# PRELIMINARY DATASHEET 初版规格书

# SISD0450ST120i23_C01

ST-Type phase leg IGBT module
ST 封装半桥 IGBT 模块



**$V_{CE}$ = 1200 V**
**$I_C$ = 2 x 450 A**

- *i23* ultra-low loss fine pattern Trench IGBT chipset
  *i23* 超低损耗精细沟槽栅型 IGBT 芯片组
- Baseplate isolation with efficient $Al_2O_3$ ceramic
  高效 $Al_2O_3$ 绝缘陶瓷基板
- Cu baseplate for low thermal resistance
  低热阻铜底板
- Industry standard package
  行业标准封装

## Maximum ratings[1] 最大额定值 [1]

| PARAMETER<br>参数 | SYMBOL<br>符号 | CONDITIONS<br>工作条件 | MIN<br>最小值 | MAX<br>最大值 | UNIT<br>单位 |
|---|---|---|---|---|---|
| **Collector-emitter voltage**<br>集电极-发射极电压 | $V_{CES}$ | $V_{GE}$ = 0 V, $T_{vj}$ = 25 °C | | 1200 | V |
| **DC collector current** 集电极直流电流 | $I_C$ | $T_C$ = 125 °C, $T_{vj}$ = 175 °C | | 450 | A |
| **Peak collector current** 集电极峰值电流 | $I_{CM}$ | $t_p$ = 1 ms | | 900 | A |
| **Gate-emitter voltage** 栅极-发射极驱动电压 | $V_{GES}$ | | -20 | 20 | V |
| **Total power dissipation** 最大功率损耗 | $P_{tot}$ | $T_C$ = 25 °C, $T_{vj}$ = 175 °C, per switch | | 2450 | W |
| **DC forward current** 二极管直流正向电流 | $I_F$ | | | 450 | A |
| **Peak forward current** 二极管最大脉冲正向电流 | $I_{FRM}$ | $t_p$ = 1 ms | | 900 | A |
| **Surge current** 二极管最大浪涌电流 | $I_{FSM}$ | $V_R$ = 0 V, $T_{vj}$ = 150 °C, $t_p$ = 10 ms, half-sinewave | | 3000<br>45000 | A<br>$A^2s$ |
| **Isolation voltage** 绝缘电压 | $V_{isol}$ | 1 min, f = 50 Hz | | 4000 | V |
| **Junction operating temperature** 运行结温 | $T_{vj(op)}$ | | -40 | 175 | °C |
| **Case temperature** 壳温 | $T_C$ | | -40 | 125 | °C |
| **Storage temperature** 存储温度 | $T_{stg}$ | | -40 | 125 | °C |
| **Mounting torques** 紧固力矩 [2] | $M_S$ | Base-heatsink, M6 screws | 3 | 6 | Nm |
| | $M_{t1}$ | Main terminals, M6 screws | 2.5 | 5 | Nm |

[1] Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747; 根据标准 IEC 60747 要求，最大额定值表示超过该限值可能会对器件造成损坏
[2] For details, please refer to the mounting instructions. 详细信息，请参考安装说明书

## IGBT[3]

| PARAMETER<br>参数 | SYMBOL<br>符号 | CONDITIONS<br>工作条件 | | MIN<br>最小值 | TYP<br>典型 | MAX<br>最大值 | UNIT<br>单位 |
|---|---|---|---|---|---|---|---|
| **Collector(-emitter) breakdown voltage** 集电极-发射极击穿电压 | $V_{(BR)CES}$ | $V_{GE}$ = 0 V, $I_C$ = 10 mA, $T_{vj}$ = 25°C | | 1200 | | | V |
| **Collector-emitter saturation voltage** [4]<br>集电极-发射极饱和电压 | $V_{CE\ sat}$ | $I_c$ = 450 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 1.39 | 1.7 | V |
| | | | $T_{vj}$ = 125 °C | | 1.53 | | V |
| | | | $T_{vj}$ = 175 °C | | 1.61 | | V |
| **Collector cut-off current**<br>集电极截止电流 | $I_{CES}$ | $V_{CE}$ = 1200 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 1 | mA |
| | | | $T_{vj}$ = 125 °C | | 4 | | mA |
| | | | $T_{vj}$ = 175 °C | | 24 | | mA |
| **Gate leakage current** 栅极漏电流 | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = ±20 V | | -0.5 | | 0.5 | µA |
| **Gate-emitter threshold voltage**<br>栅极-发射极阈值电压 | $V_{GE(th)}$ | $I_C$ = 10 mA, $V_{CE}$ = $V_{GE}$, $T_{vj}$ = 25°C | | 5 | 6.3 | 7.0 | V |
| **Gate charge** 栅极电荷 | $Q_G$ | $I_C$ = 450 A, $V_{CE}$ = 600 V, $V_{GE}$ = -15 V .. 15 V | | | 5 | | µC |
| **Input capacitance** 输入电容 | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 100kHz, $T_{vj}$ = 25 °C | | | 78 | | nF |
| **Reverse tansfer capacitance**<br>反向传输电容 | $C_{res}$ | | | | 0.72 | | |
| **Internal gate resistor** 栅极内阻 | $R_{Gint}$ | Per switch, f = 1 MHz, $V_{GE}$ = 0V, CE short | | | 1.05 | | Ω |
| **Turn-on delay time**<br>开通延迟 | $t_{d(on)}$ | $V_{CC}$ = 600 V, $I_C$ = 450 A,<br>$R_G$ = 1 Ω, $V_{GE}$ = ± 15 V,<br>$L_s$ = 35 nH, inductive load | $T_{vj}$ = 25 °C | | 344 | | ns |
| | | | $T_{vj}$ = 125 °C | | 355 | | |
| | | | $T_{vj}$ = 175 °C | | 360 | | |
| **Rise time**<br>上升时间 | $t_r$ | | $T_{vj}$ = 25 °C | | 62 | | |
| | | | $T_{vj}$ = 125 °C | | 72 | | |
| | | | $T_{vj}$ = 175 °C | | 77 | | |
| **Turn-off delay time**<br>关断延迟 | $t_{d(off)}$ | $V_{CC}$ = 600 V, $I_C$ = 450 A,<br>$R_G$ = 1 Ω, $V_{GE}$ = ± 15 V,<br>$L_s$ = 35 nH, inductive load | $T_{vj}$ = 25 °C | | 356 | | ns |
| | | | $T_{vj}$ = 125 °C | | 426 | | |
| | | | $T_{vj}$ = 175 °C | | 462 | | |
| **Fall time**<br>下降时间 | $t_f$ | | $T_{vj}$ = 25 °C | | 231 | | |
| | | | $T_{vj}$ = 125 °C | | 338 | | |
| | | | $T_{vj}$ = 175 °C | | 395 | | |
| **Turn-on switching energy**<br>开通损耗 | $E_{on}$ | $V_{CC}$ = 600 V, $I_C$ = 450 A,<br>$R_G$ = 1 Ω, $V_{GE}$ = ± 15 V,<br>$L_s$ = 35 nH, inductive load | $T_{vj}$ = 25 °C | | 44 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 62 | | |
| | | | $T_{vj}$ = 175 °C | | 73 | | |
| **Turn-off switching energy**<br>关断损耗 | $E_{off}$ | $V_{CC}$ = 600 V, $I_C$ = 450 A,<br>$R_G$ = 1 Ω, $V_{GE}$ = ± 15 V,<br>$L_s$ = 35 nH, inductive load | $T_{vj}$ = 25 °C | | 41 | | |
| | | | $T_{vj}$ = 125 °C | | 56 | | |
| | | | $T_{vj}$ = 175 °C | | 64 | | |
| **Short circuit current**<br>短路电流 | $I_{SC}$ | $t_{pcs}$ ≤ 8 µs, $V_{GE}$ = 15 V, $T_{vj}$ = 175 °C,<br>$V_{CC}$ = 800 V, $V_{CEM\ Chip}$ ≤ 1200 V | | | 3200 | | A |

[3] Characteristic values according to IEC 60747-9
[4] Collector-emitter saturation voltage is given at chip-level 集电极-发射极饱和电压

## Diode[5]

| PARAMETER<br>参数 | SYMBOL<br>符号 | CONDITIONS<br>工作条件 | | MIN<br>最小值 | TYP<br>典型 | MAX<br>最大值 | UNIT<br>单位 |
|---|---|---|---|---|---|---|---|
| **Forward voltage**[6]<br>正向压降 | $V_F$ | $I_F$ = 450 A | $T_{vj}$ = 25 °C | | 1.56 | 1.9 | V |
| | | | $T_{vj}$ = 125 °C | | 1.58 | | V |
| | | | $T_{vj}$ = 175 °C | | 1.51 | | V |
| **Peak reverse recovery current**<br>反向恢复电流峰值 | $I_{RM}$ | $V_R$ = 600 V, $I_F$ = 450 A, dI/dt = 6036 A/µs (175 °C), $R_G$ = 1 Ω, $V_{GE}$ = ± 15 V, $L_s$ = 35 nH, inductive load | $T_{vj}$ = 25 °C | | 422 | | A |
| | | | $T_{vj}$ = 125 °C | | 473 | | A |
| | | | $T_{vj}$ = 175 °C | | 511 | | A |
| **Recovery charge**<br>恢复电荷 | $Q_{rr}$ | | $T_{vj}$ = 25 °C | | 53 | | µC |
| | | | $T_{vj}$ = 125 °C | | 89 | | µC |
| | | | $T_{vj}$ = 175 °C | | 112 | | µC |
| **Reverse recovery time**<br>反向恢复时间 | $t_{rr}$ | | $T_{vj}$ = 25 °C | | 602 | | ns |
| | | | $T_{vj}$ = 125 °C | | 716 | | ns |
| | | | $T_{vj}$ = 175 °C | | 852 | | ns |
| **Reverse recovery energy**<br>反向恢复能量 | $E_{rec}$ | | $T_{vj}$ = 25 °C | | 19 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 33 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 42 | | mJ |

## Package properties 封装特性 [7]

| PARAMETER<br>参数 | SYMBOL<br>符号 | CONDITIONS<br>工作条件 | | MIN<br>最小值 | TYP<br>典型 | MAX<br>最大值 | UNIT<br>单位 |
|---|---|---|---|---|---|---|---|
| **IGBT thermal resistance junction to case IGBT** 结-壳热阻 | $R_{th(j-c)IGBT}$ | Per switch | | | | 0.061 | K/W |
| **Diode thermal resistance junction to case** 二极管结-壳热阻 | $R_{th(j-c)Diode}$ | | | | | 0.102 | K/W |
| **IGBT thermal resistance case to heatsink IGBT** 壳到散热器热阻 | $R_{th(c-s)IGBT}$ | IGBT per switch, lambda grease = 1 W/m x K | | | 0.032 | | K/W |
| **Diode thermal resistance case to heatsink** 二极管壳到散热器热阻 | $R_{th(c-s)Diode}$ | diode per switch, lambda grease = 1 W/m x K | | | 0.039 | | K/W |
| **Comparative tracking index**<br>相对漏电起痕指数 | CTI | | | >400 | | | |
| **Module stray inductance**<br>模块自身杂散电感 | $L_{s\,CE}$ | Per switch | | | 20 | | nH |
| **Resistance, terminal chip**<br>端子到芯片之间的阻抗 | $R_{CC'+EE'}$ | Per switch | $T_{vj}$ = 25 °C | | 0.7 | | mΩ |
| | | | $T_{vj}$ = 125 °C | | | | |
| | | | $T_{vj}$ = 175 °C | | | | |

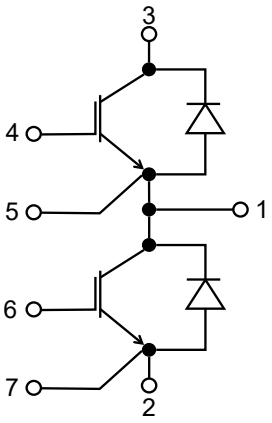
[5] Characteristic values according to IEC 60747-2
[6] Forward voltage is given at chip-level 正向压降是芯片两端的电压值。
[7] Package and mechanical properties according to IEC 60747-15

## Mechanical properties 机械特性 [8]

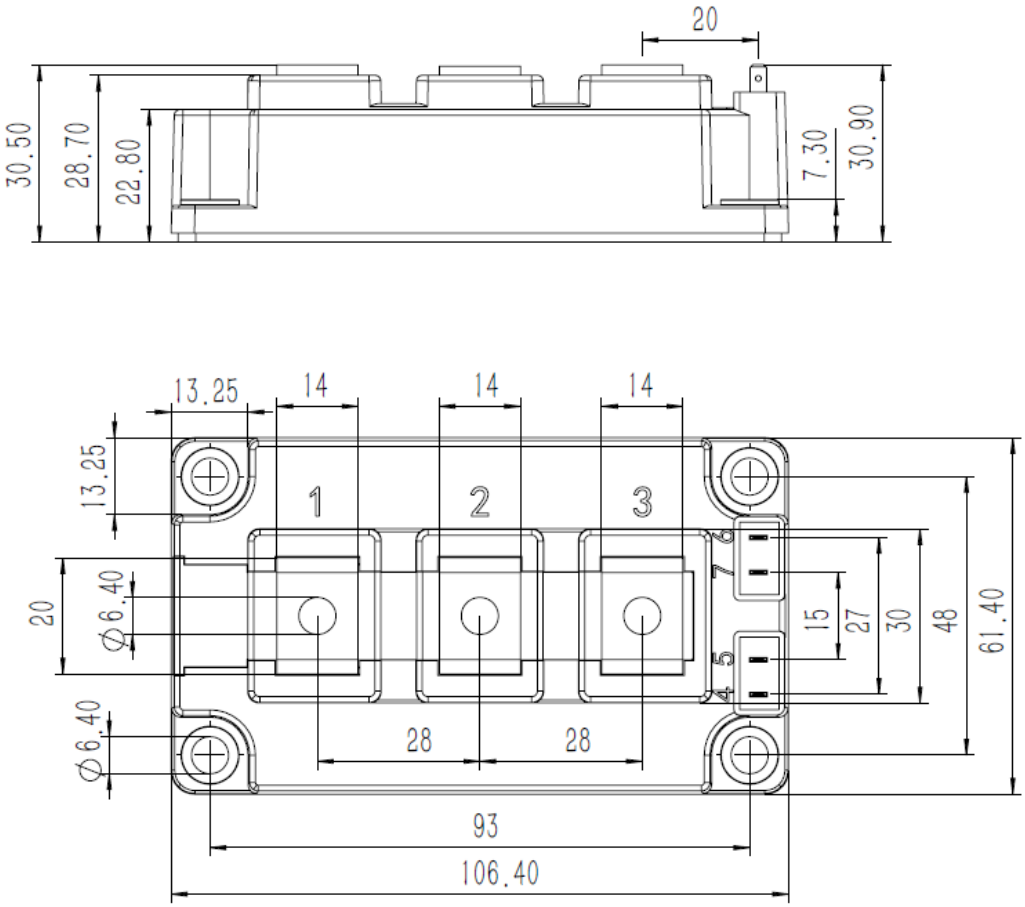
| PARAMETER<br>参数 | SYMBOL<br>符号 | CONDITIONS<br>工作条件 | | MIN<br>最小值 | TYP<br>典型 | MAX<br>最大值 | UNIT<br>单位 |
|---|---|---|---|---|---|---|---|
| **Dimensions** | L x W x H | Typical | | | 106 x 62 x 30.9 | | $mm^3$ |
| **Clearance distance in air**<br>电气间隙 | da | According to IEC 60664-1 and EN 50124-1<br>参考标准 IEC 60664-1 和 EN 50124-1 | Terminal to base:<br>端子到基板 | | 23 | | mm |
| | | | Terminal to terminal:<br>端子到端子 | | 11 | | |
| **Surface creepage distance**<br>爬电距离 | ds | | Terminal to base:<br>端子到基板 | | 29 | | mm |
| | | | Terminal to terminal:<br>端子到端子 | | 23 | | |
| **Mass** 重量 | m | | | | 310 | | g |

[8] Package and mechanical properties according to IEC 60747-15

## Electrical configuration 电气图



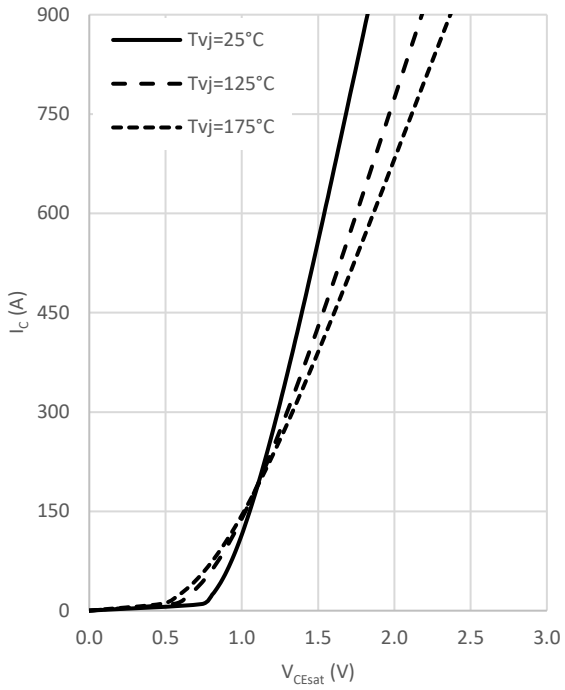

## Outline drawing 外形图



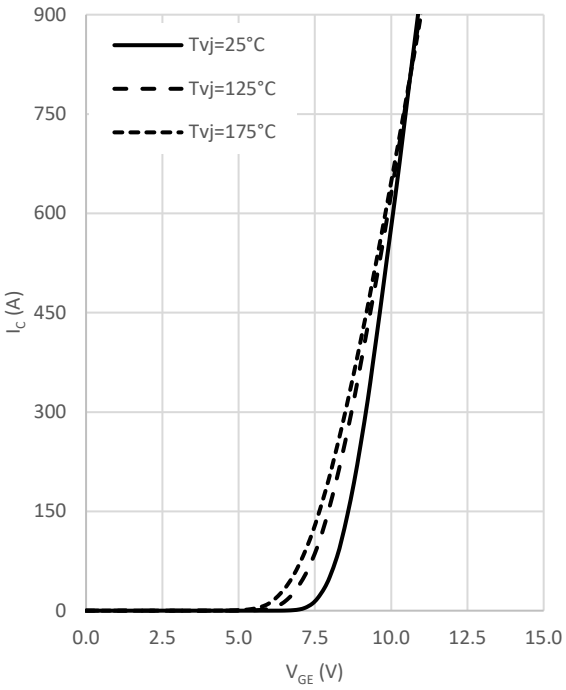

This is an electrocstatic sensitive device, please observe the international standard. 本产品对静电特别敏感.
*This product has been designed and qualified for Industrial Level. 本产品的设计符合工业级标准.*

## Characteristics 特性曲线

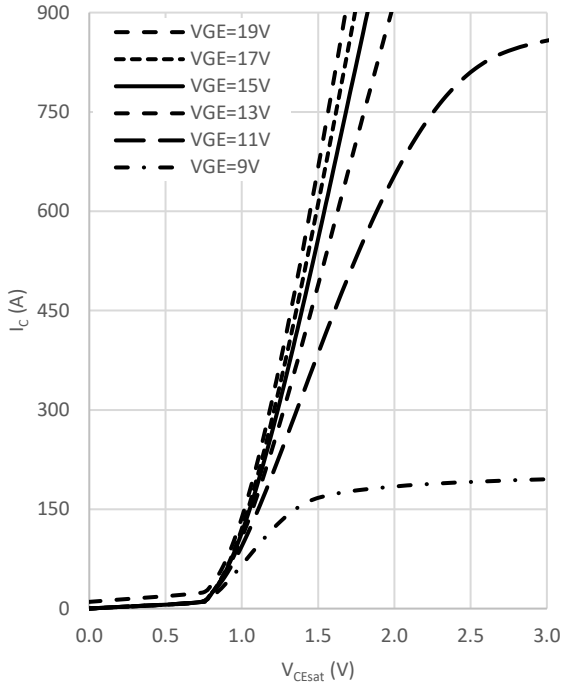
**IGBT on-state characteristics (typical)**
**IGBT 通态特性曲线（典型）**
$I_C = f(V_{CE})$
$V_{GE}$ = 15 V



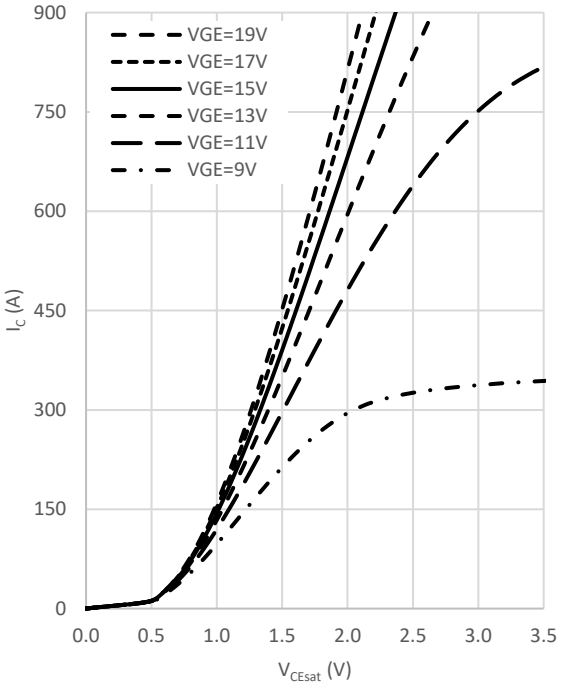

**IGBT transfer characteristics (typical)**
**IGBT 转移特性曲线（典型）**
$I_C = f(V_{GE})$
$V_{CE}$ = 20 V



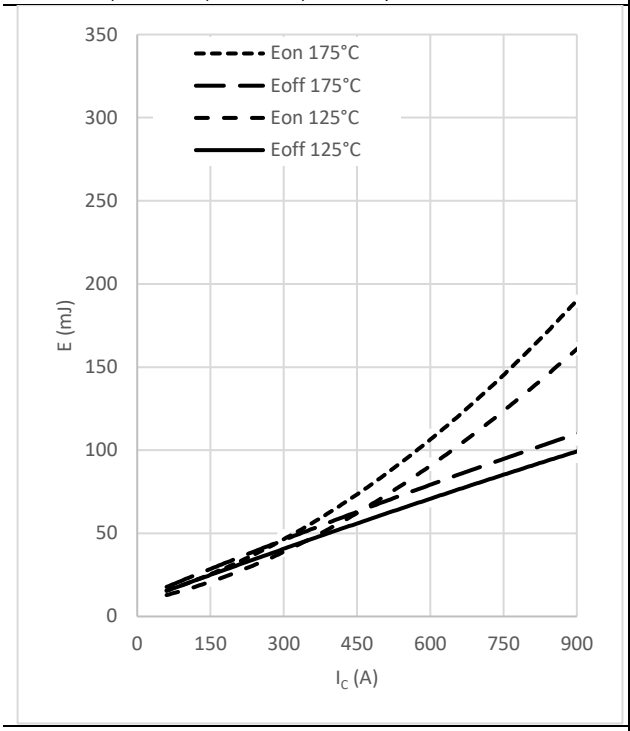

**IGBT output characteristics (typical)**
**IGBT 输出特性曲线（典型）**
$I_C = f(V_{CE})$
$T_{vj}$ = 25 °C



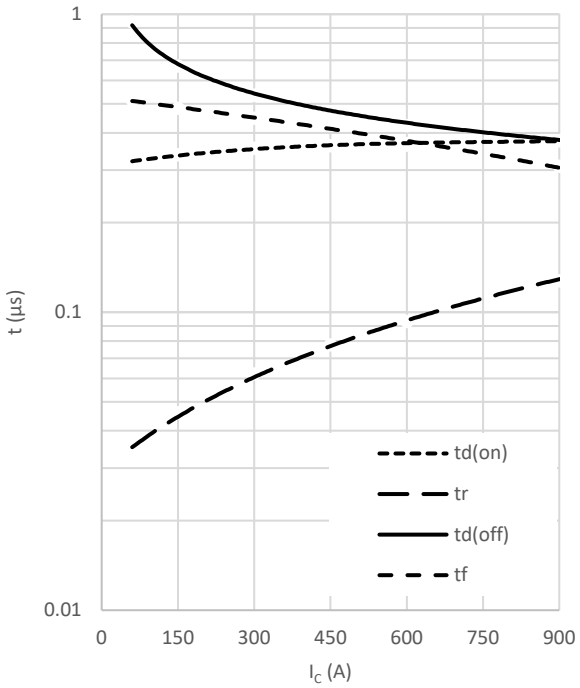

**IGBT output characteristics (typical)**
**IGBT 输出特性曲线（典型）**
$I_C = f(V_{CE})$
$T_{vj}$ = 175 °C



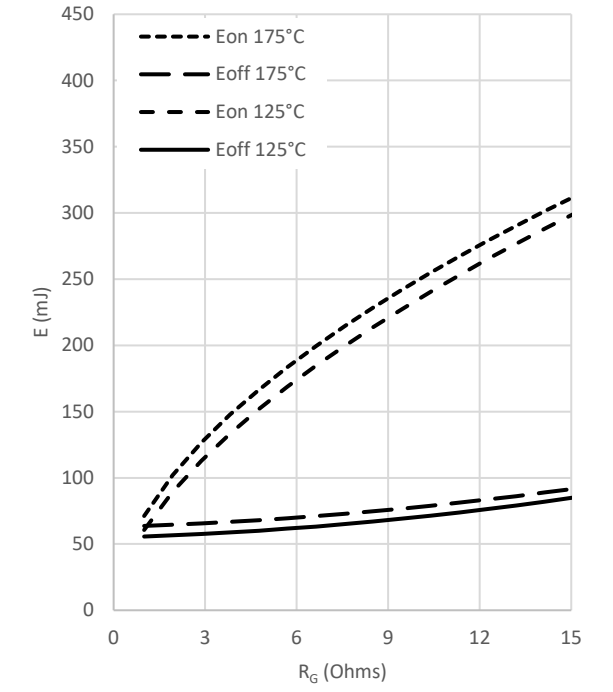
**IGBT switching losses (typical)**
**IGBT 开关损耗曲线（典型）**
E = f($I_{CE}$)
$V_{CE}$ = 600 V, $R_{Gon}$ = 1 Ω, $R_{Goff}$ = 1 Ω, $V_{GE}$ = -15/+15 V



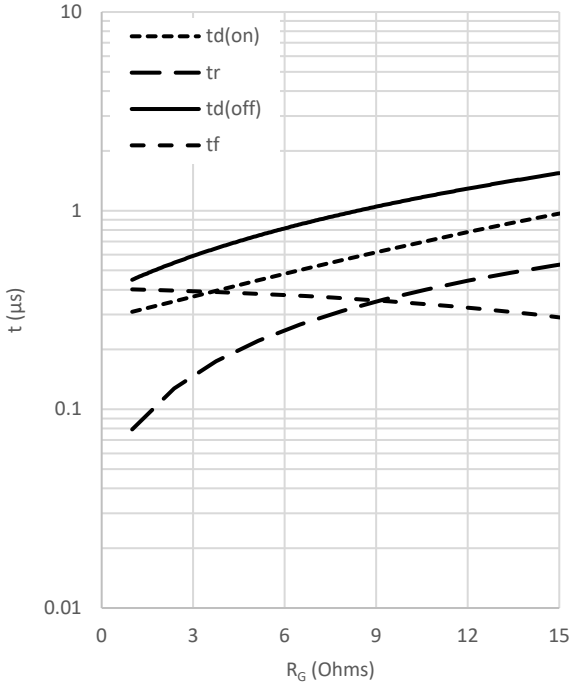

**IGBT switching times (typical)**
**IGBT 开关时间曲线（典型）**
t = f($I_{CE}$), $T_{vj}$ = 175 °C
$V_{CE}$ = 600 V, $R_{Gon}$ = 1 Ω, $R_{Goff}$ = 1 Ω, $V_{GE}$ =-15/+15 V



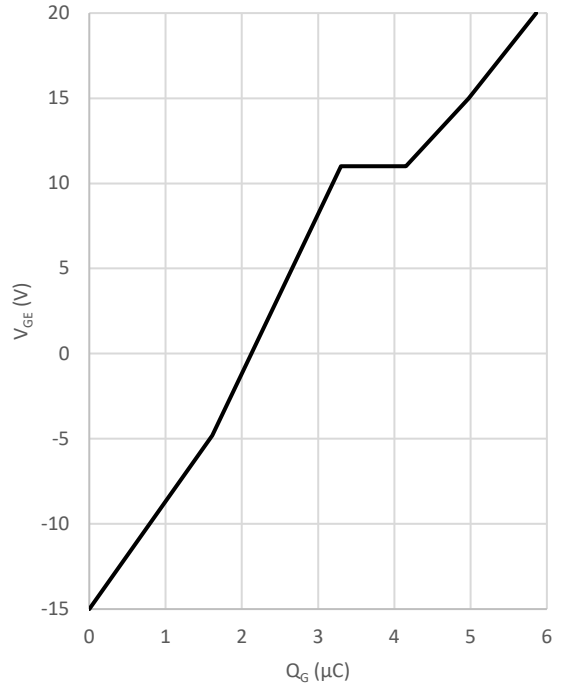

**IGBT switching losses (typical)**
**IGBT 开关损耗曲线（典型）**
E = f($R_G$)
$V_{CE}$ = 600 V, $I_C$ = 450 A, $V_{GE}$ = -15/+15 V



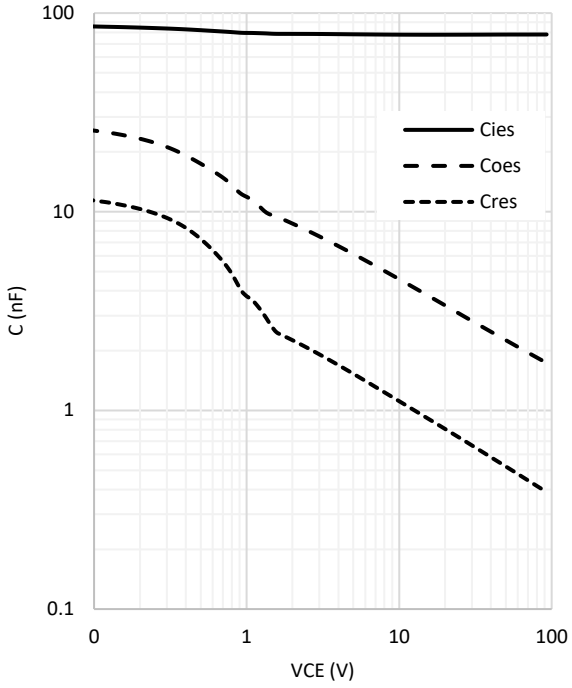

**IGBT switching times (typical)**
**IGBT 开关时间曲线（典型）**
t = f($R_G$), $T_{vj}$ = 175 °C
$V_{CE}$ = 600 V, $I_C$ = 450 A, $V_{GE}$ = -15/+15 V



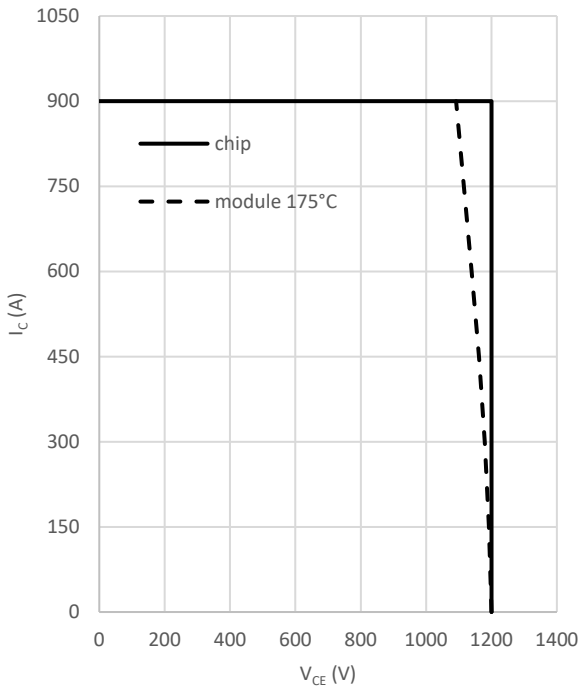
**IGBT gate charge (typical)**
**IGBT 门极电荷（典型）**
$V_{GE} = f(Q_G)$, $T_{vj} = 25$ °C
$V_{CE} = 600$ V, $I_C = 450$ A



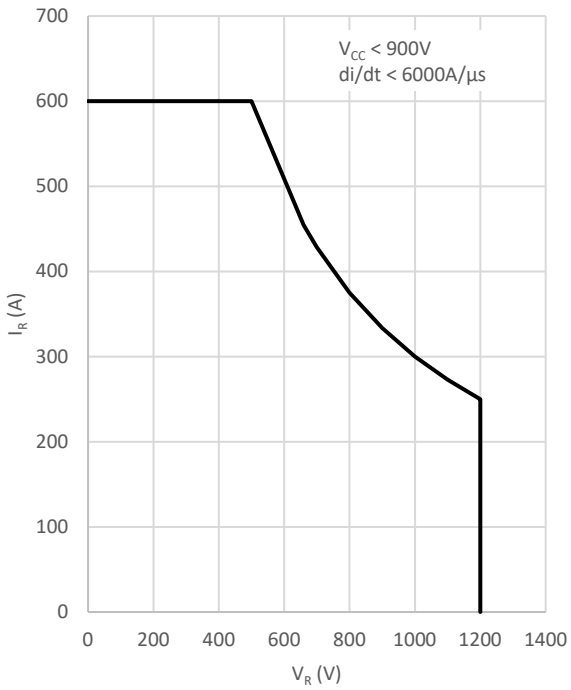

**Capacitance characteristics (typical)**
**电容特性曲线（典型）**
$C = f(V_{CE})$, $T_{vj} = 25$ °C
$f = 100$ kHz, $V_{GE} = 0$ V



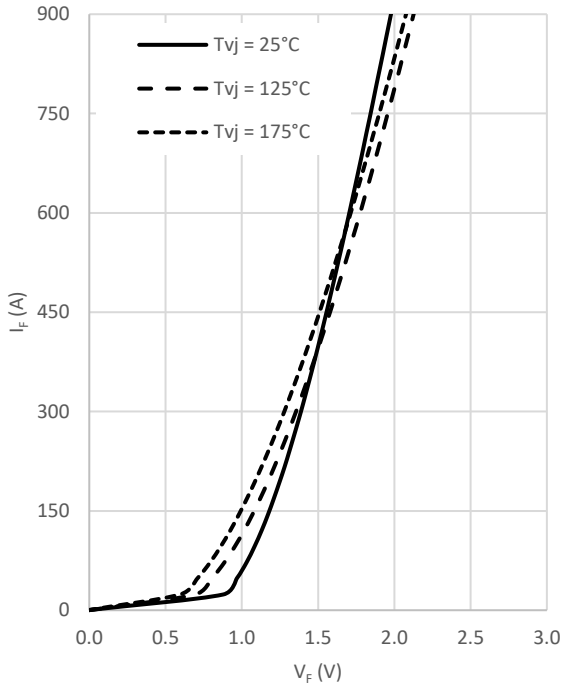

**IGBT RBSOA**
**IGBT 反偏安全工作区域**
$I_C = f(V_{CEm})$
$R_{Goff} = 1\ \Omega$, $V_{GE} = \pm 15$ V



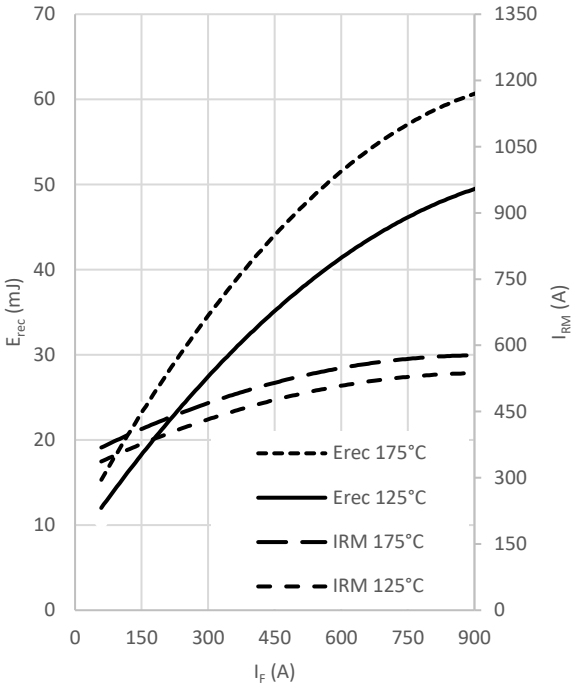

**Diode SOA**
**Diode 反偏安全工作区域**
$T_{vj} \leq 175$ °C



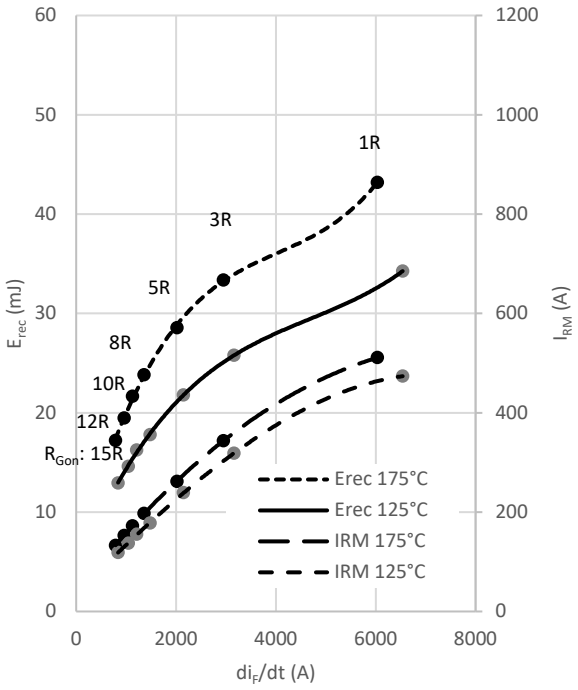
**Diode forward characteristic (typical)**
**二极管正向特性（典型）**
$I_F = f(V_F)$




**Diode switching characteristics (typical)**
**二极管开关特性（典型）**
$E_{rec} = f(I_F)$, $I_{RM} = f(I_F)$
$V_{DC}$ = 600 V, $R_{Gon}$ =1Ω (IGBT), $V_{GE}$ =-15/+15 V (IGBT)




**Diode switching characteristics (typical)**
**二极管开关特性（典型）**
$E_{rec} = f(di/dt)$, $I_{RM} = f(di/dt)$
$V_{DC}$ = 600 V, $I_F$ = 450 A, $V_{GE}$ =-15/+15 V (IGBT)




**Thermal impedance (typical)**
**热阻抗（典型）**
$Z_{th(j-c)} = f(t)$

