D$), $E_{on}$= f ($I_D$)

Fig.9 Typical MOSFET switching energy, $E_{off}$= f ($I_D$), $E_{on}$= f ($I_D$)

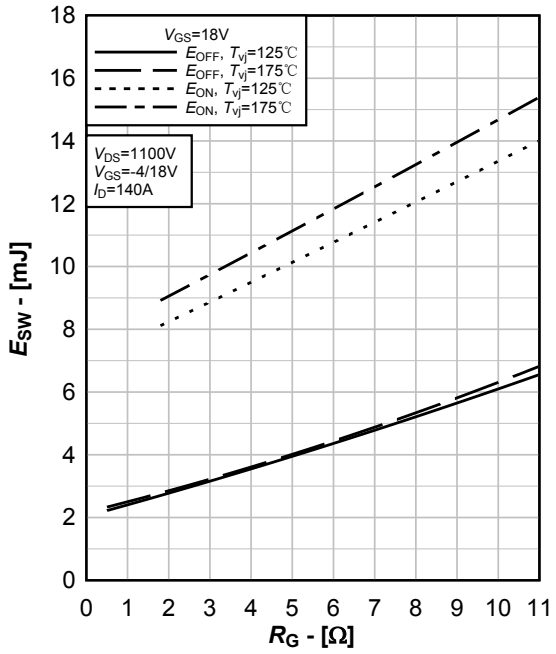



图 10. MOSFET 开关损耗典型曲线, $E_{on}$= f ($R_G$), $E_{off}$= f ($R_G$)

Fig.10 Typical MOSFET switching energy, $E_{on}$= f($R_G$), $E_{off}$= f ($R_G$)

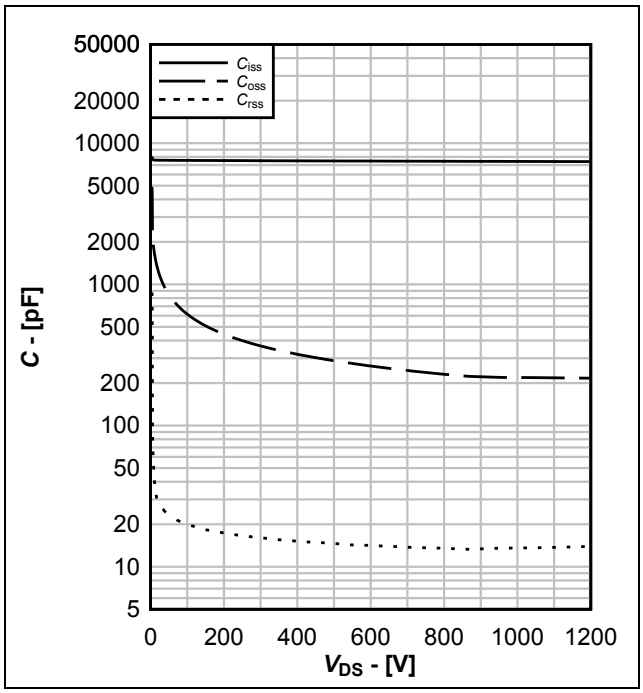



图 11. 电容特性典型曲线, $C$= f ($V_{DS}$)

Fig.11 Typical capacity characteristic, $C$= f ($V_{DS}$)

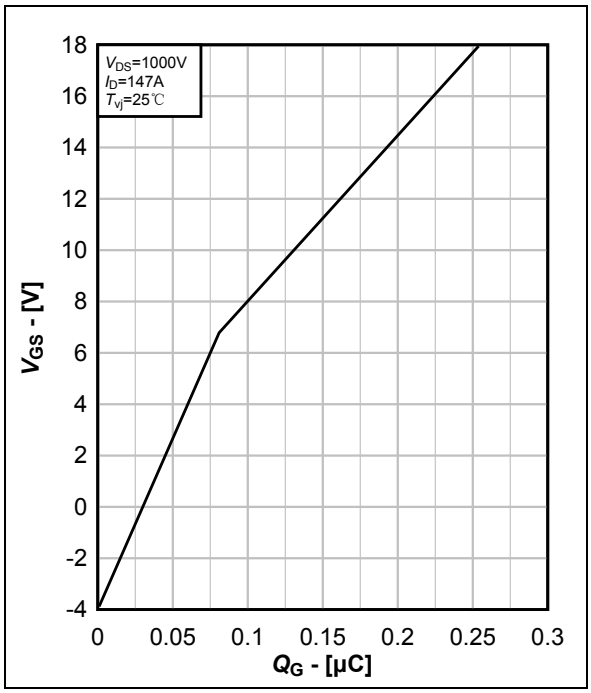



图 12. 栅极电荷特性典型曲线, $V_{GS}$ = f ($Q_G$)

Fig. 12 Typical gate charge characteristic, $V_{GS}$= f ($Q_G$)

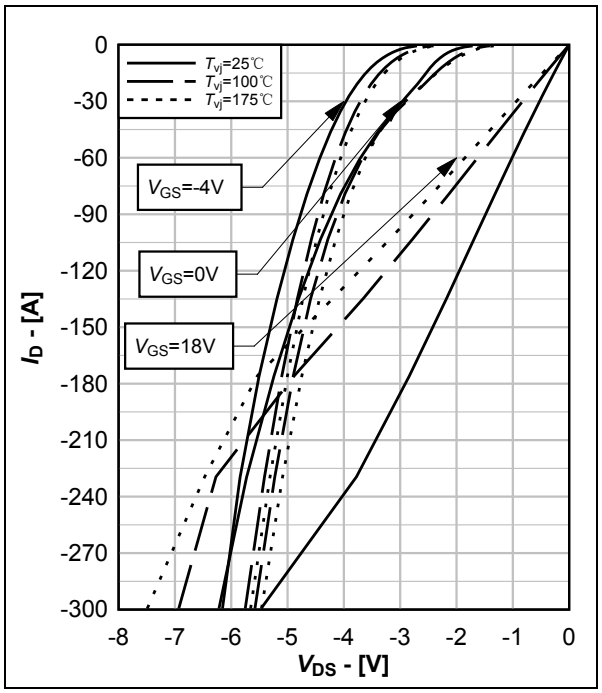



图 13. 体二极管及第三象限输出特性典型曲线, $I_D$ = f ($V_{DS}$)

Fig.13 Typical body diode output and 3rd quadrant characteristic, $I_D$ = f ($V_{DS}$)

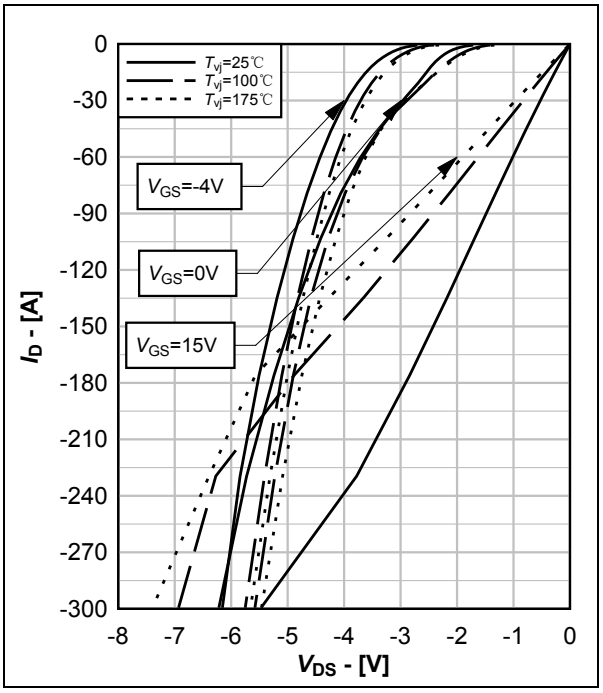
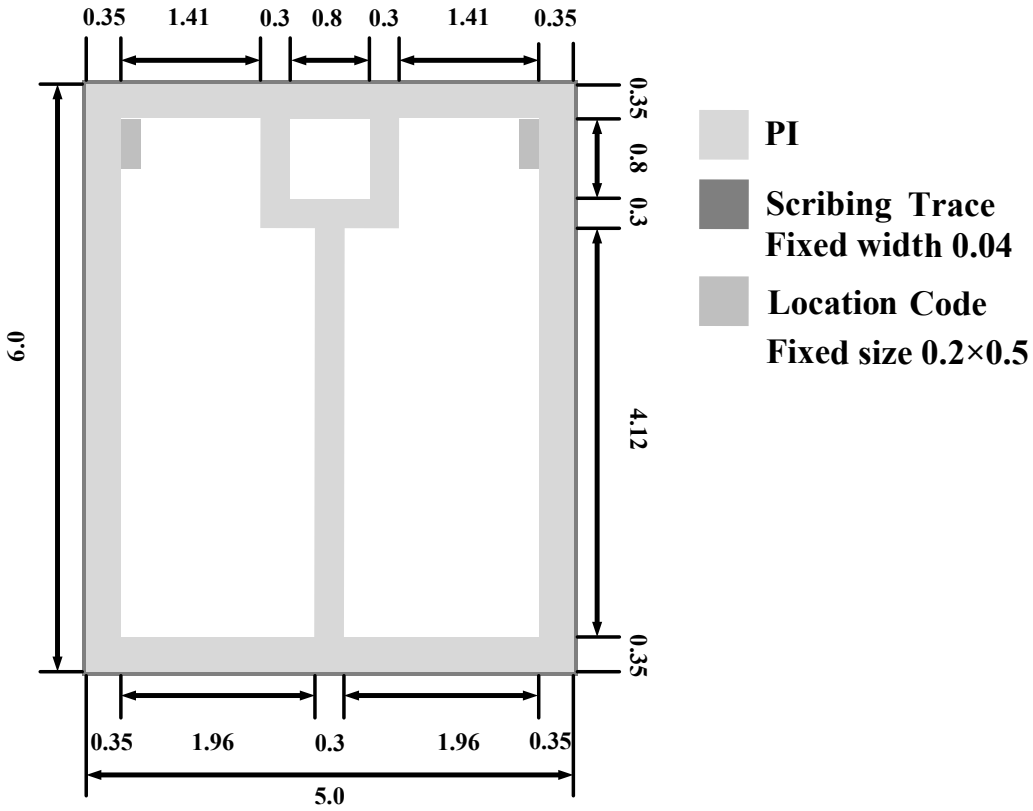



图 14. 体二极管及第三象限输出特性典型曲线, $I_D = f(V_{DS})$

Fig.14 Typical body diode output and 3rd quadrant characteristic, $I_D = f(V_{DS})$

**工艺参数值** **Mechanical Parameters**

| | | |
|---|---|---|
| 芯片尺寸<br>Chip size | 6.00*5.00 | $mm^2$ |
| 源极键合区尺寸(不包含开尔文源级)<br>Source pad size (excl. Kelvin Source pad) | 见芯片尺寸图<br>See chip drawing | $mm^2$ |
| 栅极键合区尺寸<br>Gate pad size | 0.60*0.50 | $mm^2$ |
| 总面积<br>Area total | 30.00 | $mm^2$ |
| 厚度<br>Thickness | 120±10 | μm |
| 晶圆尺寸<br>Wafer size | 150 | mm |
| 每片晶圆上最大芯片数<br>Max. possible chips per wafer | 462 | |
| 正面金属<br>Frontside (Source and Gate) metal | AlSi: 5.0μm | |
| 背面金属<br>Backside (Drain) metal | Ti:Ni:Ag (0.05:0.75:0.25μm) | |
| 正面钝化<br>Passivation frontside | Polyimide | |
| 建议存储环境<br>Recommended storage environment | 存储在原始容器中，23°C 干燥氮气柜小于 6 个月<br>Store in original container, in dry nitrogen, <6 months at an ambient temperature of 23°C | |




单位：毫米 Unit:mm

图 2. 芯片外观尺寸

Fig. 2 Chip drawing

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**ZHUZHOU CRRC TIMES SEMICONDUCTOR CO., LTD**

| | | | |
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