

高绝缘等级模块  
high insulated module



### 潜在应用

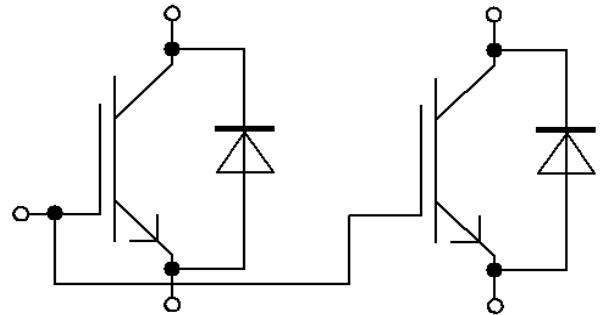
- 中压变流器
- 牵引变流器

### 电气特性

- 低  $V_{CEsat}$

### 机械特性

- 加强绝缘封装，10.4kV 交流 10 秒
- 封装的 CTI > 600
- 扩大存储温度范围至  $T_{stg} = -55^{\circ}C$
- 碳化硅铝 (AlSiC) 基板提供更高的温度循环能力
- 高爬电距离和电气间隙



$$V_{CES} = 6500V$$

$$I_{C\ nom} = 500A / I_{CRM} = 1000A$$

### Potential Applications

- Medium voltage converters
- Traction drives

### Electrical Features

- LOW  $V_{CEsat}$

### Mechanical Features

- Package with enhanced insulation of 10.4kV AC 10s
- Package with CTI > 600
- Extended storage temperature down to  $T_{stg} = -55^{\circ}C$
- AlSiC base plate for increased thermal cycling capability
- High creepage and clearance distances

## Module Label Code

Barcode Code 128



DMX - Code



### Content of the 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

## 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	$T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = -50^{\circ}\text{C}$	$V_{CES}$	6500 6500 5900	V
连续集电极直流电流 Continuous DC collector current	$T_C = 80^{\circ}\text{C}, T_{vj\max} = 150^{\circ}\text{C}$	$I_{C\text{nom}}$	500	A
集电极重复峰值电流 Repetitive peak collector current	$t_P = 1\text{ ms}$	$I_{CRM}$	1000	A
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	$I_C = 500\text{ A}, V_{GE} = 15\text{ V}$ $I_C = 500\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_{CE\text{sat}}$	3,00 3,70	3,40 4,20	V V
栅极阈值电压 Gate threshold voltage	$I_C = 70,0\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$		$V_{GEth}$	5,40	6,00	6,60 V
栅极电荷 Gate charge	$V_{GE} = -15\text{ V} \dots +15\text{ V}, V_{CE} = 3600\text{ V}$		$Q_G$	20,0		$\mu\text{C}$
内部栅极电阻 Internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$		$R_{Gint}$	1,1		$\Omega$
输入电容 Input capacitance	$f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		$C_{ies}$	135		nF
反向传输电容 Reverse transfer capacitance	$f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		$C_{res}$	2,10		nF
集电极-发射极截止电流 Collector-emitter cut-off current	$V_{CE} = 6500\text{ V}, V_{GE} = 0\text{ V}, T_{vj} = 25^{\circ}\text{C}$		$I_{CES}$		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	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 1,5\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_{don}$	0,70 0,80		$\mu\text{s}$ $\mu\text{s}$
上升时间(电感负载) Rise time, inductive load	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 1,5\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_r$	0,33 0,40		$\mu\text{s}$ $\mu\text{s}$
关断延迟时间(电感负载) Turn-off delay time, inductive load	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 10\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_{doff}$	7,30 7,60		$\mu\text{s}$ $\mu\text{s}$
下降时间(电感负载) Fall time, inductive load	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 10\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_f$	0,40 0,50		$\mu\text{s}$ $\mu\text{s}$
开通损耗能量(每脉冲) Turn-on energy loss per pulse	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}, L_S = 280\text{ nH}$ $V_{GE} = \pm 15\text{ V}, di/dt = 2000\text{ A}/\mu\text{s}$ $R_{Gon} = 1,5\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{on}$	2800 4300		mJ mJ
关断损耗能量(每脉冲) Turn-off energy loss per pulse	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}, L_S = 280\text{ nH}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 10\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{off}$	2400 2800		mJ mJ
短路数据 SC data	$V_{GE} \leq 15\text{ V}, V_{CC} = 4500\text{ V}$ $V_{CE\max} = V_{CES} - L_{SCE} \cdot di/dt$ $t_P \leq 10\ \mu\text{s}, T_{vj} = 125^{\circ}\text{C}$		$I_{SC}$	3000		A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		$R_{thJC}$		13,1	K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个 IGBT / per IGBT $\lambda_{\text{Paste}} = 1\text{ W}/(\text{m}\cdot\text{K}) / \lambda_{\text{grease}} = 1\text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$		13,2	K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj\text{op}}$	-50	125	$^{\circ}\text{C}$

## 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	$T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = -50^{\circ}\text{C}$	$V_{RRM}$	6500 6500 5900	V
连续正向直流电流 Continuous DC forward current		$I_F$	500	A
正向重复峰值电流 Repetitive peak forward current	$t_p = 1 \text{ ms}$	$I_{FRM}$	1000	A
$I^2t$ -值 $I^2t$ - value	$V_R = 0 \text{ V}$ , $t_p = 10 \text{ ms}$ , $T_{vj} = 125^{\circ}\text{C}$	$I^2t$	210	$\text{kA}^2\text{s}$
最大损耗功率 Maximum power dissipation	$T_{vj} = 125^{\circ}\text{C}$	$P_{RQM}$	2000	kW
最小开通时间 Minimum turn-on time		$t_{on \text{ min}}$	10,0	$\mu\text{s}$

## 特征值 / Characteristic Values

			min.	typ.	max.	
正向电压 Forward voltage	$I_F = 500 \text{ A}$ , $V_{GE} = 0 \text{ V}$ $I_F = 500 \text{ A}$ , $V_{GE} = 0 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_F$	3,00 2,95	3,50 3,50	V V
反向恢复峰值电流 Peak reverse recovery current	$I_F = 500 \text{ A}$ , $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ( $T_{vj}=125^{\circ}\text{C}$ ) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$I_{RM}$	730 800		A A
恢复电荷 Recovered charge	$I_F = 500 \text{ A}$ , $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ( $T_{vj}=125^{\circ}\text{C}$ ) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$Q_r$	570 1050		$\mu\text{C}$ $\mu\text{C}$
反向恢复损耗 (每脉冲) Reverse recovery energy	$I_F = 500 \text{ A}$ , $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ( $T_{vj}=125^{\circ}\text{C}$ ) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{rec}$	930 2000		mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		$R_{thJC}$		27,9	K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / per diode $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	21,0		K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj \text{ op}}$	-50	125	$^{\circ}\text{C}$

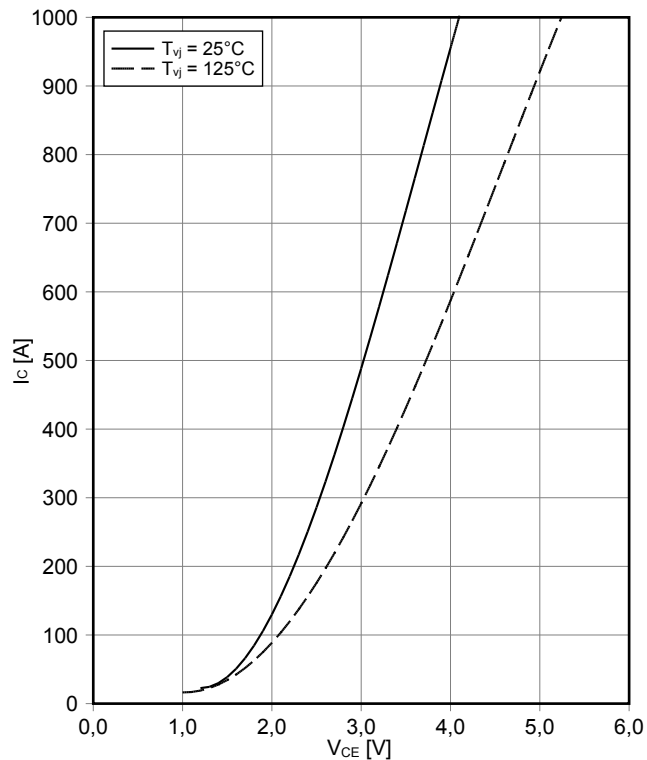
## 模块 / Module

绝缘测试电压 Isolation test voltage	RMS, f = 50 Hz, t = 10 s	V <sub>ISOL</sub>	10,4		kV
局部放电停止电压 Partial discharge extinction voltage	RMS, f = 50 Hz, Q <sub>PD</sub> typ 10 pC	V <sub>ISOL</sub>	5,1		kV
DC 稳定性 DC stability	T <sub>vj</sub> = 25°C, 100 fit	V <sub>CE D</sub>	3800		V
模块基板材料 Material of module baseplate			AlSiC		
内部绝缘 Internal isolation	基本绝缘 (class 1, IEC 61140) basic insulation (class 1, IEC 61140)		AlN		
爬电距离 Creepage distance	端子至散热器 / terminal to heatsink 端子至端子 / terminal to terminal		56,0 56,0		mm
电气间隙 Clearance	端子至散热器 / terminal to heatsink 端子至端子 / terminal to terminal		26,0 26,0		mm
相对电痕指数 Comperative tracking index		CTI	> 600		
			min.	typ.	max.
杂散电感, 模块 Stray inductance module		L <sub>sCE</sub>		20	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> R <sub>AA'+CC'</sub>		0,18 0,18	mΩ
储存温度 Storage temperature		T <sub>stg</sub>	-55		125 °C
模块安装的安装扭矩 Mounting torque for modul mounting	螺丝 M6 根据相应的应用手册进行安装 Screw M6 - Mounting according to valid application note	M	4,25		5,75 Nm
端子联接扭矩 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		1000	g

输出特性 IGBT, 逆变器 (典型)

output characteristic IGBT, Inverter (typical)

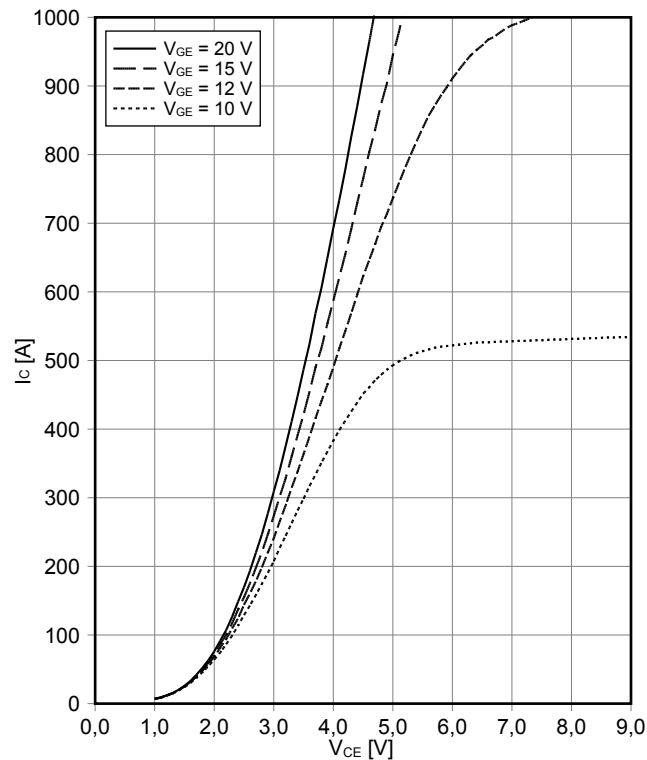
$I_C = f(V_{CE})$   
 $V_{GE} = 15\text{ V}$



输出特性 IGBT, 逆变器 (典型)

output characteristic IGBT, Inverter (typical)

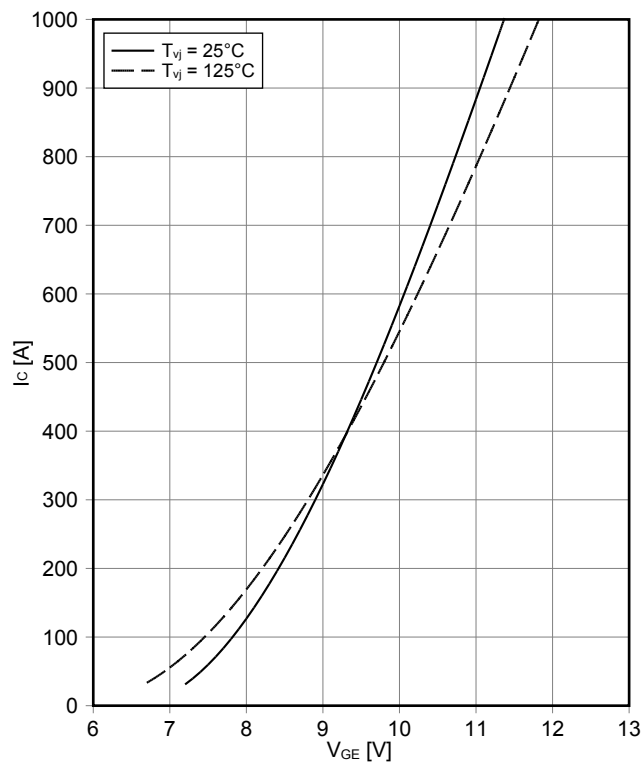
$I_C = f(V_{CE})$   
 $T_{vj} = 125^\circ\text{C}$



传输特性 IGBT, 逆变器 (典型)

transfer characteristic IGBT, Inverter (typical)

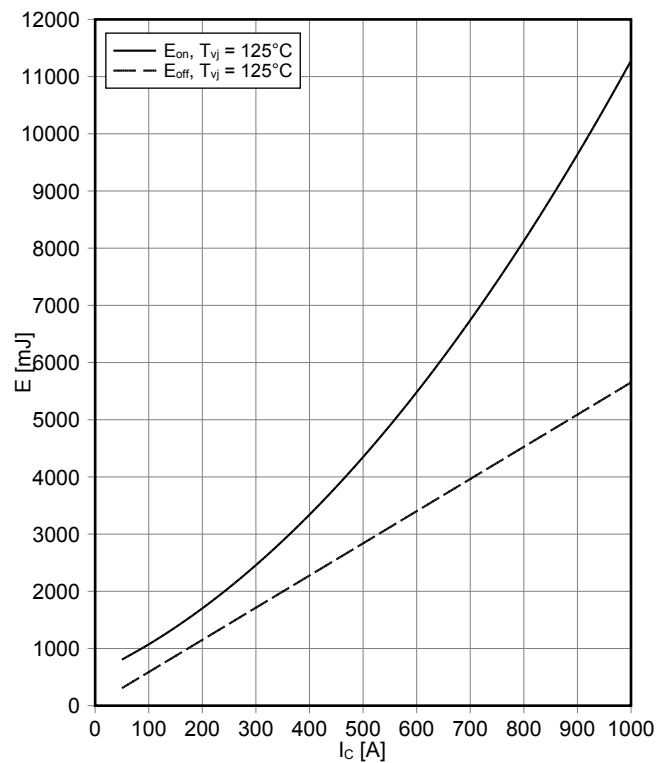
$I_C = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



开关损耗 IGBT, 逆变器 (典型)

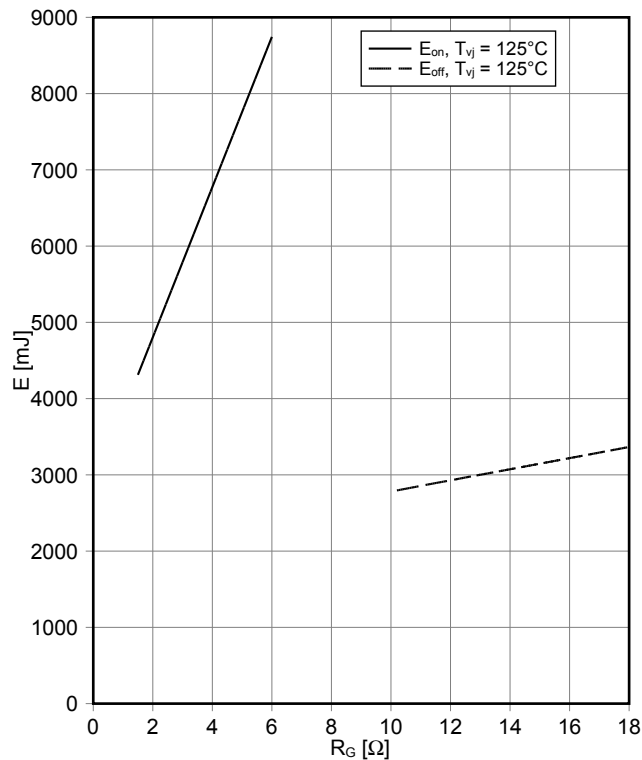
switching losses IGBT, Inverter (typical)

$E_{on} = f(I_C)$ ,  $E_{off} = f(I_C)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Gon} = 1.5\ \Omega$ ,  $R_{Goff} = 10\ \Omega$ ,  $V_{CE} = 3600\text{ V}$

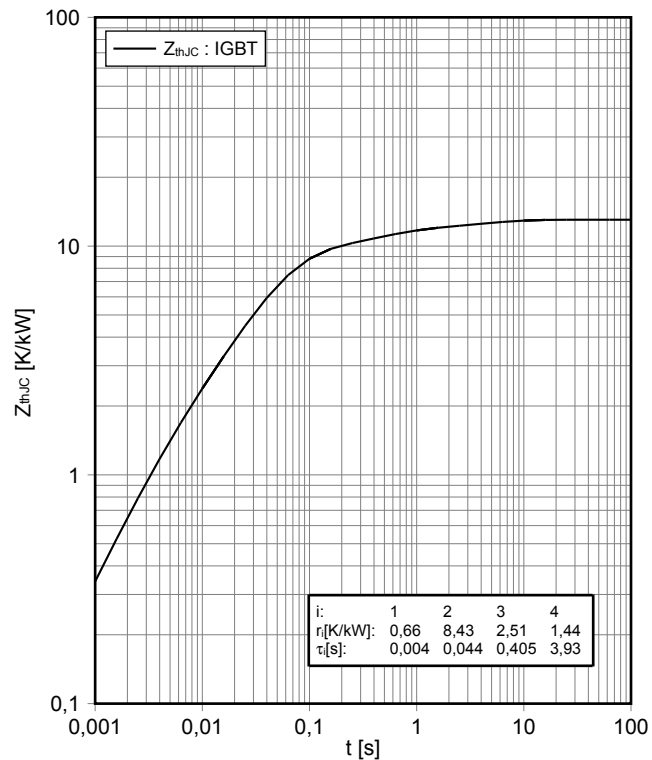


开关损耗 IGBT, 逆变器 (典型)  
**switching losses IGBT, Inverter (typical)**

$E_{on} = f(R_G), E_{off} = f(R_G)$   
 $V_{GE} = \pm 15 \text{ V}, I_C = 500 \text{ A}, V_{CE} = 3600 \text{ V}$

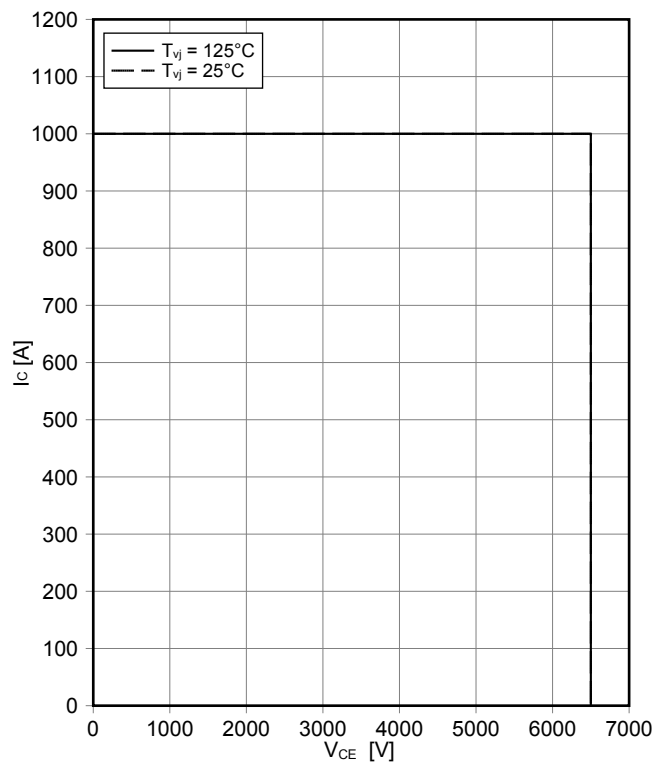


瞬态热阻抗 IGBT, 逆变器  
**transient thermal impedance IGBT, Inverter**  
 $Z_{thJC} = f(t)$

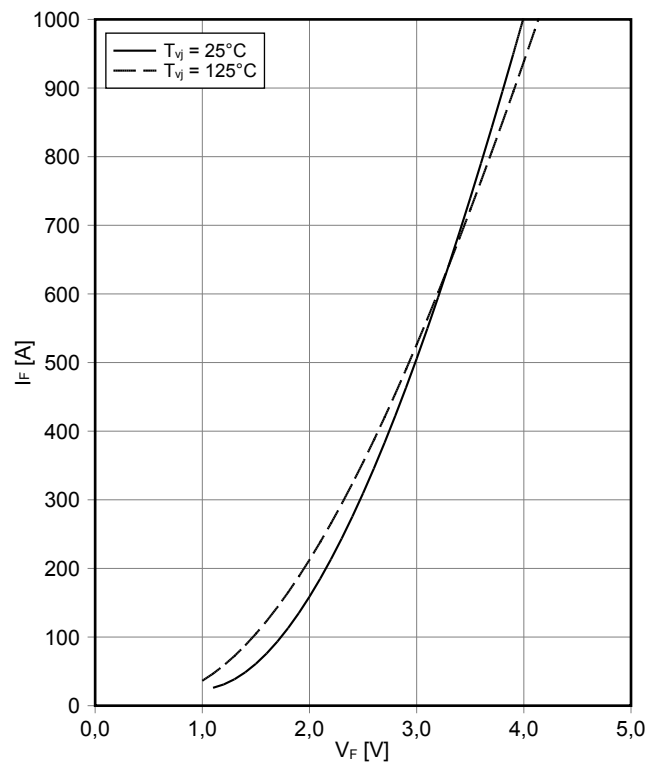


反偏安全工作区 IGBT, 逆变器 (RBSOA)  
**reverse bias safe operating area IGBT, Inverter (RBSOA)**

$I_C = f(V_{CE})$   
 $V_{GE} = \pm 15 \text{ V}, R_{Goff} = 10 \Omega, T_{vj} = 125^\circ\text{C}$

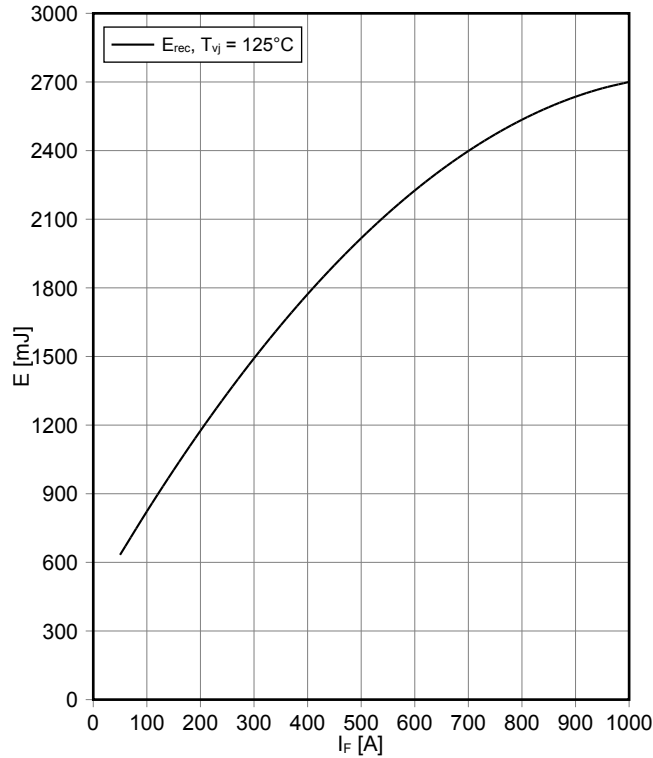


正向偏压特性 二极管, 逆变器 (典型)  
**forward characteristic of Diode, Inverter (typical)**  
 $I_F = f(V_F)$



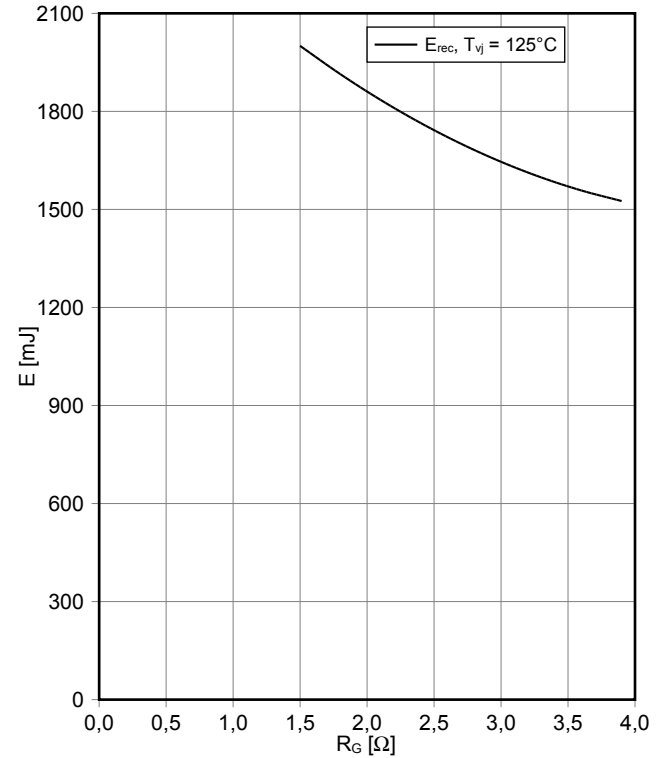
开关损耗 二极管,逆变器 (典型)  
**switching losses Diode, Inverter (typical)**

$E_{rec} = f(I_F)$   
 $R_{Gon} = 1.5 \Omega, V_{CE} = 3600 V$



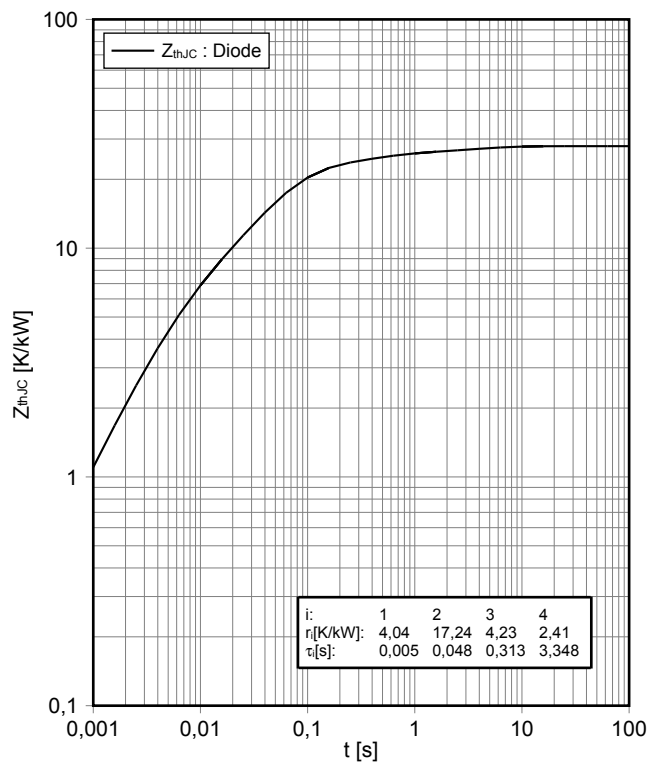
开关损耗 二极管,逆变器 (典型)  
**switching losses Diode, Inverter (typical)**

$E_{rec} = f(R_G)$   
 $I_F = 500 A, V_{CE} = 3600 V$



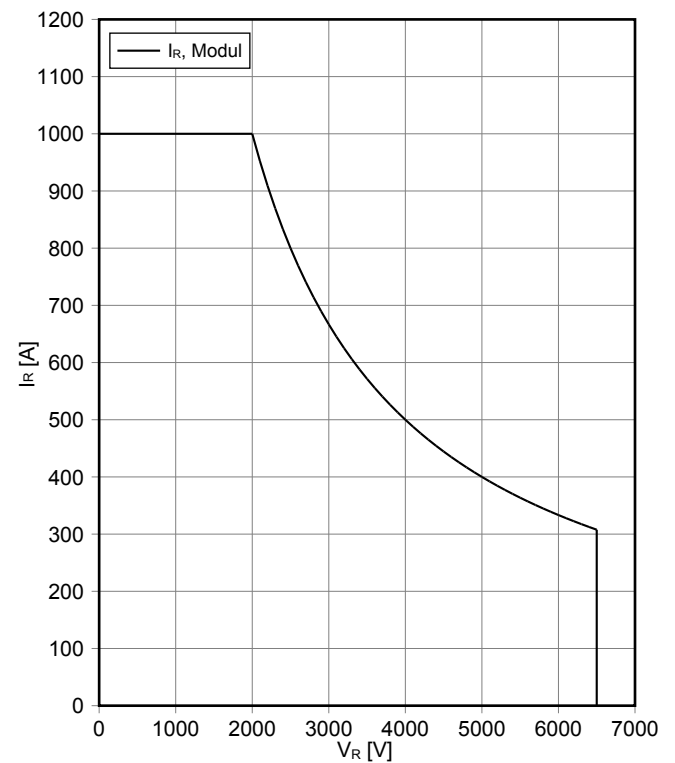
瞬态热阻抗 二极管,逆变器  
**transient thermal impedance Diode, Inverter**

$Z_{thJC} = f(t)$

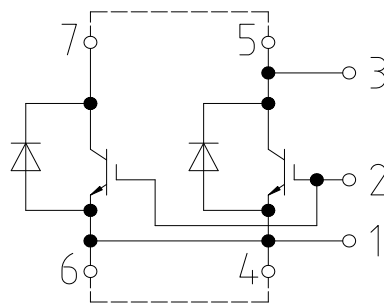


安全工作区 二极管,逆变器 (SOA)  
**safe operation area Diode, Inverter (SOA)**

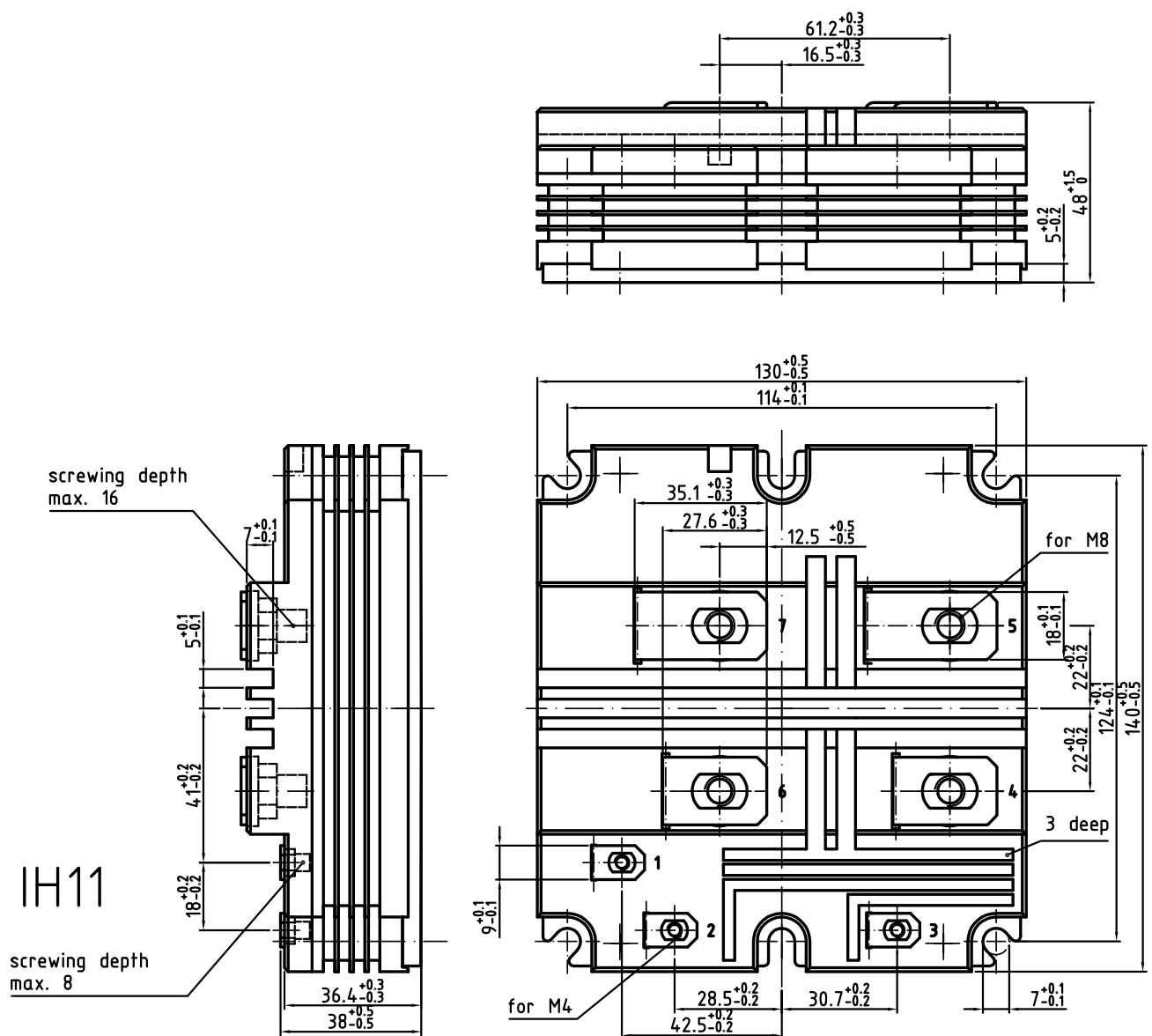
$I_R = f(V_R)$   
 $T_{vj} = 125^\circ C$



## 接线图 / Circuit diagram



## 封装尺寸 / Package outlines





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