

## 技术信息 / Technical Information

IGBT-模块  
IGBT-modules

## FF300R12KS4

62mm C-Serien Modul mit schnellem IGBT2 für hochfrequentes Schalten  
62mm C-series module with the fast IGBT2 for high-frequency switching

## IGBT, 逆变器 / IGBT, Inverter

## 最大额定值 / Maximum Rated Values

|                                                |                                                                                                                              |                             |            |        |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------|--------|
| 集电极 - 发射极电压<br>Collector-emitter voltage       | $T_{vj} = 25^{\circ}\text{C}$                                                                                                | $V_{CES}$                   | 1200       | V      |
| 连续集电极直流电流<br>Continuous DC collector current   | $T_C = 60^{\circ}\text{C}, T_{vj\max} = 150^{\circ}\text{C}$<br>$T_C = 25^{\circ}\text{C}, T_{vj\max} = 150^{\circ}\text{C}$ | $I_{C\text{ nom}}$<br>$I_C$ | 300<br>370 | A<br>A |
| 集电极重复峰值电流<br>Repetitive peak collector current | $t_P = 1\text{ ms}$                                                                                                          | $I_{CRM}$                   | 600        | A      |
| 总功率损耗<br>Total power dissipation               | $T_C = 25^{\circ}\text{C}, T_{vj\max} = 150$                                                                                 | $P_{\text{tot}}$            | 1950       | W      |
| 栅极 - 发射极峰值电压<br>Gate-emitter peak voltage      |                                                                                                                              | $V_{GES}$                   | +/-20      | V      |

## 特征值 / Characteristic Values

|                                                       |                                                                                                                                                                     |                                                                 | min.                | typ.         | max.  |                                |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------|--------------|-------|--------------------------------|
| 集电极 - 发射极饱和电压<br>Collector-emitter saturation voltage | $I_C = 300\text{ A}, V_{GE} = 15\text{ V}$<br>$I_C = 300\text{ A}, V_{GE} = 15\text{ V}$                                                                            | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $V_{CE\text{ sat}}$ | 3,20<br>3,85 | 3,75  | V<br>V                         |
| 栅极阈值电压<br>Gate threshold voltage                      | $I_C = 12,0\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$                                                                                                |                                                                 | $V_{GEth}$          | 4,5          | 5,5   | 6,5 V                          |
| 栅极电荷<br>Gate charge                                   | $V_{GE} = -15\text{ V} \dots +15\text{ V}$                                                                                                                          |                                                                 | $Q_G$               | 3,20         |       | $\mu\text{C}$                  |
| 内部栅极电阻<br>Internal gate resistor                      | $T_{vj} = 25^{\circ}\text{C}$                                                                                                                                       |                                                                 | $R_{Gint}$          | 1,0          |       | $\Omega$                       |
| 输入电容<br>Input capacitance                             | $f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$                                                                          |                                                                 | $C_{ies}$           | 20,0         |       | nF                             |
| 反向传输电容<br>Reverse transfer capacitance                | $f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$                                                                          |                                                                 | $C_{res}$           | 1,40         |       | nF                             |
| 集电极-发射极截止电流<br>Collector-emitter cut-off current      | $V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_{vj} = 25^{\circ}\text{C}$                                                                                          |                                                                 | $I_{CES}$           |              | 5,0   | mA                             |
| 栅极-发射极漏电流<br>Gate-emitter leakage current             | $V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}, T_{vj} = 25^{\circ}\text{C}$                                                                                            |                                                                 | $I_{GES}$           |              | 400   | nA                             |
| 开通延迟时间(电感负载)<br>Turn-on delay time, inductive load    | $I_C = 300\text{ A}, V_{CE} = 600\text{ V}$<br>$V_{GE} = \pm 15\text{ V}$<br>$R_{Gon} = 3,0\ \Omega$                                                                | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $t_{d\text{ on}}$   | 0,10<br>0,11 |       | $\mu\text{s}$<br>$\mu\text{s}$ |
| 上升时间(电感负载)<br>Rise time, inductive load               | $I_C = 300\text{ A}, V_{CE} = 600\text{ V}$<br>$V_{GE} = \pm 15\text{ V}$<br>$R_{Gon} = 3,0\ \Omega$                                                                | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $t_r$               | 0,06<br>0,07 |       | $\mu\text{s}$<br>$\mu\text{s}$ |
| 关断延迟时间(电感负载)<br>Turn-off delay time, inductive load   | $I_C = 300\text{ A}, V_{CE} = 600\text{ V}$<br>$V_{GE} = \pm 15\text{ V}$<br>$R_{Goff} = 3,0\ \Omega$                                                               | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $t_{d\text{ off}}$  | 0,53<br>0,55 |       | $\mu\text{s}$<br>$\mu\text{s}$ |
| 下降时间(电感负载)<br>Fall time, inductive load               | $I_C = 300\text{ A}, V_{CE} = 600\text{ V}$<br>$V_{GE} = \pm 15\text{ V}$<br>$R_{Goff} = 3,0\ \Omega$                                                               | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $t_f$               | 0,03<br>0,04 |       | $\mu\text{s}$<br>$\mu\text{s}$ |
| 开通损耗能量(每脉冲)<br>Turn-on energy loss per pulse          | $I_C = 300\text{ A}, V_{CE} = 600\text{ V}, L_S = 60\text{ nH}$<br>$V_{GE} = \pm 15\text{ V}, di/dt = 5000\text{ A}/\mu\text{s}$<br>$R_{Gon} = 3,0\ \Omega$         | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $E_{on}$            | 25,0         |       | mJ<br>mJ                       |
| 关断损耗能量(每脉冲)<br>Turn-off energy loss per pulse         | $I_C = 300\text{ A}, V_{CE} = 600\text{ V}, L_S = 60\text{ nH}$<br>$V_{GE} = \pm 15\text{ V}, du/dt = 7500\text{ V}/\mu\text{s}$<br>$R_{Goff} = 3,0\ \Omega$        | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $E_{off}$           | 15,0         |       | mJ<br>mJ                       |
| 短路数据<br>SC data                                       | $V_{GE} \leq 15\text{ V}, V_{CC} = 900\text{ V}$<br>$V_{CE\text{ max}} = V_{CES} - L_{SCE} \cdot di/dt$<br>$t_P \leq 10\ \mu\text{s}, T_{vj} = 125^{\circ}\text{C}$ |                                                                 | $I_{SC}$            | 2000         |       | A                              |
| 结 - 外壳热阻<br>Thermal resistance, junction to case      | 每个 IGBT / per IGBT                                                                                                                                                  |                                                                 | $R_{thJC}$          |              | 0,064 | K/W                            |
| 外壳 - 散热器热阻<br>Thermal resistance, case to heatsink    | 每个 IGBT / per IGBT<br>$\lambda_{\text{Paste}} = 1\text{ W}/(\text{m}\cdot\text{K}) \quad / \quad \lambda_{\text{grease}} = 1\text{ W}/(\text{m}\cdot\text{K})$      |                                                                 | $R_{thCH}$          | 0,03         |       | K/W                            |
| 在开关状态下温度<br>Temperature under switching conditions    |                                                                                                                                                                     |                                                                 | $T_{vj\text{ op}}$  | -40          | 125   | $^{\circ}\text{C}$             |

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## 二极管, 逆变器 / Diode, Inverter

### 最大额定值 / Maximum Rated Values

|                                             |                                                                        |           |       |                      |
|---------------------------------------------|------------------------------------------------------------------------|-----------|-------|----------------------|
| 反向重复峰值电压<br>Repetitive peak reverse voltage | $T_{vj} = 25^{\circ}\text{C}$                                          | $V_{RRM}$ | 1200  | V                    |
| 连续正向直流电流<br>Continuous DC forward current   |                                                                        | $I_F$     | 300   | A                    |
| 正向重复峰值电流<br>Repetitive peak forward current | $t_P = 1 \text{ ms}$                                                   | $I_{FRM}$ | 600   | A                    |
| $I_{2t}$ -值<br>$I_{2t}$ - value             | $V_R = 0 \text{ V}, t_P = 10 \text{ ms}, T_{vj} = 125^{\circ}\text{C}$ | $I_{2t}$  | 18000 | $\text{A}^2\text{s}$ |

### 特征值 / Characteristic Values

|                                                    |                                                                                                                                                       |                                                                 | min.                | typ.         | max. |                                |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------|--------------|------|--------------------------------|
| 正向电压<br>Forward voltage                            | $I_F = 300 \text{ A}, V_{GE} = 0 \text{ V}$<br>$I_F = 300 \text{ A}, V_{GE} = 0 \text{ V}$                                                            | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $V_F$               | 2,00<br>1,70 | 2,55 | V<br>V                         |
| 反向恢复峰值电流<br>Peak reverse recovery current          | $I_F = 300 \text{ A}, -di_F/dt = 5000 \text{ A}/\mu\text{s} (T_{vj}=125^{\circ}\text{C})$<br>$V_R = 600 \text{ V}$<br>$V_{GE} = -15 \text{ V}$        | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $I_{RM}$            | 230<br>300   |      | A<br>A                         |
| 恢复电荷<br>Recovered charge                           | $I_F = 300 \text{ A}, -di_F/dt = 5000 \text{ A}/\mu\text{s} (T_{vj}=125^{\circ}\text{C})$<br>$V_R = 600 \text{ V}$<br>$V_{GE} = -15 \text{ V}$        | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $Q_r$               | 18,0<br>42,0 |      | $\mu\text{C}$<br>$\mu\text{C}$ |
| 反向恢复损耗 (每脉冲)<br>Reverse recovery energy            | $I_F = 300 \text{ A}, -di_F/dt = 5000 \text{ A}/\mu\text{s} (T_{vj}=125^{\circ}\text{C})$<br>$V_R = 600 \text{ V}$<br>$V_{GE} = -15 \text{ V}$        | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$ | $E_{rec}$           | 7,00<br>15,0 |      | mJ<br>mJ                       |
| 结 - 外壳热阻<br>Thermal resistance, junction to case   | 每个二极管 / per diode                                                                                                                                     |                                                                 | $R_{thJC}$          |              | 0,10 | K/W                            |
| 外壳 - 散热器热阻<br>Thermal resistance, case to heatsink | 每个二极管 / per diode<br>$\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$ |                                                                 | $R_{thCH}$          | 0,06         |      | K/W                            |
| 在开关状态下温度<br>Temperature under switching conditions |                                                                                                                                                       |                                                                 | $T_{vj \text{ op}}$ | -40          | 125  | $^{\circ}\text{C}$             |

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IGBT-模块  
IGBT-modules

## FF300R12KS4



### 模块 / Module

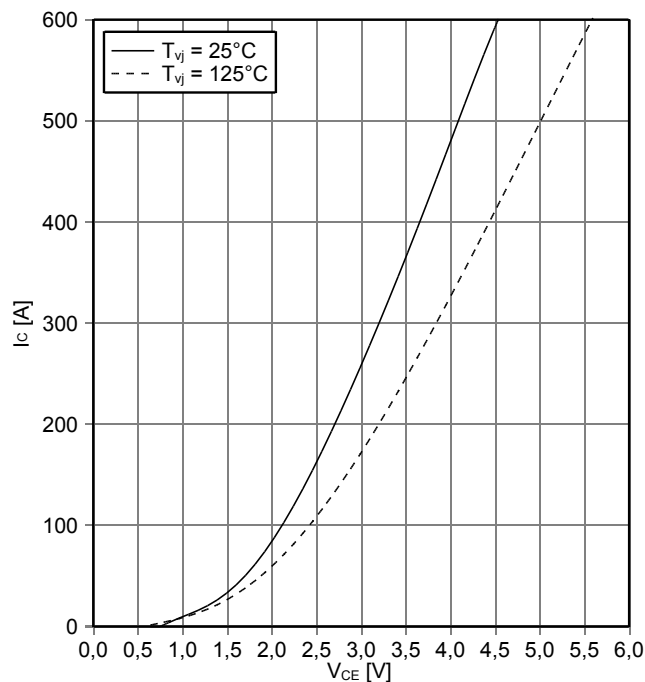
|                                                          |                                                                                                                                       |                      |                                |           |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------|-----------|
| 绝缘测试电压<br>Isolation test voltage                         | RMS, f = 50 Hz, t = 1 min.                                                                                                            | V <sub>ISOL</sub>    | 2,5                            | kV        |
| 模块基板材料<br>Material of module baseplate                   |                                                                                                                                       |                      | Cu                             |           |
| 内部绝缘<br>Internal isolation                               | 基本绝缘 (class 1, IEC 61140)<br>basic insulation (class 1, IEC 61140)                                                                    |                      | Al <sub>2</sub> O <sub>3</sub> |           |
| 爬电距离<br>Creepage distance                                | 端子- 散热片 / terminal to heatsink<br>端子- 端子 / terminal to terminal                                                                       |                      | 29,0<br>23,0                   | mm        |
| 电气间隙<br>Clearance                                        | 端子- 散热片 / terminal to heatsink<br>端子- 端子 / terminal to terminal                                                                       |                      | 23,0<br>11,0                   | mm        |
| 相对电痕指数<br>Comperative tracking index                     |                                                                                                                                       | CTI                  | > 400                          |           |
| min. typ. max.                                           |                                                                                                                                       |                      |                                |           |
| 外壳 - 散热器热阻<br>Thermal resistance, case to heatsink       | 每个模块 / per module<br>$\lambda_{\text{Paste}} = 1 \text{ W/(m}\cdot\text{K)} / \lambda_{\text{grease}} = 1 \text{ W/(m}\cdot\text{K)}$ | R <sub>thCH</sub>    | 0,01                           | K/W       |
| 杂散电感,模块<br>Stray inductance module                       |                                                                                                                                       | L <sub>sCE</sub>     | 20                             | nH        |
| 模块引线电阻,端子-芯片<br>Module lead resistance, terminals - chip | T <sub>C</sub> = 25°C, 每个开关 / per switch                                                                                              | R <sub>CC'+EE'</sub> | 0,70                           | mΩ        |
| 储存温度<br>Storage temperature                              |                                                                                                                                       | T <sub>stg</sub>     | -40                            | 125 °C    |
| 模块安装的安装扭矩<br>Mounting torque for modul mounting          | 螺丝 M6 根据相应的应用手册进行安装<br>Screw M6 - Mounting according to valid application note                                                        | M                    | 3,00                           | - 6,00 Nm |
| 端子联接扭矩<br>Terminal connection torque                     | 螺丝 M6 根据相应的应用手册进行安装<br>Screw M6 - Mounting according to valid application note                                                        | M                    | 2,5                            | - 5,0 Nm  |
| 重量<br>Weight                                             |                                                                                                                                       | G                    | 340                            | g         |

|                 |                                 |
|-----------------|---------------------------------|
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输出特性 IGBT, 逆变器 (典型)

output characteristic IGBT, Inverter (typical)

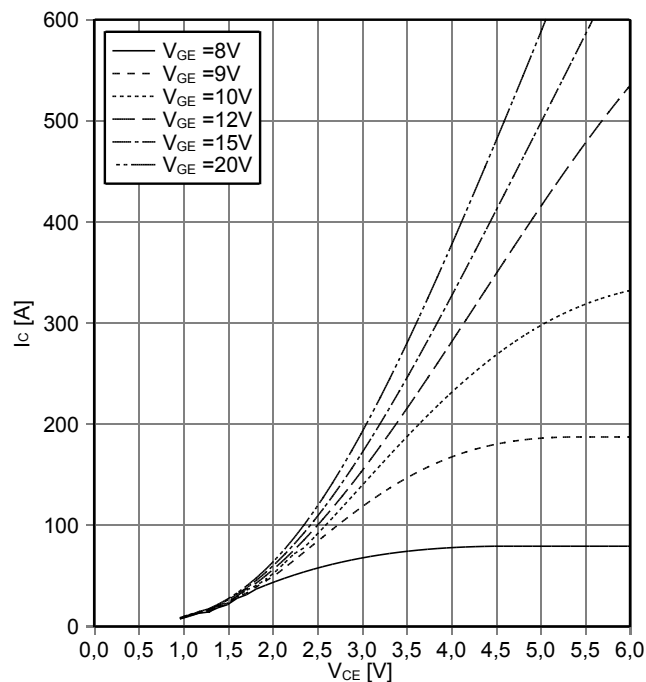
$I_C = f(V_{CE})$   
 $V_{GE} = 15\text{ V}$



输出特性 IGBT, 逆变器 (典型)

output characteristic IGBT, Inverter (typical)

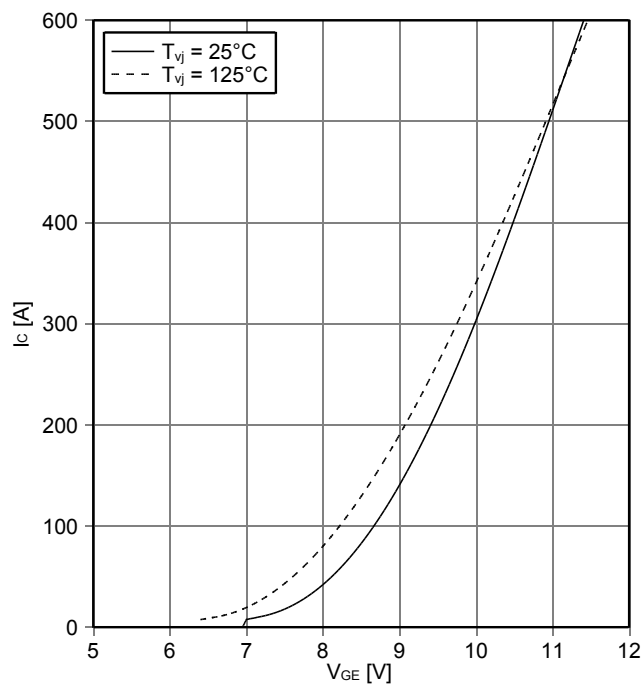
$I_C = f(V_{CE})$   
 $T_{vj} = 125^\circ\text{C}$



传输特性 IGBT, 逆变器 (典型)

transfer characteristic IGBT, Inverter (typical)

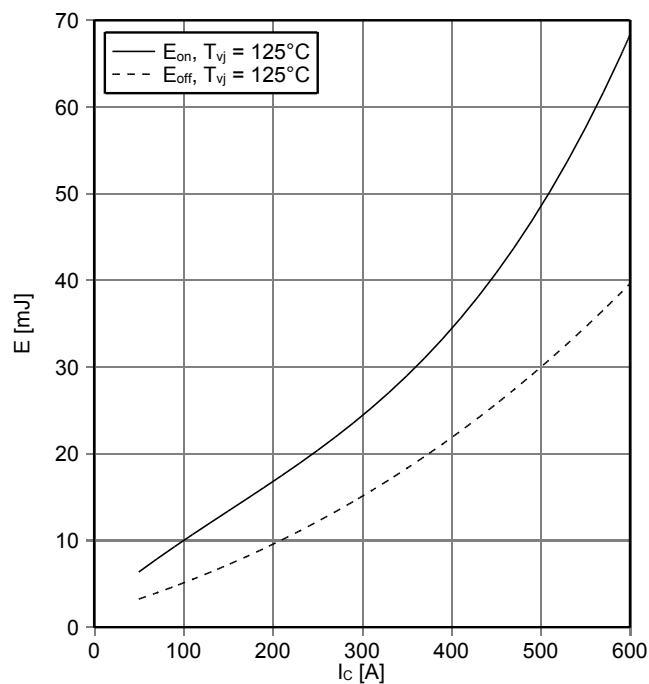
$I_C = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



开关损耗 IGBT, 逆变器 (典型)

switching losses IGBT, Inverter (typical)

$E_{on} = f(I_C)$ ,  $E_{off} = f(I_C)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Gon} = 3\ \Omega$ ,  $R_{Goff} = 3\ \Omega$ ,  $V_{CE} = 600\text{ V}$



# 技术信息 / Technical Information

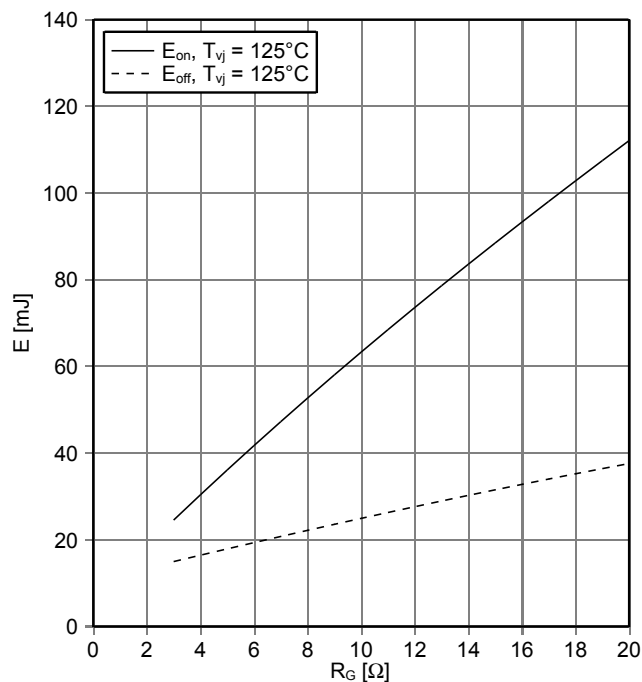
IGBT-模块  
IGBT-modules

## FF300R12KS4



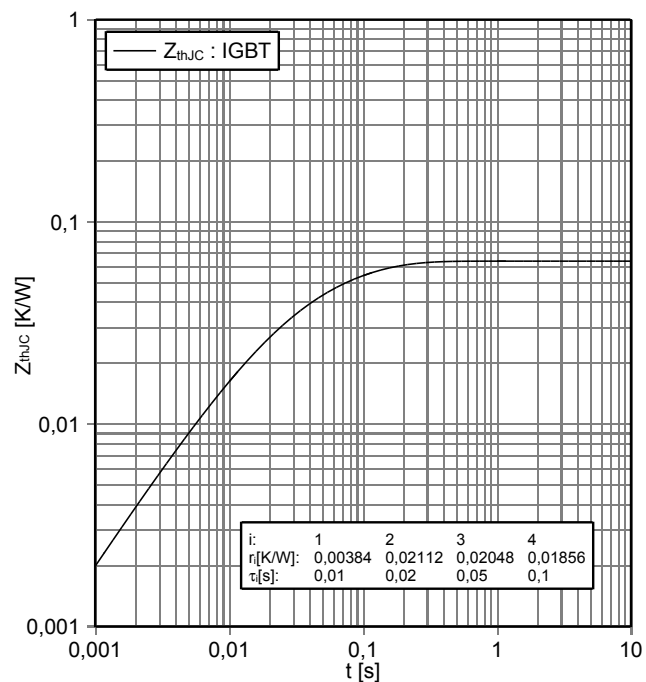
### 开关损耗 IGBT, 逆变器 (典型) switching losses IGBT, Inverter (typical)

$E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 300\text{ A}$ ,  $V_{CE} = 600\text{ V}$



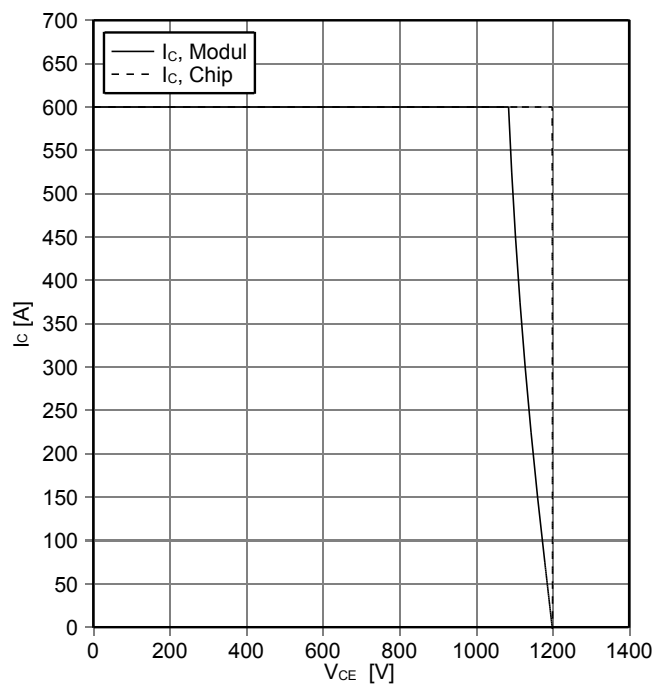
### 瞬态热阻抗 IGBT, 逆变器 transient thermal impedance IGBT, Inverter

$Z_{thJC} = f(t)$



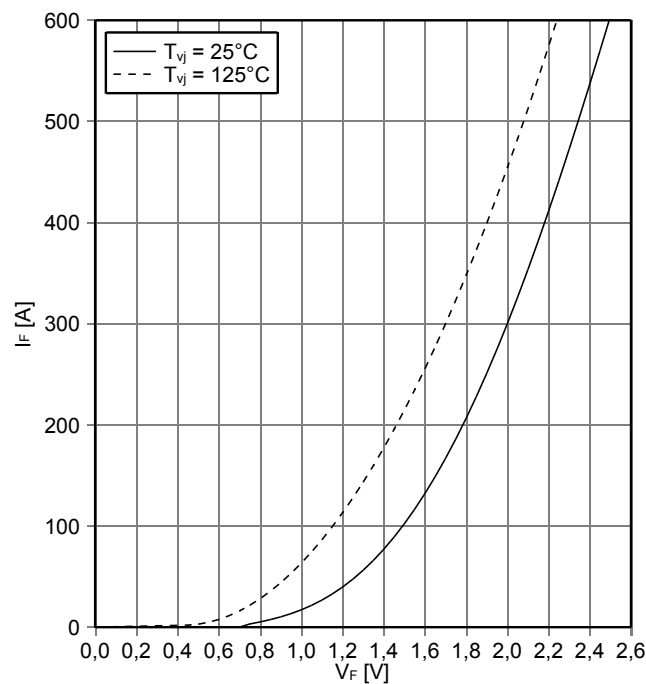
### 反偏安全工作区 IGBT, 逆变器 (RBSOA) reverse bias safe operating area IGBT, Inverter (RBSOA)

$I_C = f(V_{CE})$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Goff} = 3\ \Omega$ ,  $T_{vj} = 125^\circ\text{C}$



### 正向偏压特性 二极管, 逆变器 (典型) forward characteristic of Diode, Inverter (typical)

$I_F = f(V_F)$

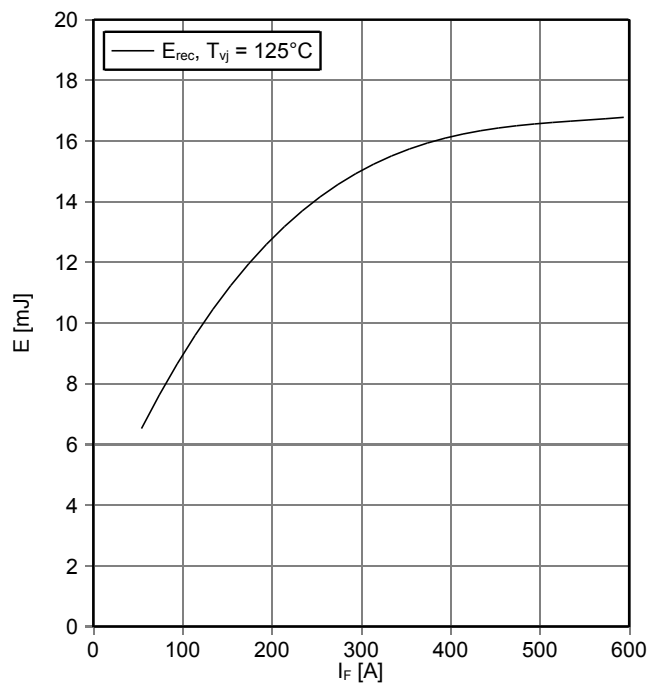


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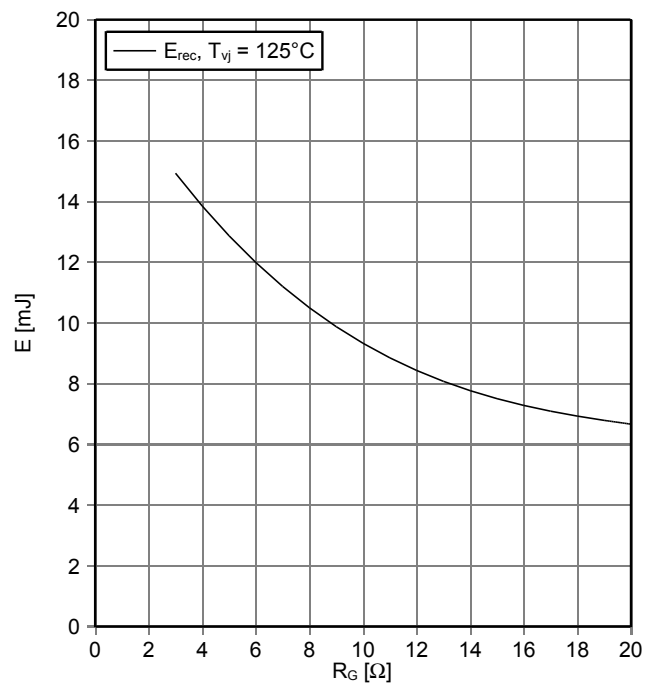
开关损耗 二极管,逆变器 (典型)  
switching losses Diode, Inverter (typical)

$E_{rec} = f(I_F)$   
 $R_{Gon} = 3 \Omega$ ,  $V_{CE} = 600 V$



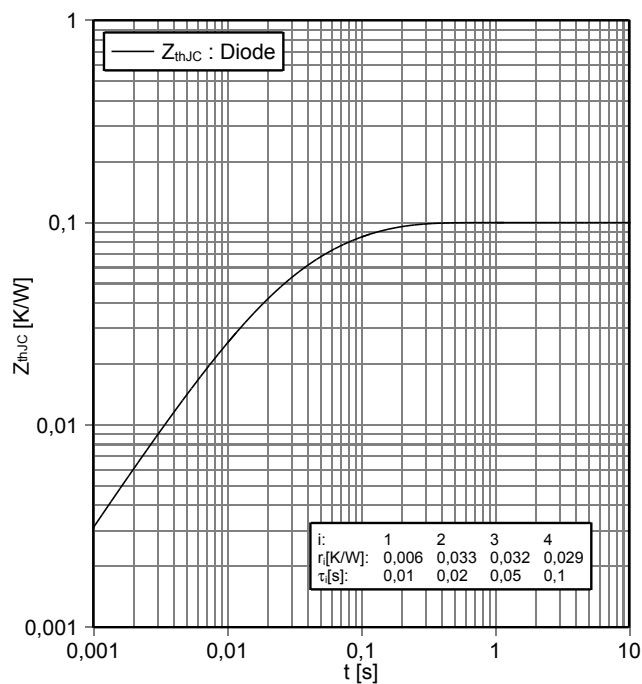
开关损耗 二极管,逆变器 (典型)  
switching losses Diode, Inverter (typical)

$E_{rec} = f(R_G)$   
 $I_F = 300 A$ ,  $V_{CE} = 600 V$



瞬态热阻抗 二极管,逆变器  
transient thermal impedance Diode, Inverter

$Z_{thJC} = f(t)$



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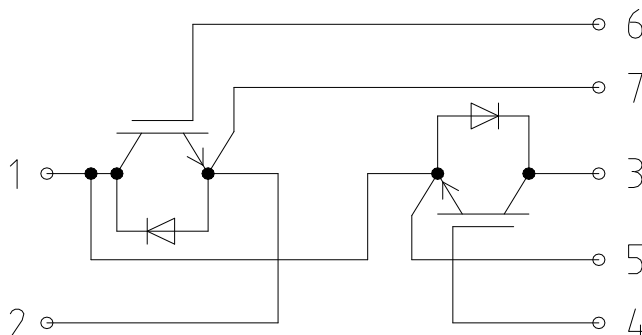
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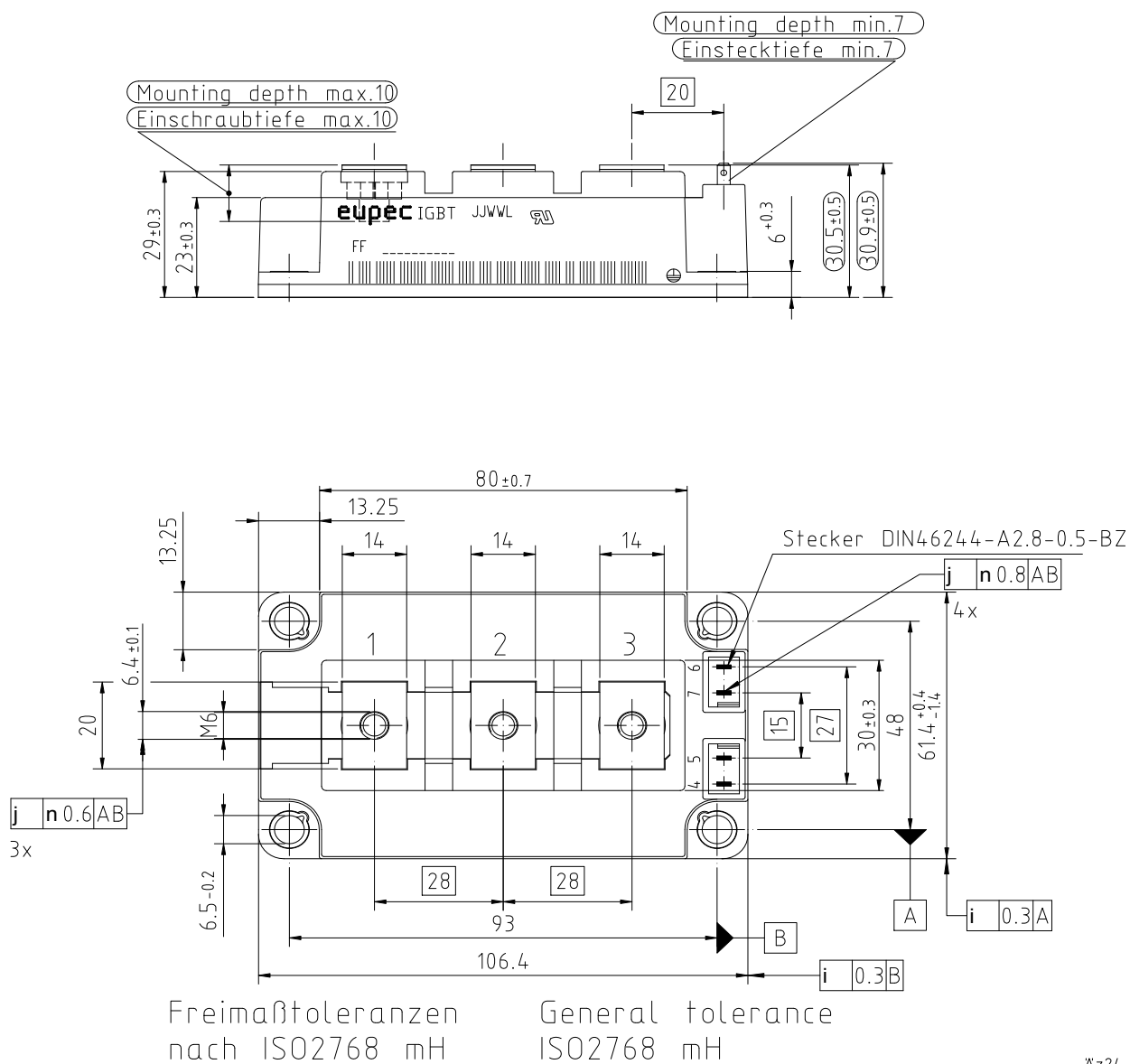
## FF300R12KS4



### 接线图 / circuit\_diagram\_headline



### 封装尺寸 / package outlines



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### 使用条件和条款

#### 使用条件和条款

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-得到质量协议的结论

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- the conclusion of Quality Agreements;

- to establish joint measures of an ongoing product survey, and that we may make delivery depended on the realization of any such measures.

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