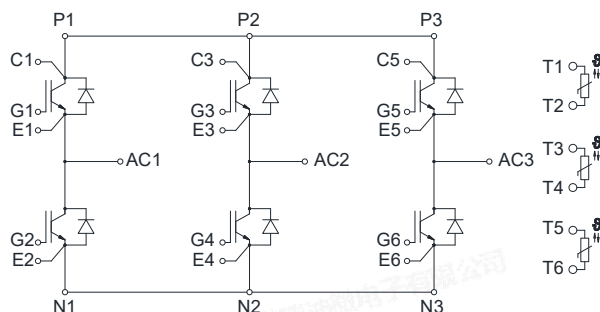


A4 package: 750V 750A IGBT module



等效电路图

Equivalent Circuit Schematic

### Features:

- 750V 750A,  $V_{CE(sat)} = 1.62V @ 25^{\circ}C$
- High RBSOA capability
- Micro pattern trench/FS technology
- Low switching losses
- High SC capability
- Direct Cooled Base Plate with PinFin

### 产品特性:

- 750V 750A,  $V_{CE(sat)} = 1.62V @ 25^{\circ}C$
- 高 RBSOA 能力
- 微沟槽/场终止技术
- 低开关损耗
- 高短路能力
- 直接冷却 PinFin 基板

### Typical Applications:

- Automotive Applications
- Motor Drives
- Inverters

### 典型应用:

- 汽车应用
- 电机驱动
- 逆变器

# IGBT, Inverter / IGBT, 逆变部分

## Maximum Rated Values / 最大标称参数

|                                                 |                                                                 |                    |                   |   |
|-------------------------------------------------|-----------------------------------------------------------------|--------------------|-------------------|---|
| Collector-emitter voltage<br>集电极-发射极电压          | $T_{vj}=25^{\circ}\text{C}$                                     | $V_{CES}$          | 750               | V |
| Continuous DC collector current<br>集电极连续直流电流    |                                                                 | $I_{C\text{ nom}}$ | 750               | A |
|                                                 | $T_F=95^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$ | $I_C$              | 480 <sup>1)</sup> | A |
| Repetitive peak collector current<br>集电极可重复峰值电流 | $t_p=1\text{ms}$                                                | $I_{CRM}$          | 1500              | A |
| Total power dissipation<br>功率损耗                 | $T_F=75^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$ | $P_{\text{tot}}$   | 980 <sup>1)</sup> | W |
| Gate-emitter peak voltage<br>门极-发射极峰值电压         |                                                                 | $V_{GES}$          | $\pm 20$          | V |

## Characteristic Values / 性能参数

| Characteristic Values / 性能参数                        |                                                                                                                                                 |                                                                        | min.        | typ. | max.                 |      |          |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|-------------|------|----------------------|------|----------|
| Collector-emitter saturation voltage<br>集电极-发射极饱和压降 | $I_C=450A, V_{GE}=15V$                                                                                                                          | $T_{vj}=25^{\circ}C$<br>$T_{vj}=150^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $V_{CEsat}$ |      | 1.28<br>1.33<br>1.36 | V    |          |
|                                                     | $I_C=750A, V_{GE}=15V$                                                                                                                          | $T_{vj}=25^{\circ}C$<br>$T_{vj}=175^{\circ}C$                          |             |      | 1.62<br>1.80         | 2.1  |          |
| Gate threshold voltage<br>门极阈值电压                    | $V_{CE}=V_{GE}, I_C=20mA$                                                                                                                       | $T_{vj}=25^{\circ}C$                                                   | $V_{GEth}$  | 5.00 | 6.00                 | 7.00 | V        |
| Internal gate resistor<br>内置门极电阻                    |                                                                                                                                                 | $T_{vj}=25^{\circ}C$                                                   | $R_{Gint}$  |      | 0.56                 |      | $\Omega$ |
| Input capacitance<br>输入电容                           | $V_{CE}=25V, V_{GE}=0V, f=100kHz$                                                                                                               | $T_{vj}=25^{\circ}C$                                                   | $C_{ies}$   |      | 41.7                 |      | nF       |
| Output capacitance<br>输出电容                          | $V_{CE}=25V, V_{GE}=0V, f=100kHz$                                                                                                               | $T_{vj}=25^{\circ}C$                                                   | $C_{oes}$   |      | 3.9                  |      | nF       |
| Reverse transfer capacitance<br>反向传输电容              | $V_{CE}=25V, V_{GE}=0V, f=100kHz$                                                                                                               | $T_{vj}=25^{\circ}C$                                                   | $C_{res}$   |      | 0.15                 |      | nF       |
| Gate charge<br>门极电荷                                 | $V_{GE}=-8V\sim+15V, V_{CE}=400V$                                                                                                               | $T_{vj}=25^{\circ}C$                                                   | $Q_G$       |      | 1.8                  |      | $\mu C$  |
| Collector-emitter cut-off current<br>集电极-发射极关断漏电流   | $V_{CE}=750V, V_{GE}=0V$                                                                                                                        | $T_{vj}=25^{\circ}C$                                                   | $I_{CES}$   |      |                      | 1.0  | mA       |
| Gate-emitter leakage current<br>门极-发射极漏电流           | $V_{CE}=0V, V_{GE}=20V$                                                                                                                         | $T_{vj}=25^{\circ}C$                                                   | $I_{GES}$   |      |                      | 500  | nA       |
| Turn-on delay time, inductive load<br>开通延迟时间, 感性负载  | $I_C=450A, V_{CE}=400V$<br>$V_{GE}=-8V/15V R_{Gon}=2.0\Omega$                                                                                   | $T_{vj}=25^{\circ}C$<br>$T_{vj}=150^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $t_{don}$   |      | 67<br>73<br>88       |      | ns       |
| Rise time, inductive load<br>上升时间, 感性负载             | $I_C=450A, V_{CE}=400V$<br>$V_{GE}=-8V/15V R_{Gon}=2.0\Omega$                                                                                   | $T_{vj}=25^{\circ}C$<br>$T_{vj}=150^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $t_r$       |      | 43<br>48<br>50       |      | ns       |
| Turn-off delay time, inductive load<br>关断延迟时间, 感性负载 | $I_C=450A, V_{CE}=400V$<br>$V_{GE}=-8V/15V R_{Goff}=18\Omega$                                                                                   | $T_{vj}=25^{\circ}C$<br>$T_{vj}=150^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $t_{doff}$  |      | 1049<br>1116<br>1138 |      | ns       |
| Fall time, inductive load<br>下降时间, 感性负载             | $I_C=450A, V_{CE}=400V$<br>$V_{GE}=-8V/15V R_{Goff}=18\Omega$                                                                                   | $T_{vj}=25^{\circ}C$<br>$T_{vj}=150^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $t_f$       |      | 67<br>137<br>157     |      | ns       |
| Turn-on energy loss per pulse<br>开通损耗               | $I_C=450A, V_{CE}=400V$<br>$V_{GE}=-8V/15V R_{Gon}=2.0\Omega,$<br>$di/dt(T_{vj}=25^{\circ}C)=8300A/us$<br>$di/dt(T_{vj}=175^{\circ}C)=7200A/us$ | $T_{vj}=25^{\circ}C$<br>$T_{vj}=150^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $E_{on}$    |      | 7.3<br>10.6<br>12.0  |      | mJ       |

|                                                          |                                                                                                                                                                                                                           |             |            |                      |            |            |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|----------------------|------------|------------|
| Turn-off energy loss per pulse<br>关断损耗                   | $I_C=600A, V_{CE}=400V$<br>$V_{GE} = -8V/15V$ $R_{Goff} = 18\Omega$<br>$dv/dt(T_{vj}=25^\circ C)=2200A/us$<br>$dv/dt(T_{vj}=175^\circ C)=2200A/us$<br>$T_{vj}=25^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$ | $E_{off}$   |            | 22.0<br>30.1<br>32.4 |            | mJ         |
| SC data<br>短路耐量                                          | $V_{CC}=400V, V_{GE} = -8V/15V$ $t_p \leq 6\mu s$ $T_{vj}=25^\circ C$<br>$V_{CEmax}=V_{CES}-L_{sCE} \cdot di/dt$ $t_p \leq 3\mu s$ $T_{vj}=175^\circ C$                                                                   | $I_{sc}$    |            | 3200<br>2400         |            | A          |
| Thermal resistance, junction to cooling fluid<br>结-冷却液热阻 | Per IGBT/单个 IGBT<br>Cooling fluid =<br>50%water/50% ethylene glycol;<br>$\Delta V/\Delta T=10.0dm^3/min$ $T_F=65^\circ C$                                                                                                 | $R_{thJF}$  |            | 0.102                |            | K/W        |
| Temperature under switching conditions<br>工作温度           | $t_{op}$ continuous<br>for 10s within a period of 30s,<br>occurrence<br>maximum 3000 times over lifetime                                                                                                                  | $T_{vj op}$ | -40<br>150 |                      | 150<br>175 | $^\circ C$ |

## Diode, Inverter / 二极管，逆变部分

### Maximum Rated Values / 最大标称参数

|                                              |                        |            |                    |   |
|----------------------------------------------|------------------------|------------|--------------------|---|
| Repetitive peak reverse voltage<br>可重复反向峰值电压 | $T_{vj}=25^\circ C$    | $V_{RRM}$  | 750                | V |
| Continuous DC forward current<br>可连续正向直流电流   |                        | $I_{Fnom}$ | 750                | A |
| Repetitive peak forward current<br>可重复正向峰值电流 | $I_{FRM}=2 \times I_F$ | $I_{FRM}$  | 1500 <sup>1)</sup> | A |

### Characteristic Values / 性能参数

|                                                          |                                                                                                                                                        |             | min.       | typ.                 | max.       |            |
|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|----------------------|------------|------------|
| Forward voltage <sup>1)</sup><br>正向通态压降                  | $I_F=450A, V_{GE}=0V$<br>$T_{vj}=25^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$                                                           | $V_F$       |            | 1.53<br>1.61<br>1.62 |            | V          |
|                                                          | $I_F=750A, V_{GE}=0V$<br>$T_{vj}=25^\circ C$<br>$T_{vj}=175^\circ C$                                                                                   |             |            | 1.81<br>1.94         | 2.4        |            |
| Reverse recovery time<br>反向恢复时间                          | $I_F=450A, V_R=400V$<br>$-di_F/dt=8500A/us(T_{vj}=175^\circ C)$<br>$V_{GE}=-8V$<br>$T_{vj}=25^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$ | $t_{rr}$    |            | 119<br>146<br>155    |            | ns         |
| Peak reverse recovery current<br>反向恢复峰值电流                | $I_F=450A, V_R=400V$<br>$-di_F/dt=8500A/us(T_{vj}=175^\circ C)$<br>$V_{GE}=-8V$<br>$T_{vj}=25^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$ | $I_{RM}$    |            | 392<br>445<br>454    |            | A          |
| Recovery charge<br>反向恢复电荷                                | $I_F=450A, V_R=400V$<br>$-di_F/dt=8500A/us(T_{vj}=175^\circ C)$<br>$V_{GE}=-8V$<br>$T_{vj}=25^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$ | $Q_R$       |            | 26.8<br>37.1<br>40.0 |            | $\mu C$    |
| Reverse recovery energy<br>反向恢复损耗                        | $I_F=450A, V_R=400V$<br>$-di_F/dt=8500A/us(T_{vj}=175^\circ C)$<br>$V_{GE}=-8V$<br>$T_{vj}=25^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$ | $E_{rec}$   |            | 7.6<br>11.3<br>12.3  |            | mJ         |
| Thermal resistance, junction to cooling fluid<br>结-冷却液热阻 | Per FRD/单个 FRD<br>Cooling fluid =<br>50%water/50% ethylene glycol;<br>$\Delta V/\Delta T=10.0dm^3/min$ $T_F=65^\circ C$                                | $R_{thJF}$  |            | 0.131                |            | K/W        |
| Temperature under switching conditions<br>工作温度           | $t_{op}$ continuous<br>for 10s within a period of 30s,<br>occurrence<br>maximum 3000 times over lifetime                                               | $T_{vj op}$ | -40<br>150 |                      | 150<br>175 | $^\circ C$ |

## NTC-Thermistor/ NTC-热敏电阻

### Characteristic Values / 性能参数

|                               |                                                         | min.         | typ. | max. |                  |
|-------------------------------|---------------------------------------------------------|--------------|------|------|------------------|
| Rated resistance<br>标称电阻      | $T_{NTC}=25^{\circ}\text{C}$                            | $R_{25}$     | -    | 5    | $\text{K}\Omega$ |
| Deviation of R100<br>R100 偏移值 | $T_{NTC}=100^{\circ}\text{C}$ , $R_{100}=493.3\Omega$   | $\Delta R/R$ | -5   | -    | 5                |
| Power dissipation<br>功率耗散     | $T_{NTC}=25^{\circ}\text{C}$                            | $P_{25}$     | -    | -    | 20               |
| B-value<br>B 值                | $R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$  | $B_{25/50}$  | -    | 3375 | K                |
|                               | $R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$  | $B_{25/80}$  | -    | 3414 | K                |
|                               | $R_2=R_{25} \exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$ | $B_{25/100}$ | -    | 3436 | K                |

## Module / 模块

|                                        |                                              |            |                         |    |
|----------------------------------------|----------------------------------------------|------------|-------------------------|----|
| Isolation test voltage<br>绝缘测试电压       | RMS, $f=50\text{Hz}$ , $t=1\text{min}$       | $V_{ISOL}$ | 3                       | KV |
| Material of module baseplate<br>模块底板材料 |                                              |            | Cu+Ni                   |    |
| Internal isolation<br>内部绝缘             |                                              |            | $\text{Si}_3\text{N}_4$ |    |
| Creepage distance<br>爬电距离              | Terminal to heatsink<br>Terminal to terminal |            | 18.2<br>8.2             | mm |
| Clearance<br>电气间隙                      | Terminal to heatsink<br>Terminal to terminal |            | 18.2<br>5.9             | mm |
| Comparative tracking index<br>相对漏电起痕指数 |                                              | CTI        | 200 <sup>2)</sup>       |    |

|                                                         |                                           | min.          | typ. | max. |                  |
|---------------------------------------------------------|-------------------------------------------|---------------|------|------|------------------|
| Stray inductance module<br>模块杂散电感                       |                                           | $L_{sCE}$     | -    | 15   | nH               |
| Module lead resistance, terminals-chip<br>模块引脚电阻, 端子-芯片 | $T_C=25^{\circ}\text{C}$ , Per Switch     | $R_{CC'+EE'}$ | -    | 1.0  | $\text{m}\Omega$ |
| Storage temperature<br>贮存温度                             |                                           | $T_{stg}$     | -40  | -    | 125              |
| Mounting torque for module mounting<br>模块安装力矩           | Screw M5 / M5 螺丝<br>Baseplate to heatsink | M             | 4.0  | -    | 6.0              |
| Terminal connection torque<br>功率端子连接力矩                  | Screw M6 / M6 螺丝                          | M             | 4.0  | -    | 6.0              |
| Weight<br>重量                                            |                                           | G             | -    | 715  | g                |

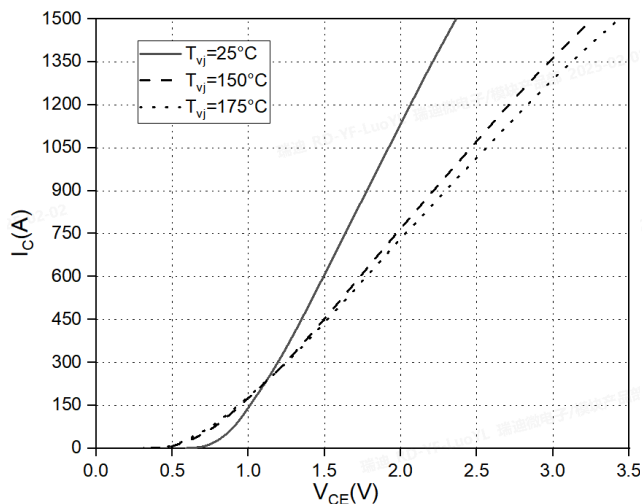
- 1) Verified by characterization/design not by test.  
非测试值, 设计计算所得。
- 2) CTI is about 200.  
CTI 约等于 200。

## Circuit Diagram / 曲线图

Output characteristic IGBT, Inverter (typical),  
Inclusive  $R_{CC'+EE'}$

IGBT 输出特性, 逆变 (典型值), 包含  $R_{CC'+EE'}$

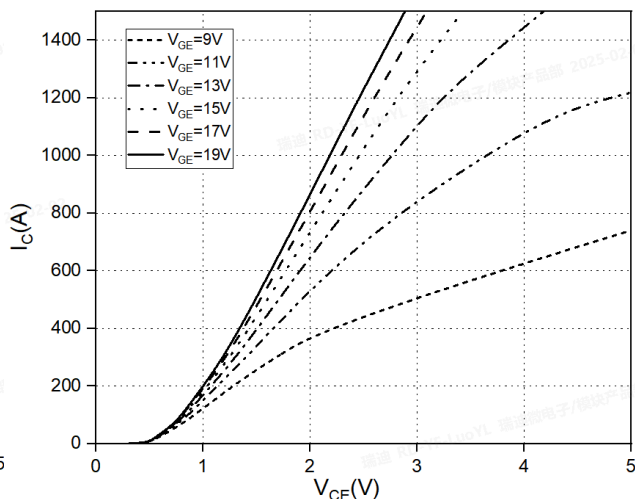
$I_C = f(V_{CE}), V_{GE} = 15V$



Output characteristic IGBT, Inverter (typical),  
Inclusive  $R_{CC'+EE'}$

IGBT 输出特性, 逆变 (典型值), 包含  $R_{CC'+EE'}$

$I_C = f(V_{CE}), T_{vj} = 175^\circ\text{C}$



Transfer characteristic IGBT, Inverter (typical),  
Inclusive  $R_{CC'+EE'}$

IGBT 传输特性, 逆变 (典型值), 包含  $R_{CC'+EE'}$

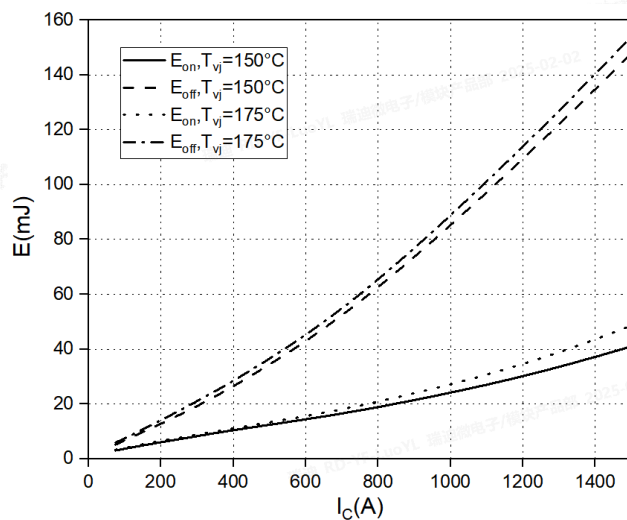
$I_C = f(V_{GE}), V_{CE} = 20V$

TBD

Switching losses IGBT, Inverter (typical),  
Inclusive  $R_{CC'+EE'}$

IGBT 开关损耗, 逆变 (典型值), 包含  $R_{CC'+EE'}$

$E = f(I_C), V_{GE} = +15V/-8V,$   
 $R_{Gon} = 2\Omega, R_{Goff} = 18\Omega, V_{CE} = 400V$



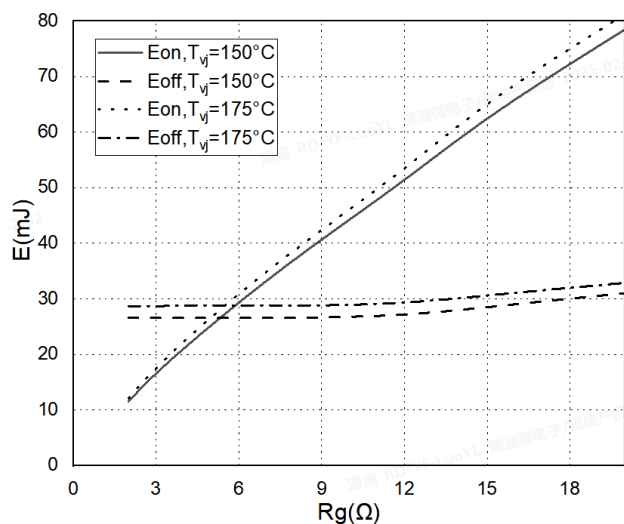
### Switching losses IGBT, Inverter (typical),

Inclusive  $R_{CC} + EE$

IGBT 开关损耗, 逆变 (典型值), 包含  $R_{CC} + EE$

$E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$

$V_{GE} = +15V/-8V$ ,  $I_C = 450A$ ,  $V_{CE} = 400V$



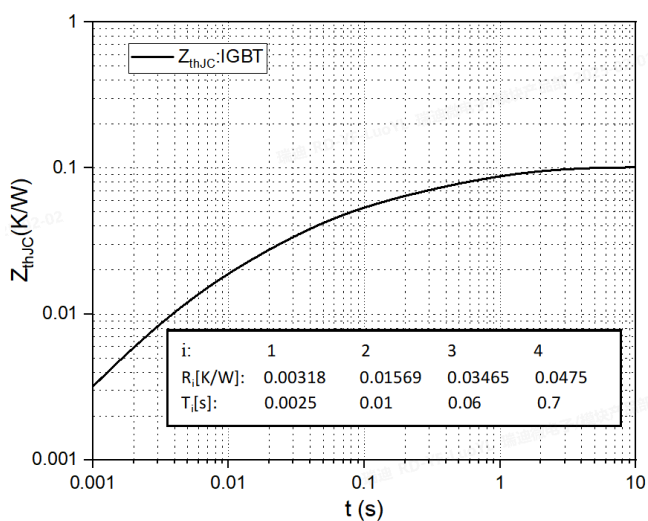
### Transient thermal impedance IGBT, Inverter

IGBT 瞬态热阻, 逆变

$Z_{thJC} = f(t)$

Cooling fluid = 50% water/50% ethylene glycol;

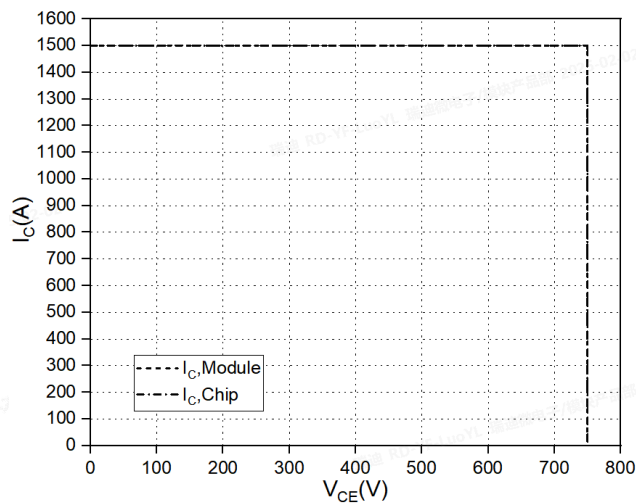
$\Delta V/\Delta T = 10.0 dm^3/min$ ;  $T_F = 65^\circ C$



### Reverse bias safe operating area IGBT, Inverter (RBSOA)

IGBT 反向安全工作区, 逆变 (RBSOA)

$I_C = f(V_{CE})$ ,  $V_{GE} = +15V/-8V$ ,  $R_{Goff} = 18\Omega$ ,  $T_{vj} = 175^\circ C$

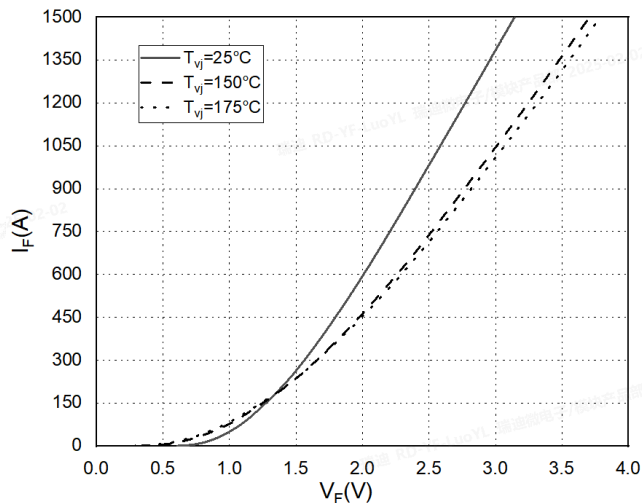


### Forward characteristic FRD, Inverter (typical),

Inclusive  $R_{CC} + EE$

FRD 正向特性, 逆变 (典型值), 包含  $R_{CC} + EE$

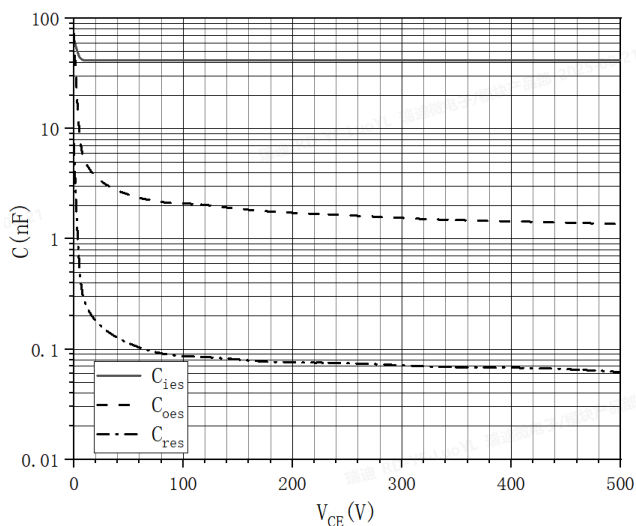
$I_F = f(V_F)$



### Capacity characteristic IGBT, Inverter (typical)

$C=f(V_{CE})$ ,  
电容特性 IGBT, 逆变器(典型值)

$V_{CE}=50V$ ,  $V_{GE}=0V$ ,  $f=100kHz$ ,  $T_{vj}=25^{\circ}C$

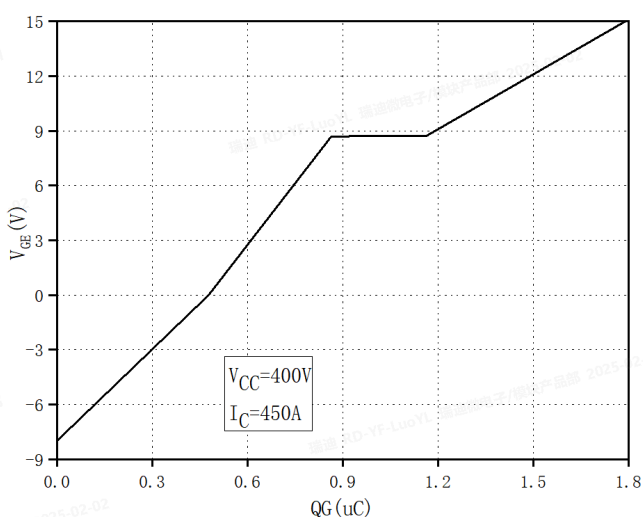


### Gate charge characteristic IGBT, Inverter (typical)

$V_{GE}=f(Q_G)$ ,

栅极电荷特性 IGBT, 逆变器(典型值)

$V_{GE}=-8V \sim +15V$ ,  $V_{CE}=400V$ ,  $I_C=450A$ ,  $T_{vj}=25^{\circ}C$

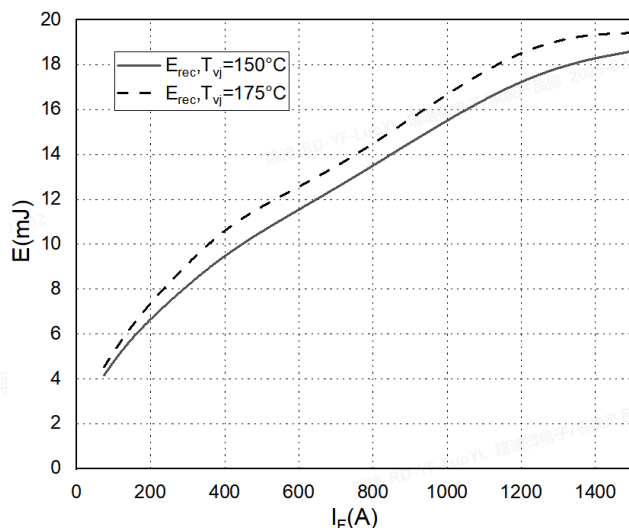


### Swiching losses FRD, Inverter (typical),

Inclusive  $R_{CC}+EE$

FRD 开关损耗, 逆变 (典型值), 包含  $R_{CC}+EE$

$E_{rec}=f(I_F)$ ,  $R_{Gon}=2\Omega$ ,  $V_{CE}=400V$

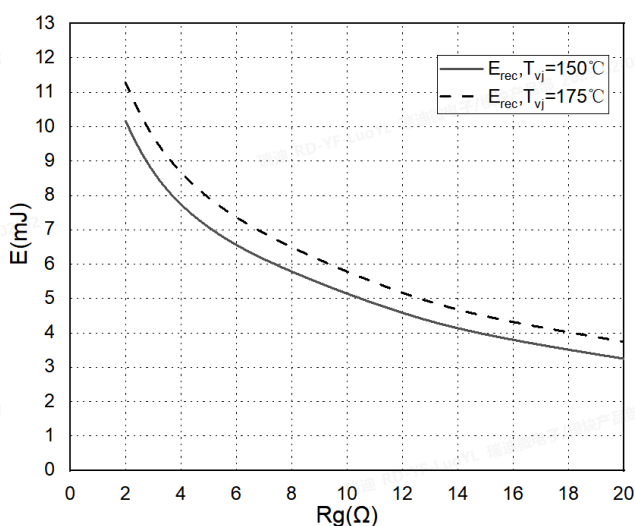


### Swiching losses FRD, Inverter (typical),

Inclusive  $R_{CC}+EE$

FRD 开关损耗, 逆变 (典型值), 包含  $R_{CC}+EE$

$E_{rec}=f(R_G)$ ,  $I_F=450A$ ,  $V_{CE}=400V$



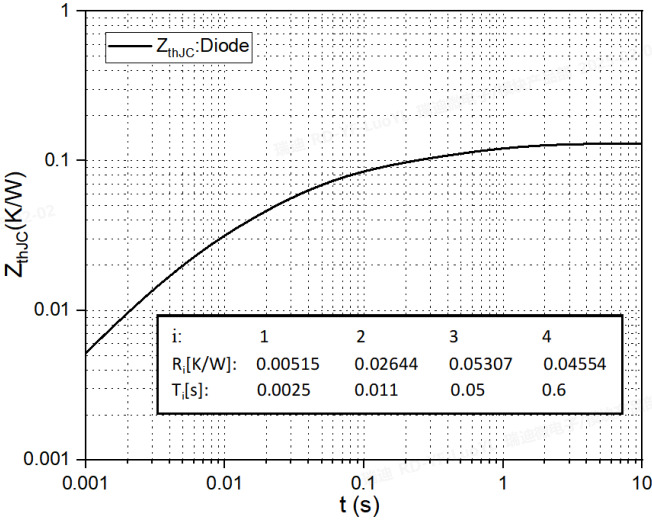
Transient thermal impedance FRD, Inerter

FRD 瞬态热阻, 逆变

$Z_{thJC}=f(t)$

Cooling fluid = 50%water/50% ethylene glycol;

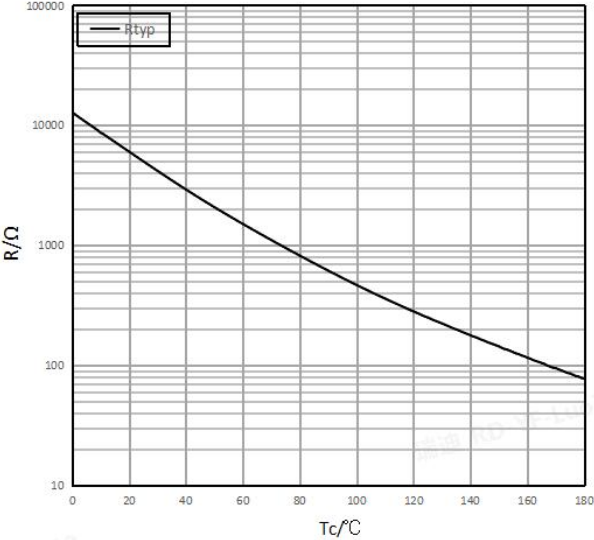
$\Delta V/\Delta T=10.0dm^3/min; T_F=65^{\circ}C$



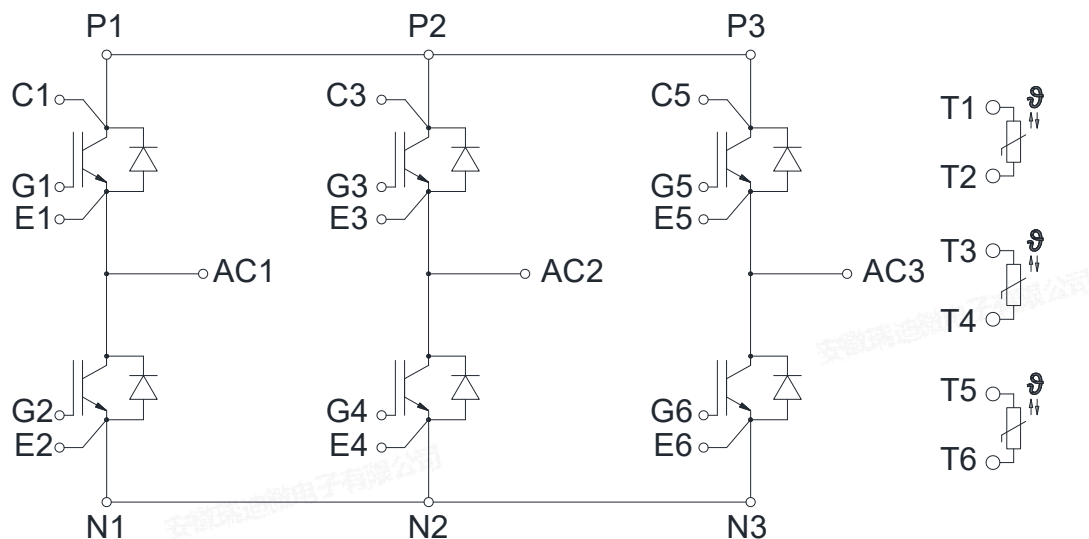
NTC Thermistor temperature characteristic (typical)

NTC 热敏电阻

$R=f(T)$



## Internal Circuit / 内部电路



## Package Dimension / 封装尺寸

Dimensions in Millimeters / 毫米为单位

