

# 技术信息 / Technical Information

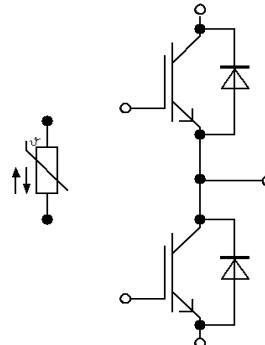
IGBT-模块  
IGBT-modules

FF650R17IE4



PrimePACK™2 模块 带有温度检测NTC

PrimePACK™2 module and NTC



$V_{CES} = 1700V$   
 $I_{C\ nom} = 650A / I_{CRM} = 1300A$

## 典型应用

- 三电平应用
- 辅助逆变器
- 大功率变流器
- 电机传动
- 风力发电机

## Typical Applications

- 3-Level-Applications
- Auxiliary Inverters
- High Power Converters
- Motor Drives
- Wind Turbines

## 电气特性

- 提高工作结温  $T_{vj\ op}$
- 高直流电压稳定性
- 高电流密度
- 低开关损耗
- $T_{vj\ op} = 150^{\circ}\text{C}$
- 低  $V_{CEsat}$

## Electrical Features

- Extended Operation Temperature  $T_{vj\ op}$
- High DC Stability
- High Current Density
- Low Switching Losses
- $T_{vj\ op} = 150^{\circ}\text{C}$
- Low  $V_{CEsat}$

## 机械特性

- 封装的 CTI > 400
- 高爬电距离和电气间隙
- 高功率循环和温度循环能力
- 高功率密度
- 铜基板
- 标封装

## Mechanical Features

- Package with CTI > 400
- High Creepage and Clearance Distances
- High Power and Thermal Cycling Capability
- High Power Density
- Copper Base Plate
- Standard Housing

## Module Label Code

Barcode Code 128



000001234560000000000000

DMX - Code



## Content of the Code

	Digit
Module Serial Number	1 - 5
Module Material Number	6 - 11
Production Order Number	12 - 19
Datecode (Production Year)	20 - 21
Datecode (Production Week)	22 - 23

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## IGBT, 逆变器 / IGBT, Inverter

### 最大额定值 / Maximum Rated Values

集电极 - 发射极电压 Collector-emitter voltage	$T_{vj} = 25^\circ\text{C}$	$V_{CES}$	1700	V
连续集电极直流电流 Continuous DC collector current	$T_C = 100^\circ\text{C}, T_{vj \max} = 175^\circ\text{C}$ $T_C = 25^\circ\text{C}, T_{vj \max} = 175^\circ\text{C}$	$I_{C \text{ nom}}$ $I_C$	650 930	A A
集电极重复峰值电流 Repetitive peak collector current	$t_P = 1 \text{ ms}$	$I_{CRM}$	1300	A
总功率损耗 Total power dissipation	$T_C = 25^\circ\text{C}, T_{vj \max} = 175^\circ\text{C}$	$P_{\text{tot}}$	4,15	kW
栅极 - 发射极峰值电压 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 Collector-emitter saturation voltage	$I_C = 650 \text{ A}, V_{GE} = 15 \text{ V}$ $I_C = 650 \text{ A}, V_{GE} = 15 \text{ V}$ $I_C = 650 \text{ A}, V_{GE} = 15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$V_{CE \text{ sat}}$	2,00 2,35 2,45	2,45 2,80 V
栅极阈值电压 Gate threshold voltage	$I_C = 24,0 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^\circ\text{C}$		$V_{GE \text{ th}}$	5,2	5,8 6,4
栅极电荷 Gate charge	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		$Q_G$	7,00	$\mu\text{C}$
内部栅极电阻 Internal gate resistor	$T_{vj} = 25^\circ\text{C}$		$R_{Gint}$	2,3	$\Omega$
输入电容 Input capacitance	$f = 1 \text{ MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		$C_{ies}$	54,0	nF
反向传输电容 Reverse transfer capacitance	$f = 1 \text{ MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		$C_{res}$	1,70	nF
集电极-发射极截止电流 Collector-emitter cut-off current	$V_{CE} = 1700 \text{ V}, V_{GE} = 0 \text{ V}, T_{vj} = 25^\circ\text{C}$		$I_{CES}$	5,0	mA
栅极-发射极漏电流 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) Turn-on delay time, inductive load	$I_C = 650 \text{ A}, V_{CE} = 900 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Gon} = 1,8 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$t_{d \text{ on}}$	0,55 0,60 0,60	$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
上升时间(电感负载) Rise time, inductive load	$I_C = 650 \text{ A}, V_{CE} = 900 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Gon} = 1,8 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$t_r$	0,09 0,11 0,12	$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
关断延迟时间(电感负载) Turn-off delay time, inductive load	$I_C = 650 \text{ A}, V_{CE} = 900 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Goff} = 2,7 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$t_{d \text{ off}}$	1,00 1,25 1,30	$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
下降时间(电感负载) Fall time, inductive load	$I_C = 650 \text{ A}, V_{CE} = 900 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Goff} = 2,7 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$t_f$	0,29 0,49 0,57	$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	$I_C = 650 \text{ A}, V_{CE} = 900 \text{ V}, L_S = 45 \text{ nH}$ $V_{GE} = \pm 15 \text{ V}, di/dt = 5000 \text{ A}/\mu\text{s} (T_{vj} = 150^\circ\text{C})$ $R_{Gon} = 1,8 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$E_{on}$	205 300 320	mJ mJ mJ
关断损耗能量 (每脉冲 ) Turn-off energy loss per pulse	$I_C = 650 \text{ A}, V_{CE} = 900 \text{ V}, L_S = 45 \text{ nH}$ $V_{GE} = \pm 15 \text{ V}, du/dt = 3200 \text{ V}/\mu\text{s} (T_{vj} = 150^\circ\text{C})$ $R_{Goff} = 2,7 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$E_{off}$	140 205 230	mJ mJ mJ
短路数据 SC data	$V_{GE} \leq 15 \text{ V}, V_{CC} = 1000 \text{ V}$ $V_{CEmax} = V_{CES} - L_{SC} \cdot di/dt$	$t_P \leq 10 \mu\text{s}, T_{vj} = 150^\circ\text{C}$	$I_{SC}$	2700	A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		$R_{thJC}$	36,0	K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个 IGBT / per IGBT $\lambda_{Paste} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	14,0	K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj op}$	-40	150 °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 Repetitive peak reverse voltage	$T_{vj} = 25^\circ\text{C}$	$V_{RRM}$	1700	V
连续正向直流电流 Continuous DC forward current		$I_F$	650	A
正向重复峰值电流 Repetitive peak forward current	$t_P = 1 \text{ ms}$	$I_{FRM}$	1300	A
$I^2t$ -值 $I^2t$ - value	$V_R = 0 \text{ V}, t_P = 10 \text{ ms}, T_{vj} = 125^\circ\text{C}$	$I^2t$	70,5	kA <sup>2</sup> s
最大损耗功率 Maximum power dissipation	$T_{vj} = 125^\circ\text{C}$	$P_{RQM}$	650	kW

## 特征值 / Characteristic Values

			min.	typ.	max.
正向电压 Forward voltage	$I_F = 650 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 650 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 650 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$V_F$	1,85 1,95 1,95	2,25 2,35 V
反向恢复峰值电流 Peak reverse recovery current	$I_F = 650 \text{ A}, -dI_F/dt = 5200 \text{ A}/\mu\text{s} (T_{vj}=150^\circ\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$I_{RM}$	695 760 805	A A A
恢复电荷 Recovered charge	$I_F = 650 \text{ A}, -dI_F/dt = 5200 \text{ A}/\mu\text{s} (T_{vj}=150^\circ\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$Q_r$	160 265 310	$\mu\text{C}$ $\mu\text{C}$ $\mu\text{C}$
反向恢复损耗 ( 每脉冲 ) Reverse recovery energy	$I_F = 650 \text{ A}, -dI_F/dt = 5200 \text{ A}/\mu\text{s} (T_{vj}=150^\circ\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 150^\circ\text{C}$	$E_{rec}$	76,0 135 160	mJ mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		$R_{thJC}$		71,5 K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / per diode $\lambda_{Paste} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	27,0	K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj op}$	-40	150 °C

## 负温度系数热敏电阻 / NTC-Thermistor

### 特征值 / Characteristic Values

			min.	typ.	max.
额定电阻值 Rated resistance	$T_C = 25^\circ\text{C}$	$R_{25}$		5,00	kΩ
R100 偏差 Deviation of R100	$T_C = 100^\circ\text{C}, R_{100} = 493 \Omega$	$\Delta R/R$	-5	5	%
耗散功率 Power dissipation	$T_C = 25^\circ\text{C}$	$P_{25}$		20,0	mW
B-值 B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25/50}$		3375	K
B-值 B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25/80}$		3411	K
B-值 B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25/100}$		3433	K

根据应用手册标定

Specification according to the valid application note.

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## 模块 / Module

绝缘测试电压 Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	V <sub>ISOL</sub>	4,0	kV
模块基板材料 Material of module baseplate			Cu	
内部绝缘 Internal isolation	基本绝缘 (class 1, IEC 61140) basic insulation (class 1, IEC 61140)		Al <sub>2</sub> O <sub>3</sub>	
爬电距离 Creepage distance	端子- 散热片 / terminal to heatsink 端子- 端子 / terminal to terminal		33,0 33,0	mm
电气间隙 Clearance	端子- 散热片 / terminal to heatsink 端子- 端子 / terminal to terminal		19,0 19,0	mm
相对电痕指数 Comperative tracking index		CTI	> 400	
			min. typ. max.	
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个模块 / per module $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$	R <sub>thCH</sub>	4,50	K/kW
杂散电感,模块 Stray inductance module		L <sub>sCE</sub>	18	nH
模块引线电阻,端子-芯片 Module lead resistance, terminals - chip	T <sub>c</sub> = 25°C, 每个开关 / per switch	R <sub>CC'EE'</sub>	0,30	mΩ
储存温度 Storage temperature		T <sub>stg</sub>	-40	150 °C
模块安装的安装扭距 Mounting torque for modul mounting	螺丝 M5 根据相应的应用手册进行安装 Screw M5 - Mounting according to valid application note	M	3,00	- 6,00 Nm
端子联接扭距 Terminal connection torque	螺丝 M4 根据相应的应用手册进行安装 Screw M4 - Mounting according to valid application note 螺丝 M8 根据相应的应用手册进行安装 Screw M8 - Mounting according to valid application note	M	1,8 8,0	- 2,1 10 Nm
重量 Weight		G	825	g

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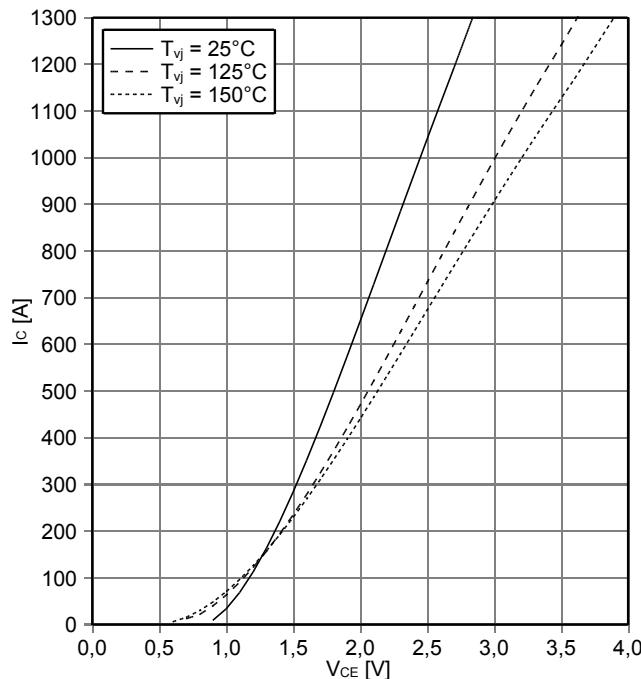
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IGBT-模块  
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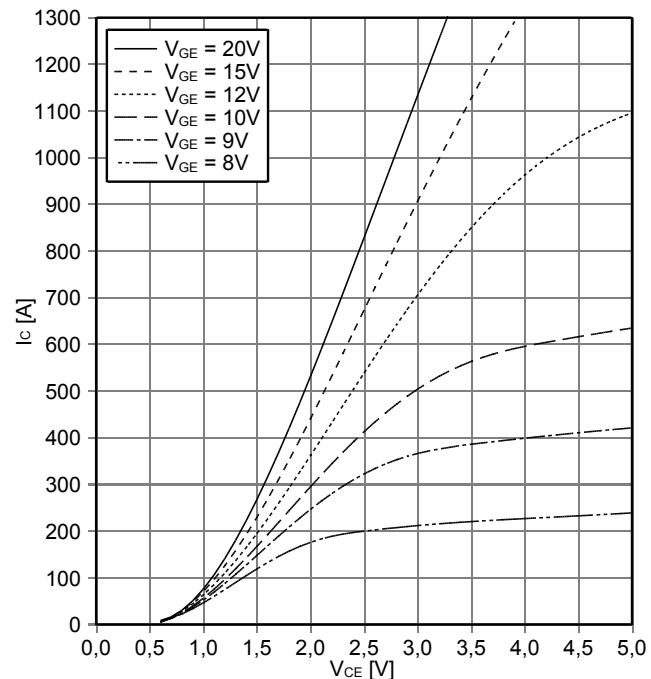
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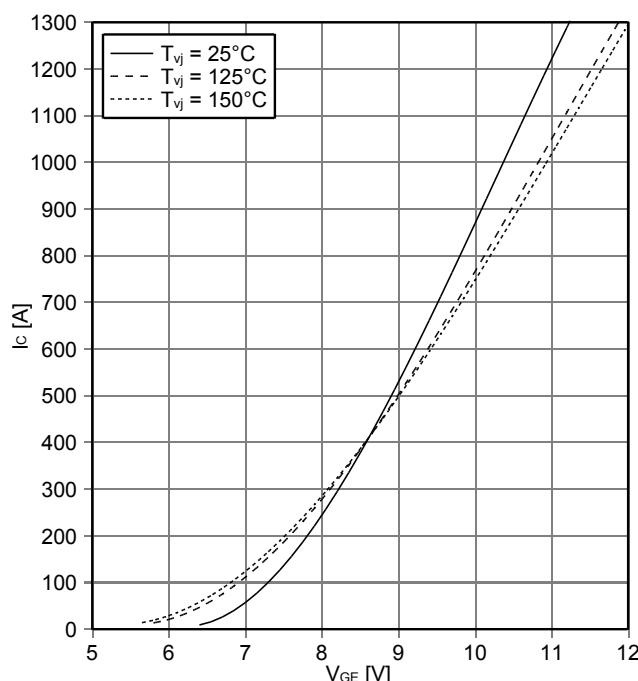
**输出特性 IGBT, 逆变器 (典型)**  
**output characteristic IGBT,Inverter (typical)**  
 $I_c = f(V_{CE})$   
 $V_{GE} = 15\text{ V}$



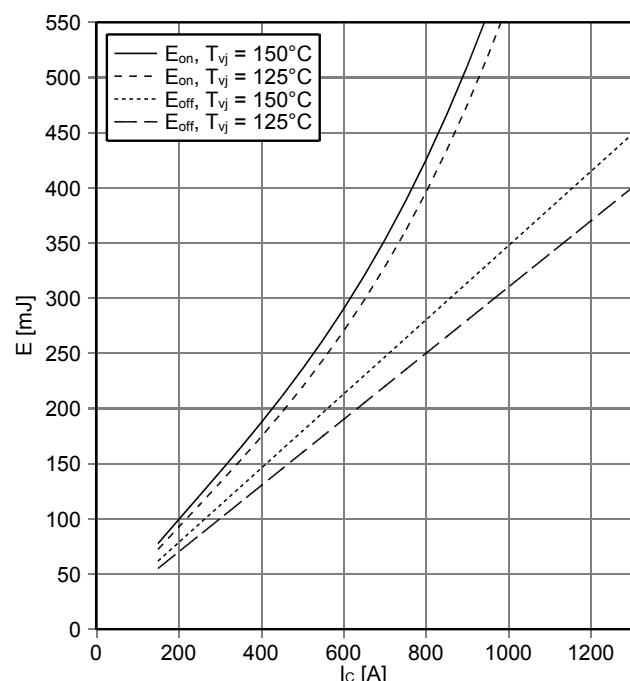
**输出特性 IGBT, 逆变器 (典型)**  
**output characteristic IGBT,Inverter (typical)**  
 $I_c = f(V_{CE})$   
 $T_{vj} = 150^\circ\text{C}$



**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)**  
 $E_{on} = f(I_c)$ ,  $E_{off} = f(I_c)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Gon} = 1.8\text{ }\Omega$ ,  $R_{Goff} = 2.7\text{ }\Omega$ ,  $V_{CE} = 900\text{ V}$



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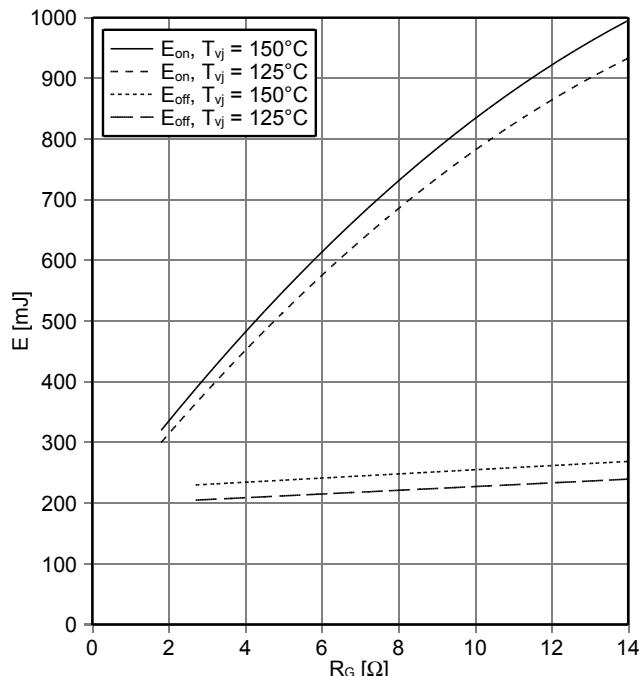
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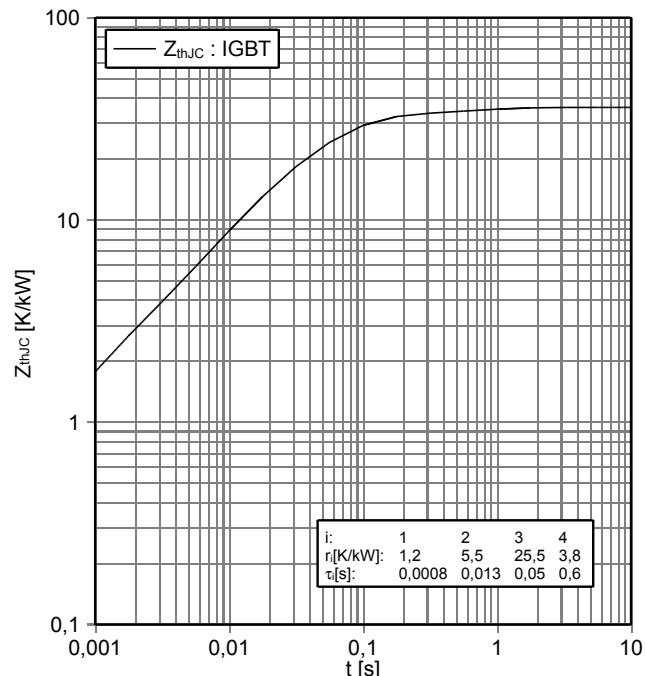
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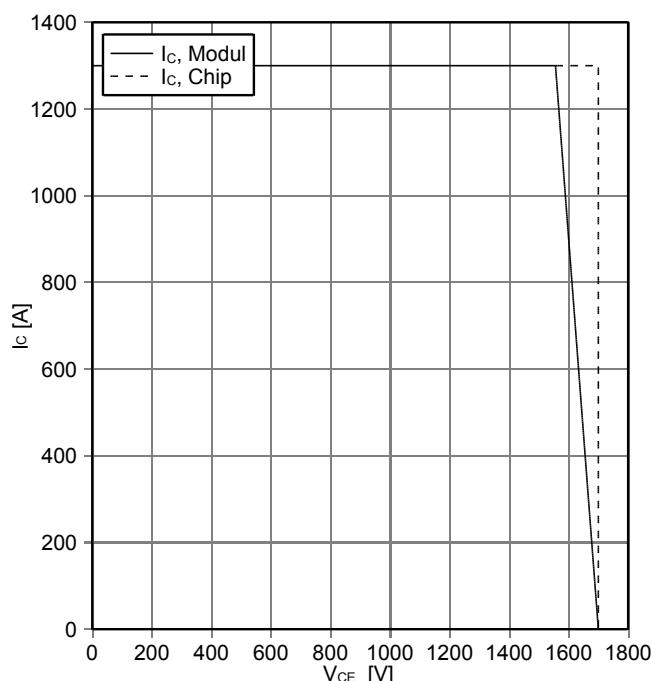
**开关损耗 IGBT, 逆变器 (典型)**  
**switching losses IGBT,Inverter (typical)**  
 $E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$   
 $V_{GE} = \pm 15 \text{ V}$ ,  $I_C = 650 \text{ A}$ ,  $V_{CE} = 900 \text{ V}$



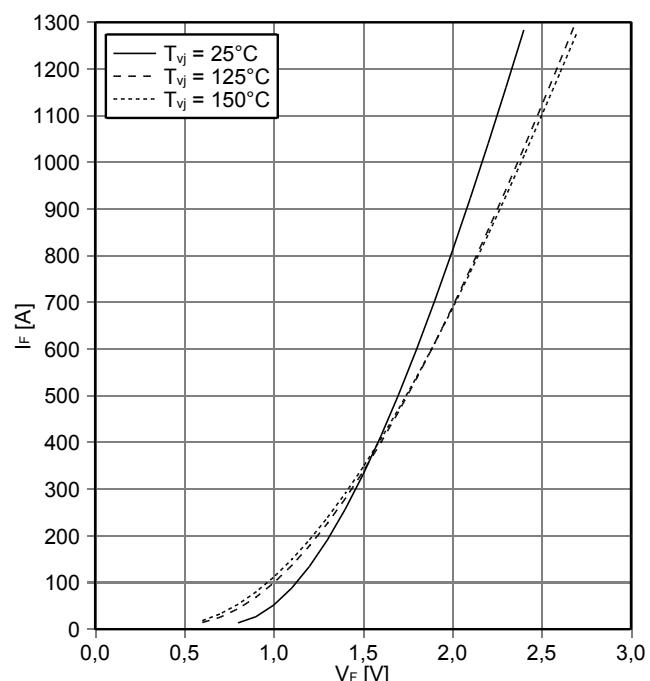
**瞬态热阻抗 IGBT, 逆变器**  
**transient thermal impedance IGBT,Inverter**  
 $Z_{thJC} = f(t)$



**反偏安全工作区 IGBT, 逆变器 (RBSOA)**  
**reverse bias safe operating area IGBT,Inverter (RBSOA)**  
 $I_C = f(V_{CE})$   
 $V_{GE} = \pm 15 \text{ V}$ ,  $R_{Goff} = 2.7 \Omega$ ,  $T_{vj} = 150^\circ\text{C}$



**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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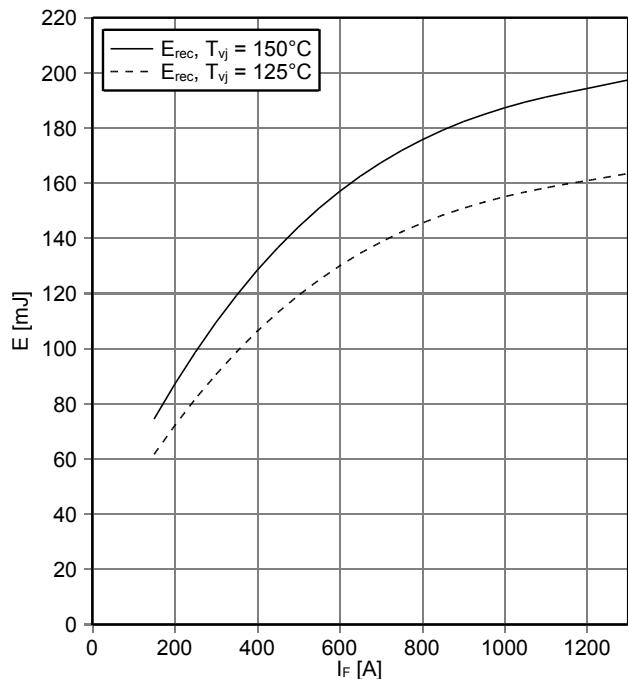
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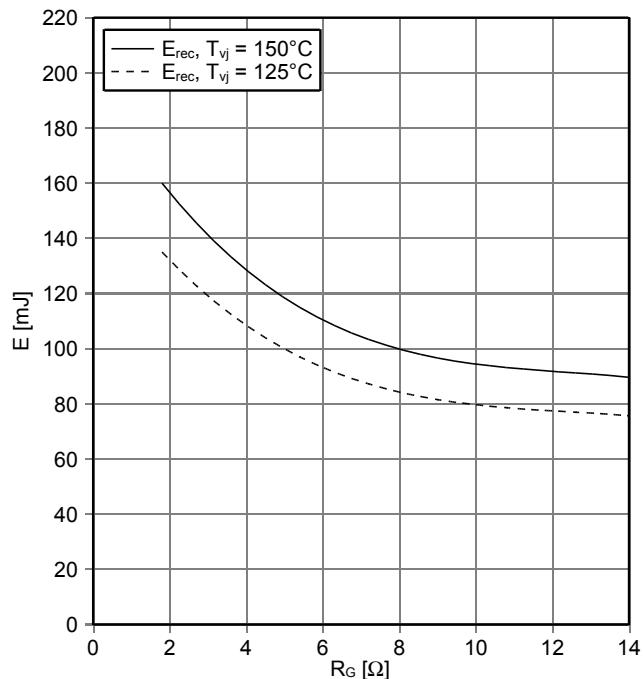
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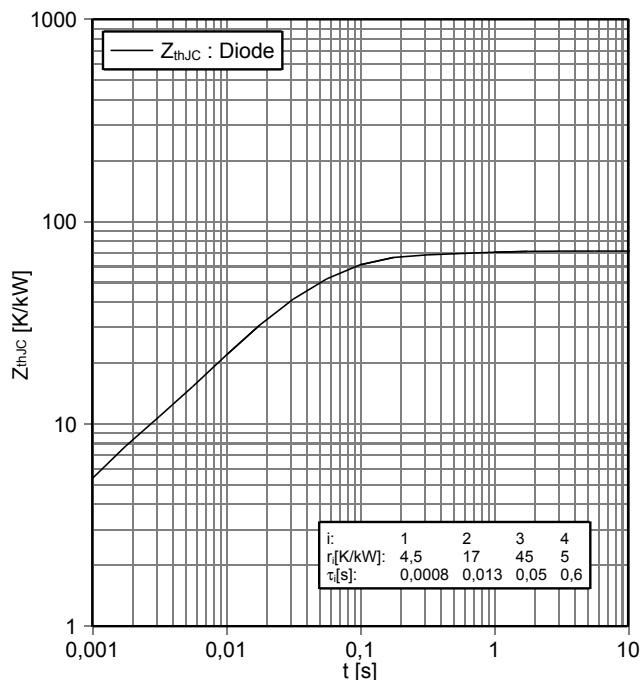
**开关损耗 二极管,逆变器 (典型)**  
**switching losses Diode, Inverter (typical)**  
 $E_{rec} = f(I_F)$   
 $R_{Gon} = 1.8 \Omega$ ,  $V_{CE} = 900 V$



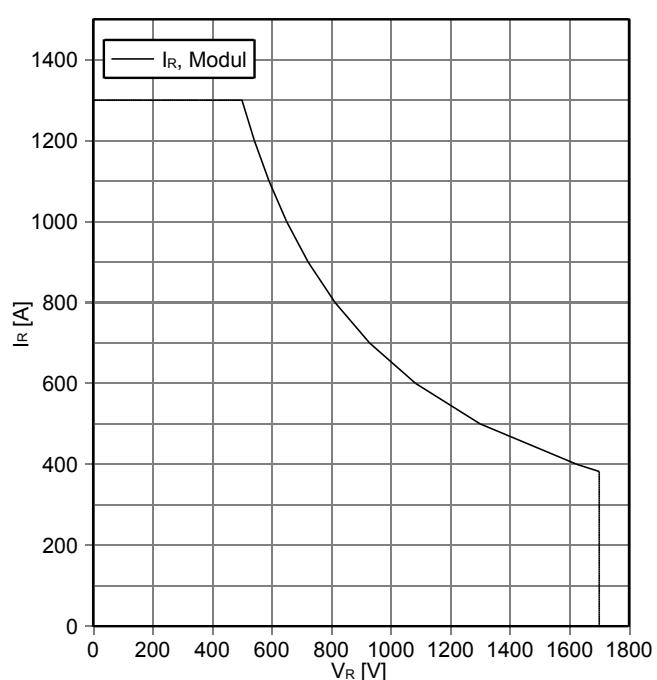
**开关损耗 二极管,逆变器 (典型)**  
**switching losses Diode, Inverter (typical)**  
 $E_{rec} = f(R_G)$   
 $I_F = 650 A$ ,  $V_{CE} = 900 V$



**瞬态热阻抗 二极管,逆变器**  
**transient thermal impedance Diode, Inverter**  
 $Z_{thJC} = f(t)$



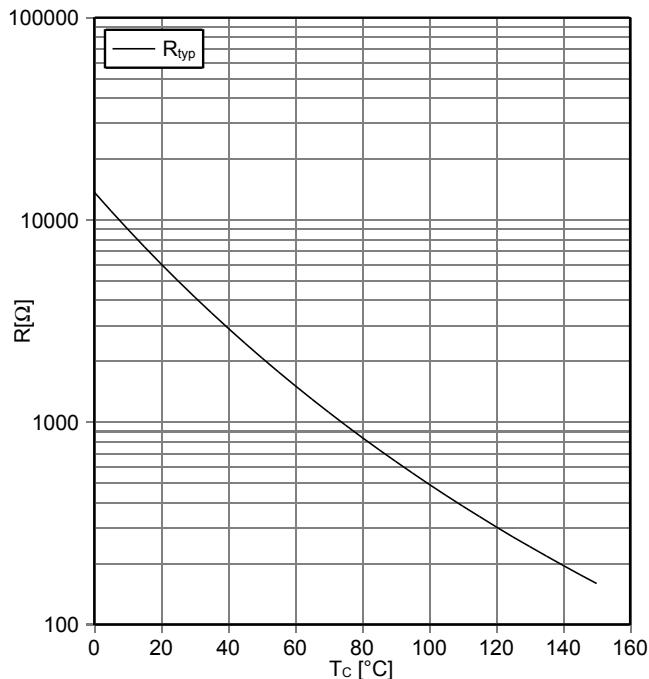
**安全工作区 二极管,逆变器 (SOA)**  
**safe operation area Diode, Inverter (SOA)**  
 $I_R = f(V_R)$   
 $T_{vj} = 150^\circ C$



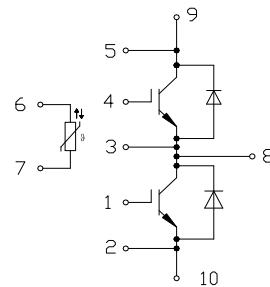
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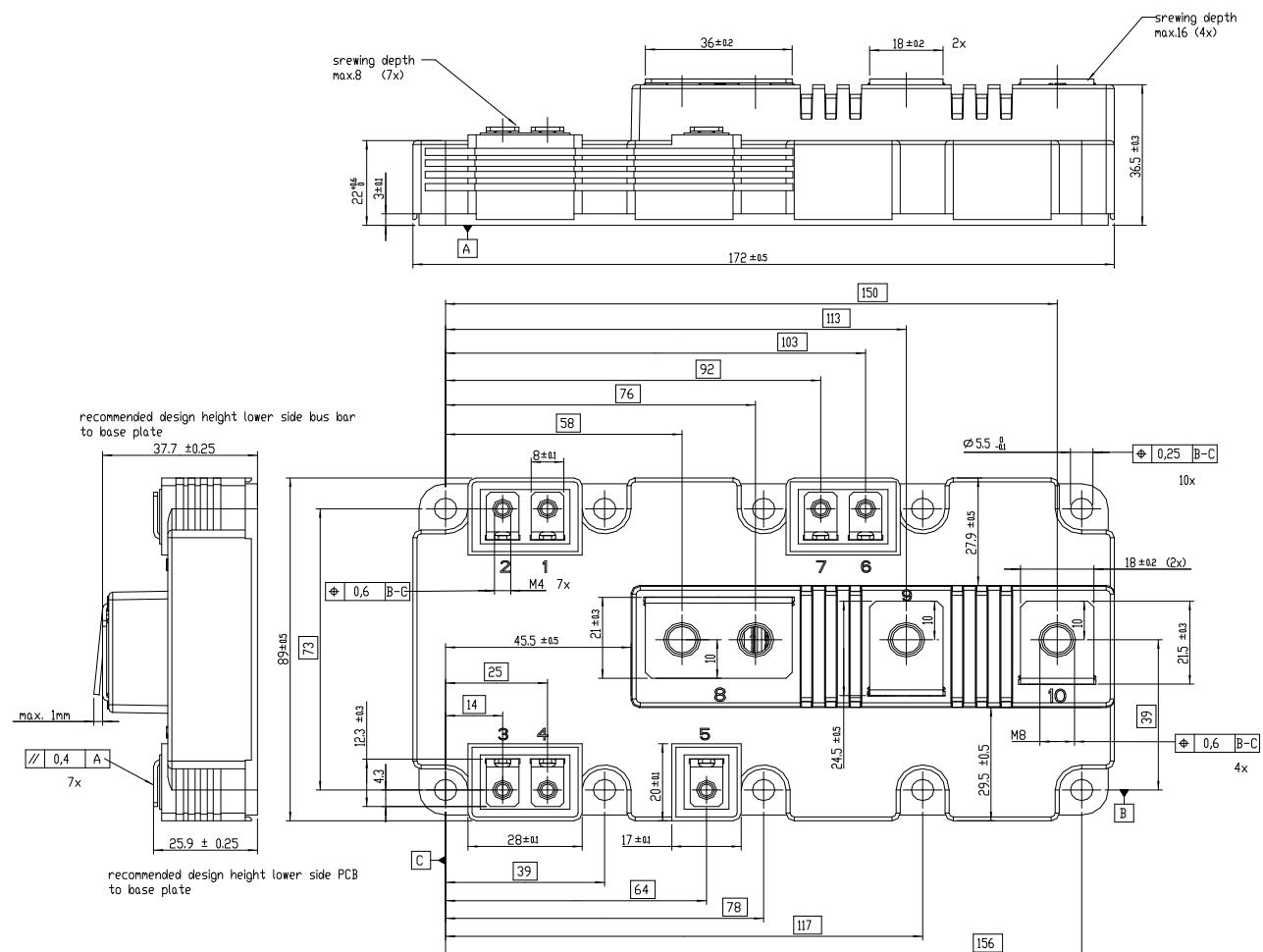
负温度系数热敏电阻 温度特性  
NTC-Thermistor-temperature characteristic (typical)  
 $R = f(T)$



## 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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如果您有超出规格书所提供的产品信息的要求或者对我们的产品针对的特殊应用有疑虑的话，请联系我们负责你的销售部门（详情查询 [www.infineon.com](http://www.infineon.com)）。对那些特别感兴趣的问题我们将提供相应的应用手册

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如果您想将我们的产品用于航天，健康，危及生命或者生命维持等应用，请申明。

请注意，对这类应用我们强烈建议

-执行联合的风险和质量评估

-得到质量协议的结论

-建立联合的测试和出厂产品检查，我们可以根据测试的实际情况供货

如果有必要，请根据实际需要将类似的说明给你的客户

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## Terms & Conditions of usage

The data contained in this product data sheet is exclusively intended for technically trained staff. You and your technical departments will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to such application.

This product data sheet is describing the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively pursuant the terms and conditions of the supply agreement. There will be no guarantee of any kind for the product and its characteristics. The information in the valid application- and assembly notes of the module must be considered.

Should you require product information in excess of the data given in this product data sheet or which concerns the specific application of our product, please contact the sales office, which is responsible for you ( see [www.infineon.com](http://www.infineon.com) ). For those that are specifically interested we may provide application notes.

Due to technical requirements our product may contain dangerous substances. For information on the types in question please contact the sales office, which is responsible for you.

Should you intend to use the Product in aviation applications, in health or live endangering or life support applications, please notify. Please note, that for any such applications we urgently recommend

- to perform joint Risk and Quality Assessments;
- 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.

If and to the extent necessary, please forward equivalent notices to your customers.

Changes of this product data sheet are reserved.

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