# DATASHEET 规格书

# SISD0450ED120i23_D01

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



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

- *i23* ultra-low loss micro pattern Trench IGBT chip-set
  *i23* 超低损耗微沟槽栅 IGBT 芯片组
- Baseplate isolation with reinforced $Al_2O_3$ ceramic
  加强 $Al_2O_3$ 绝缘陶瓷基板
- Cu baseplate for low thermal resistance
  低热阻铜底板
- Improved Package with reduced internal impedance and terminal heating
  采用改进封装技术，显著降低内部阻抗与接线端温升
- Enhanced diode performance for regenerative power flow
  增强二极管性能以更好适配能量再生应用

## 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 | $I_C$ | $T_C$ = 110 °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 | | 2300 | W |
| **DC forward current** 二极管直流正向电流 | $I_F$ | | | 600 | A |
| **Peak forward current** 二极管最大脉冲正向电流 | $I_{FRM}$ | $t_p$ = 1 ms | | 1200 | A |
| **Surge current** 二极管最大浪涌电流 | $I_{FSM}$<br>$I^2t$ | $V_R$ = 0 V, $T_{vj}$ = 150 °C, $t_p$ = 10 ms, half-sinewave | | 2000<br>20000 | A<br>$A^2s$ |
| **Isolation voltage** 绝缘电压 | $V_{isol}$ | 1 min, f = 50 Hz | | 3400 | V |
| **Junction operating temperature** 运行结温 | $T_{vj(op)}$ | | -40 | 175 | °C |
| **Case temperature** 壳温 | $T_C$ | | -40 | 125[2] | °C |
| **Storage temperature** 存储温度 | $T_{stg}$ | | -40 | 125 | °C |
| **Mounting torques** 紧固力矩[3] | $M_S$ | Base-heatsink, M5 screws | 3 | 6 | Nm |
| | $M_{t1}$ | Main terminals, M6 screws | 3 | 6 | Nm |

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[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 UL1557 compliance $T_{Cmax}$ must be limited to 125°C; UL1557 标准中要求，最大壳温不能超过 125℃

[3] For details, please refer to the mounting instructions. 详细信息，请参考安装说明书

## IGBT[4]

| 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** [5]<br>集电极-发射极饱和电压 | $V_{CEsat}$ | $I_c$ = 450 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 1.55 | 1.85 | V |
| | | | $T_{vj}$ = 125 °C | | 1.75 | | V |
| | | | $T_{vj}$ = 175 °C | | 1.85 | | 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 | | 1.5 | | mA |
| | | | $T_{vj}$ = 175 °C | | 13 | | 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 | $V_{GE(th)}$ | $I_C$ = 22 mA, $V_{CE}$ = $V_{GE}$, $T_{vj}$ = 25°C | | 5 | 6.3 | 7.5 | V |
| **Gate charge** 栅极电荷 | $Q_G$ | $I_C$ = 450 A, $V_{CE}$ = 600 V, $V_{GE}$ = -15 V .. 15 V | | | 3.75 | | µC |
| **Input capacitance** 输入电容 | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 100 kHz, $T_{vj}$ = 25 °C | | | 58 | | nF |
| **Reverse tansfer capacitance**<br>反向传输电容 | $C_{res}$ | | | | 0.54 | | nF |
| **Internal gate resistor** 栅极内阻 | $R_{Gint}$ | Per switch | | | 1.1 | | 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 | | 148 | | ns |
| | | | $T_{vj}$ = 125 °C | | 170 | | ns |
| | | | $T_{vj}$ = 175 °C | | 180 | | ns |
| **Rise time**<br>上升时间 | $t_r$ | | $T_{vj}$ = 25 °C | | 60 | | ns |
| | | | $T_{vj}$ = 125 °C | | 70 | | ns |
| | | | $T_{vj}$ = 175 °C | | 75 | | ns |
| **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 | | 297 | | ns |
| | | | $T_{vj}$ = 125 °C | | 364 | | ns |
| | | | $T_{vj}$ = 175 °C | | 393 | | ns |
| **Fall time**<br>下降时间 | $t_f$ | | $T_{vj}$ = 25 °C | | 265 | | ns |
| | | | $T_{vj}$ = 125 °C | | 379 | | ns |
| | | | $T_{vj}$ = 175 °C | | 435 | | ns |
| **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 | | 46 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 70 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 84 | | mJ |
| **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 | | 44 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 60 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 67 | | mJ |
| **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 | | | 2100 | | A |

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

## Diode[6]

| 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**[7]<br>正向压降 | $V_F$ | $I_F$ = 450 A | $T_{vj}$ = 25 °C | | 1.5 | 1.9 | V |
| | | | $T_{vj}$ = 125 °C | | 1.5 | | V |
| | | | $T_{vj}$ = 175 °C | | 1.45 | | V |
| **Peak reverse recovery current**<br>反向恢复电流峰值 | $I_{RM}$ | $V_R$ = 600 V, $I_F$ = 450 A,<br>dI/dt = 6000 A/µs (175°C),<br>$R_G$ = 1 Ω, $V_{GE}$ = ± 15 V,<br>$L_s$ = 35 nH, inductive load | $T_{vj}$ = 25 °C | | 370 | | A |
| | | | $T_{vj}$ = 125 °C | | 423 | | A |
| | | | $T_{vj}$ = 175 °C | | 454 | | A |
| **Recovery charge**<br>恢复电荷 | $Q_{rr}$ | | $T_{vj}$ = 25 °C | | 59 | | µC |
| | | | $T_{vj}$ = 125 °C | | 100 | | µC |
| | | | $T_{vj}$ = 175 °C | | 126 | | µC |
| **Reverse recovery time**<br>反向恢复时间 | $t_{rr}$ | | $T_{vj}$ = 25 °C | | 680 | | ns |
| | | | $T_{vj}$ = 125 °C | | 736 | | ns |
| | | | $T_{vj}$ = 175 °C | | 865 | | ns |
| **Reverse recovery energy**<br>反向恢复能量 | $E_{rec}$ | | $T_{vj}$ = 25 °C | | 25 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 39 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 48 | | mJ |

## NTC Thermistor

| 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 |
|---|---|---|---|---|---|---|
| **Rated resistance** 额定电阻 | $R_{25}$ | $T_C$ = 25 °C | | 5 | | kΩ |
| **R100** | $R_{100}$ | $T_C$ = 100 °C | 468 | | 518 | Ω |
| **B-value** B 值 | $B_{25/50}$ | $R_2 = R_{25} \exp [B_{25/50}(1/T2 - 1/(298.15K))]$ | | 3375 | | K |
| **B-value** B 值 | $B_{25/100}$ | $R_2 = R_{25} \exp [B_{25/100}(1/T2 - 1/(298.15K))]$ | | 3433 | | K |

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

## Package properties 封装特性[8]

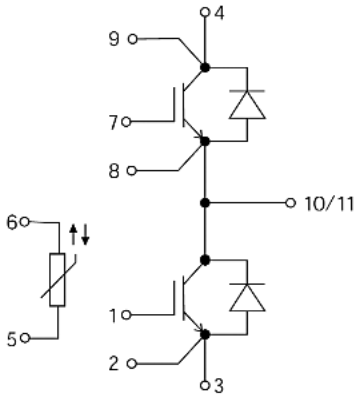
| PARAMETER<br>参数 | SYMBOL<br>符号 | CONDITIONS<br>工作条件 | | MIN<br>最小值 | TYP<br>典型 | MAX<br>最大值 | UNIT<br>单位 |
|---|---|---|---|---|---|---|---|
| **IGBT thermal resistance junction to case IGBT** 结-壳热阻 | $R_{th(j-c)IGBT}$ | Per switch<br>每一个开关 | | | | 0.064 | K/W |
| **Diode thermal resistance junction to case** 二极管结-壳热阻 | $R_{th(j-c)Diode}$ | | | | | 0.084 | K/W |
| **IGBT thermal resistance case to heatsink IGBT** 壳到散热器热阻 | $R_{th(c-s)IGBT}$ | IGBT per switch<br>IGBT 每一个开关 | | | 0.035 | | 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<br>二极管每一个开关 | | | 0.038 | | K/W |
| **Comparative tracking index**<br>相对漏电起痕指数 | CTI | | | 200 | | | |
| **Module stray inductance**<br>模块自身杂散电感 | $L_{s\,CE}$ | Per switch<br>每一个开关 | | | 16 | | nH |
| **Resistance, terminal chip**<br>端子到芯片之间的阻抗 | $R_{CC'+EE'}$ | Per switch<br>每一个开关 | $T_{vj}$ = 25 °C | | 0.75 | | mΩ |
| | | | $T_{vj}$ = 125 °C | | 1.05 | | mΩ |
| | | | $T_{vj}$ = 175 °C | | 1.15 | | mΩ |
| **Maximum RMS DC-Terminal current** 最大端子电流 | $I_{Term\,RMS}$ | | $T_{Terminal}$ = 90°C | | 580 | | A |
| | | | $T_{Terminal}$ = 105°C | | 565 | | A |

## Mechanical properties 机械特性

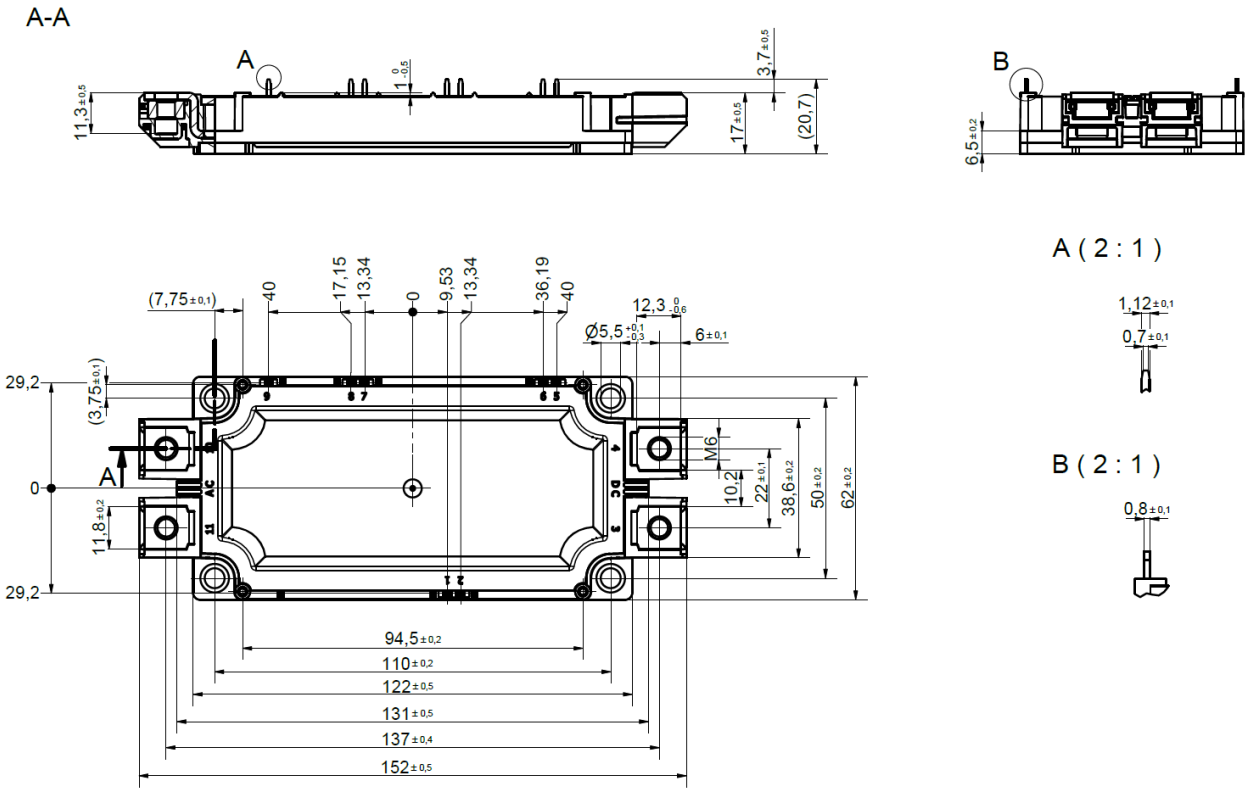
| PARAMETER<br>参数 | SYMBOL<br>符号 | CONDITIONS<br>工作条件 | | MIN<br>最小值 | TYP<br>典型 | MAX<br>最大值 | UNIT<br>单位 |
|---|---|---|---|---|---|---|---|
| **Dimensions** | L x W x H | Typical | | 152 x 62 x 17 | | | $mm^3$ |
| **Clearance distance in air**<br>电气间隙 | $d_a$ | According to IEC 60664-1 and EN 50124-1<br>参考标准 IEC 60664-1 和 EN 50124-1 | Terminal to base:<br>端子到基板 | 12.5 | | | mm |
| | | | Terminal to terminal:<br>端子到端子 | 10 | | | mm |
| **Surface creepage distance**<br>爬电距离 | $d_s$ | 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 | 15 | | | mm |
| | | | Terminal to terminal:<br>端子到端子 | 13 | | | mm |
| **Mass** 重量 | m | | | | 350 | | g |

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

## Electrical configuration 电气图



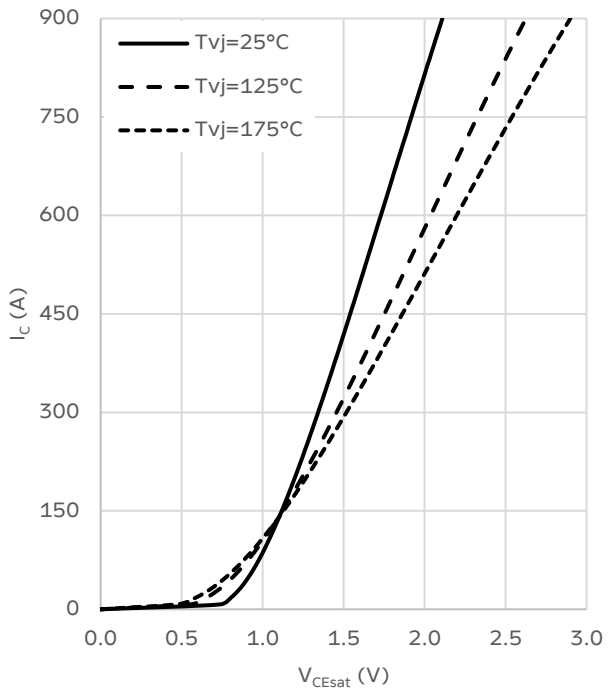

## Outline drawing 外形图



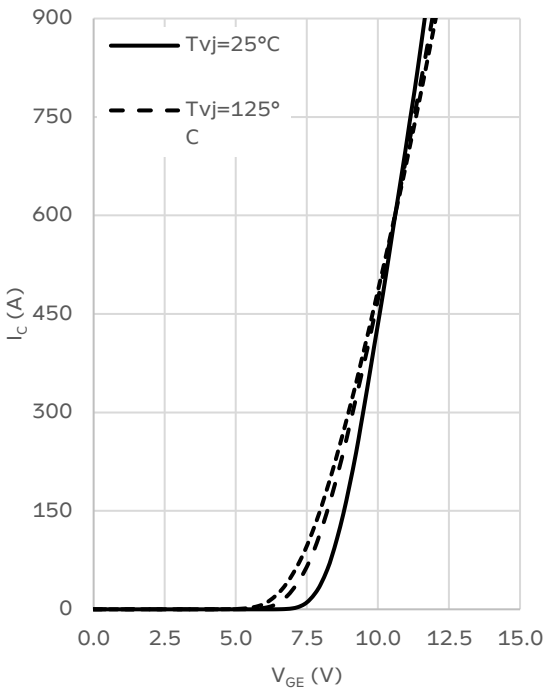

This is an electrocstatic sensitive device. 本产品对静电特别敏感.
*This product has been designed and qualified for Industrial Level. 本产品的设计符合工业级标准.*

## Characteristics 特性曲线

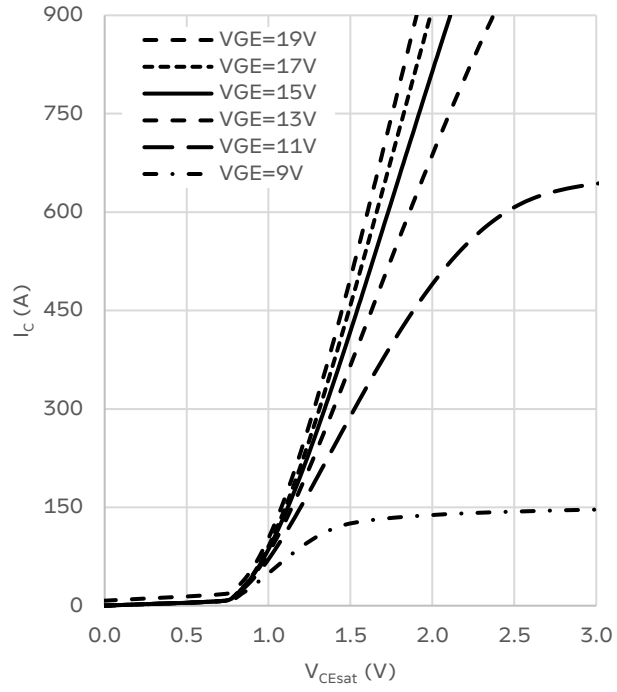
**IGBT on-state characteristics (typical)**
**IGBT 通态特性曲线（典型）**
$I_C = f(V_{CE})$
$V_{GE}$ = 15 V



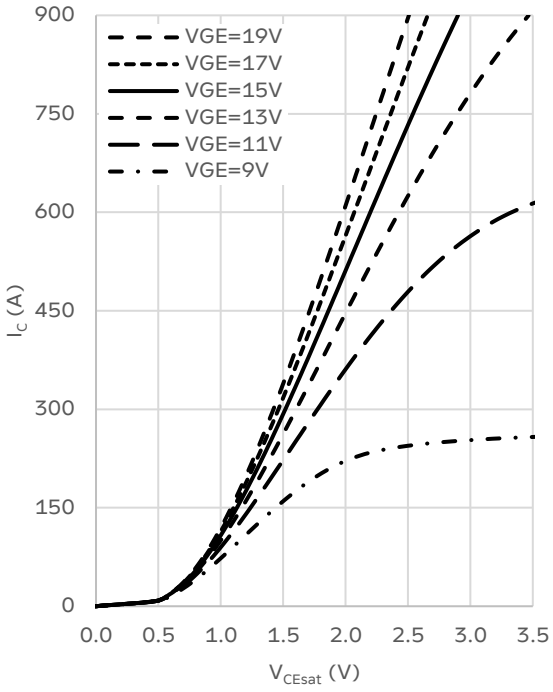

**IGBT transfer characteristics (typical)**
**IGBT 转移特性曲线（典型）**
$I_C = f(V_{GE})$
$V_{CE}$ = 20V



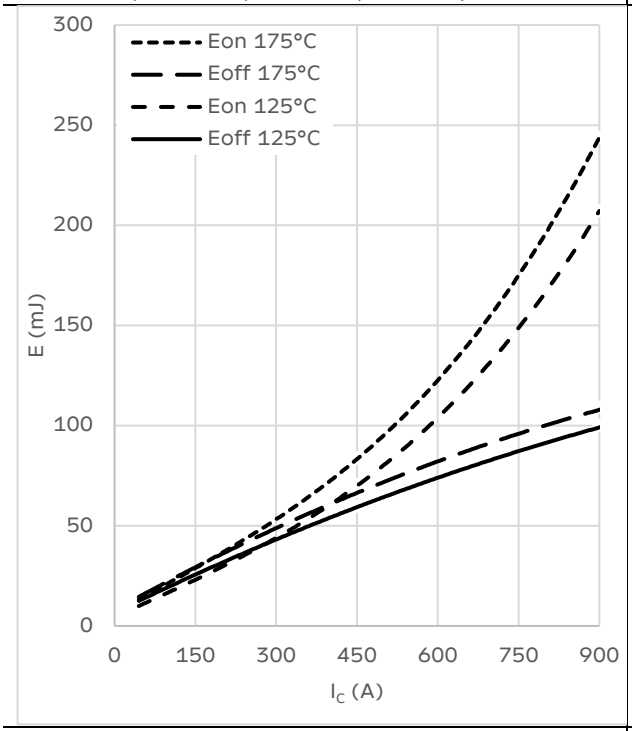

**IGBT output characteristics (typical)**
**IGBT 输出特性曲线（典型）**
$I_C = f(V_{CE})$
$T_{vj}$ = 25 °C



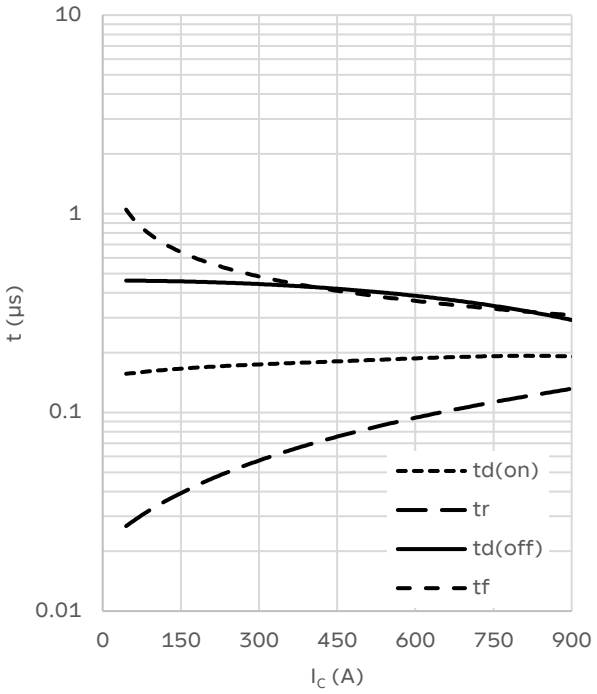

**IGBT output characteristics (typical)**
**IGBT 输出特性曲线（典型）**
$I_C = f(V_{CE})$
$T_{vj}$ = 175 °C



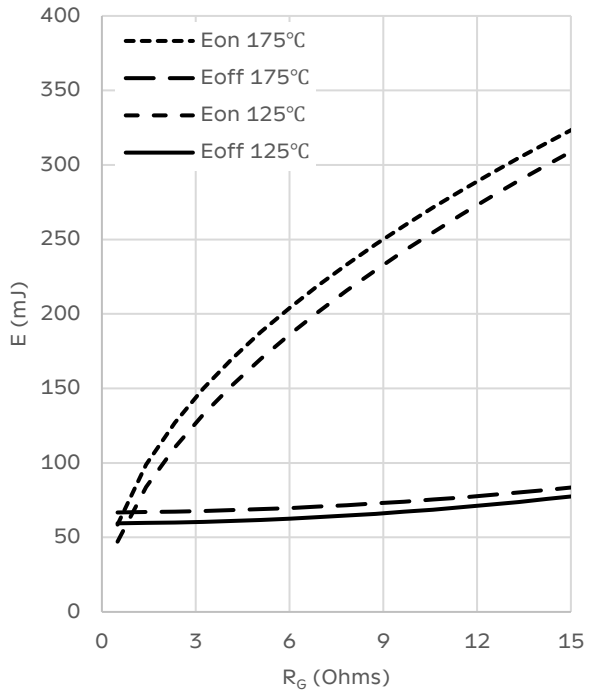
**IGBT switching losses (typical)**
**IGBT 开关损耗曲线（典型）**
$E = f(I_{CE})$
$V_{CE}$ = 600 V, $R_{Gon}$ = 1 Ω, $R_{Goff}$ = 1 Ω, $V_{GE}$ = -15/+15 V



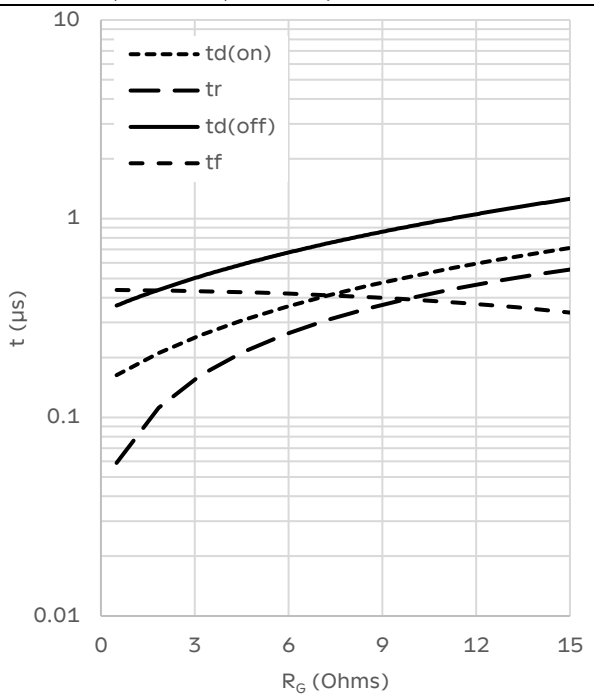

**IGBT switching times (typical)**
**IGBT 开关时间曲线（典型）**
$t = f(I_{CE})$, $T_{vj}$ = 175 °C
$V_{CE}$ = 600 V, $R_{Gon}$ = 1 Ω, $R_{Goff}$ = 3 Ω, $V_{GE}$ =-15/+15 V



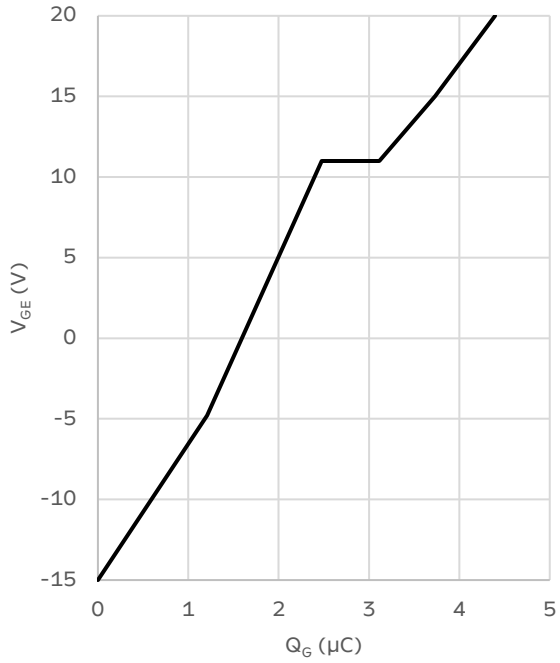

**IGBT switching losses (typical)**
**IGBT 开关损耗曲线（典型）**
$E = f(R_G)$
$V_{CE}$ = 600 V, $I_C$ = 450 A, $V_{GE}$ = -15/+15 V



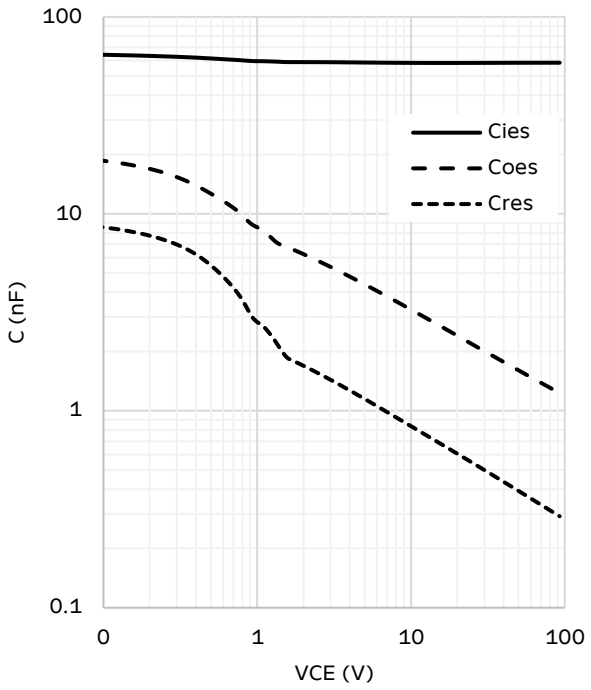

**IGBT switching times (typical)**
**IGBT 开关时间曲线（典型）**
$t = f(R_G)$, $T_{vj}$ = 175 °C
$V_{CE}$ = 600 V, $I_C$ = 450 A, $V_{GE}$ = -15/+15 V



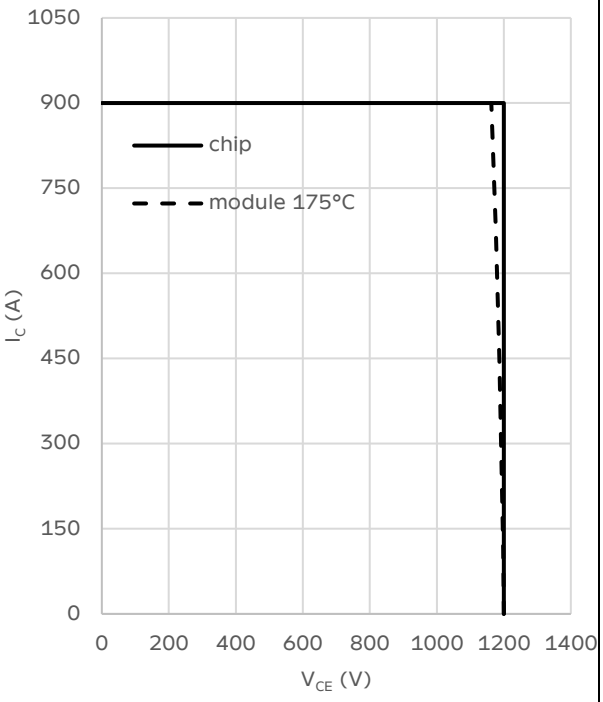
**IGBT gate charge (typical)**
**IGBT 门极电荷（典型）**
$V_{GE} = f(Q_G)$, $T_{vj} = 25$ °C
$V_{CE} = 600$ V, $I_C = 450$ A



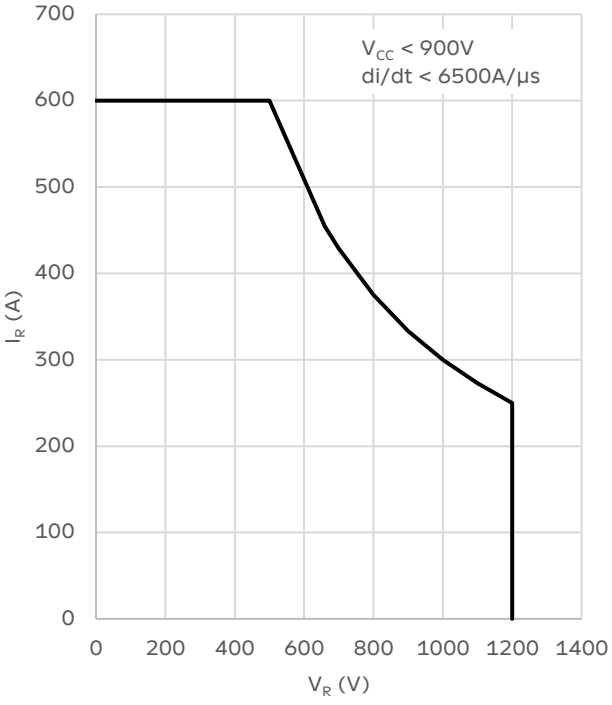

**Capacitance characteristics (typical)**
**电容特性曲线（典型）**
$C = f(V_{CE})$, $T_{vj} = 25$ °C
$f = 100$ kHz, $V_{GE} = 0$ V



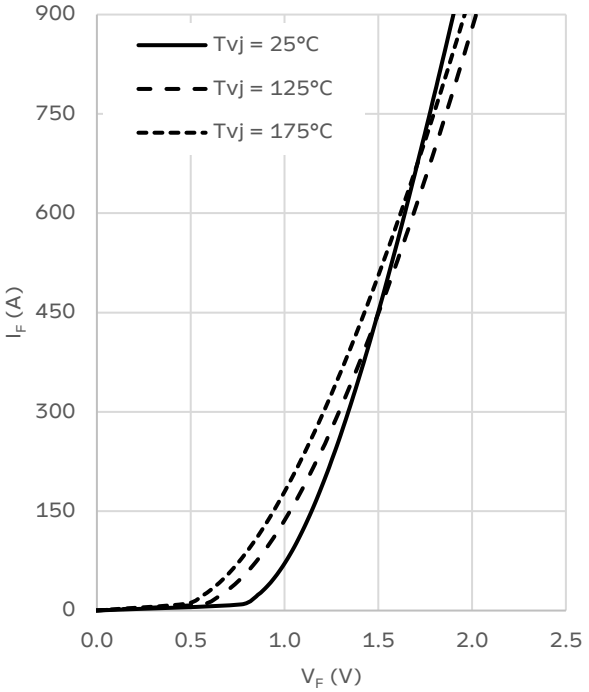

**IGBT RBSOA**
**IGBT 反偏安全工作区域**
$I_C = f(V_{CEm})$
$R_{Goff} = 1\ \Omega$, $V_{GE} = \pm 15$ V



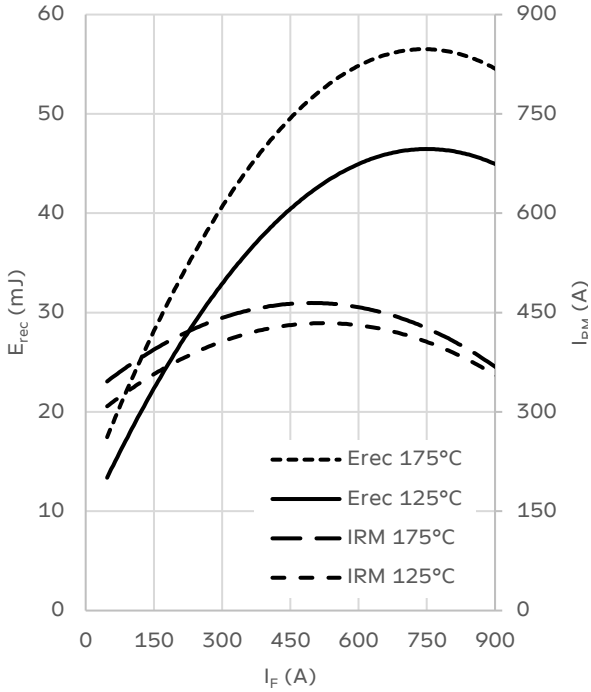

**Diode SOA**
**Diode 反偏安全工作区域**
$T_{vj} \leq 175$ °C



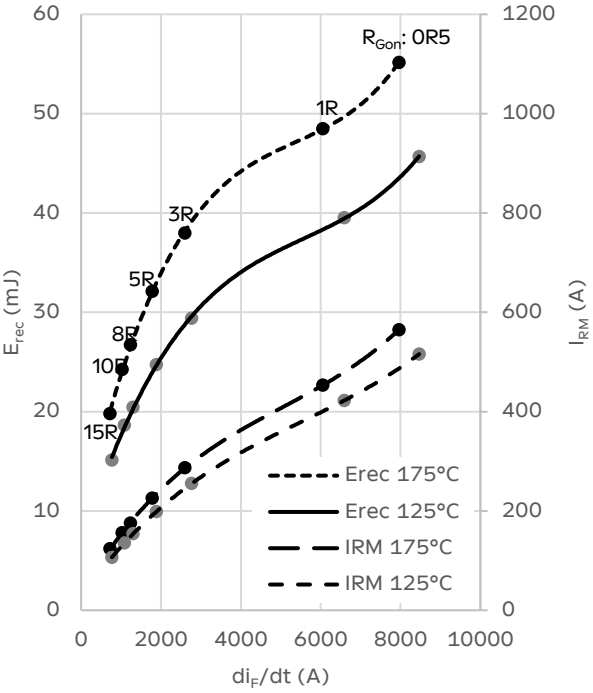
**Diode forward characteristic (typical)**
**二极管正向特性（典型）**
$I_F = f(V_F)$



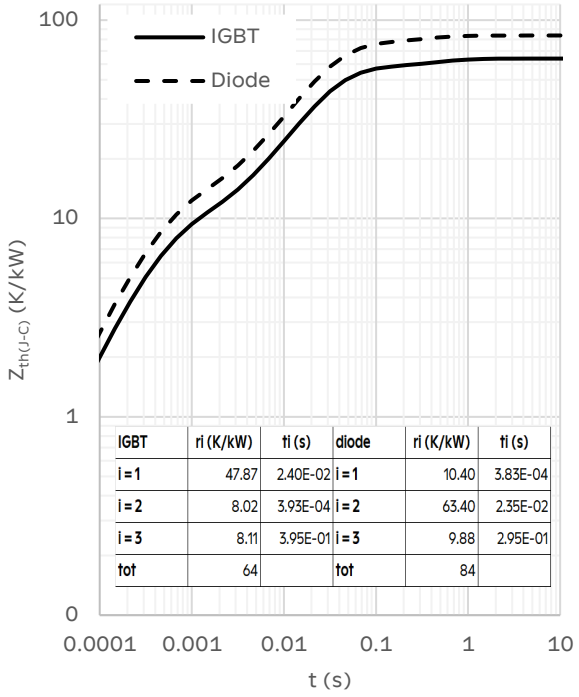

**Diode switching characteristics (typical)**
**二极管开关特性（典型）**
$E_{rec} = f(I_F)$, $I_{RM} = f(I_F)$
$V_{DC}$ = 600 V, $R_{Gon}$ = 1 Ω (IGBT), $V_{GE}$ =-15/+15 V (IGBT)




**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）**
$Z_{th(j-c)} = f(t)$




| IGBT | ri (K/kW) | ti (s) | diode | ri (K/kW) | ti (s) |
|---|---|---|---|---|---|
| i = 1 | 47.87 | 2.40E-02 | i = 1 | 10.40 | 3.83E-04 |
| i = 2 | 8.02 | 3.93E-04 | i = 2 | 63.40 | 2.35E-02 |
| i = 3 | 8.11 | 3.95E-01 | i = 3 | 9.88 | 2.95E-01 |
| tot | 64 | | tot | 84 | |