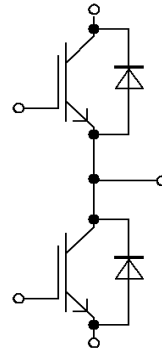


XHP™3 模块 采用第三代沟槽栅/场终止IGBT3和第三代发射极控制二极管
 XHP™3 module with Trench/Fieldstop IGBT3 and Emitter Controlled 3 diode

初步数据 / Preliminary Data



$V_{CES} = 3300V$
 $I_{C\ nom} = 450A / I_{CRM} = 900A$

潜在应用

- 中压变流器
- 牵引变流器
- 电机传动

Potential Applications

- Medium voltage converters
- Traction drives
- Motor drives

电气特性

- $T_{vj\ op} = 150^{\circ}C$
- 低 V_{CEsat}
- 低开关损耗
- 无与伦比的坚固性
- 高直流电压稳定性
- 高短路能力

Electrical Features

- $T_{vj\ op} = 150^{\circ}C$
- Low V_{CEsat}
- Low switching losses
- Unbeatable robustness
- High DC stability
- High short-circuit capability

机械特性

- 加强绝缘封装，10.4kV 交流 10秒
- 封装的 CTI > 600
- 碳化硅铝 (AlSiC) 基板提供更高的温度循环能力
- 绝缘的基板

Mechanical Features

- Package with enhanced insulation of 10.4kV AC 10s
- Package with CTI > 600
- AlSiC base plate for increased thermal cycling capability
- Isolated base plate

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

初步数据
 Preliminary Data

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	$T_{vj} = -40^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	V_{CES}	3300 3300	V
连续集电极直流电流 Continuous DC collector current	$T_C = 100^{\circ}\text{C}, T_{vj\max} = 150^{\circ}\text{C}$	I_{CDC}	450	A
集电极重复峰值电流 Repetitive peak collector current	$t_P = 1\text{ ms}$	I_{CRM}	900	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	$I_C = 450\text{ A}$ $V_{GE} = 15\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$V_{CE\text{ sat}}$	2,55 3,00 3,15	3,10 3,45	V V V
栅极阈值电压 Gate threshold voltage	$I_C = 12,0\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$		V_{GEth}	5,20	5,80	6,40 V
栅极电荷 Gate charge	$V_{GE} = -15 / 15\text{ V}, V_{CE} = 1800\text{ V}$		Q_G	12,5		μC
内部栅极电阻 Internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$		R_{Gint}	1,3		Ω
输入电容 Input capacitance	$f = 1000\text{ kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		C_{ies}	84,0		nF
反向传输电容 Reverse transfer capacitance	$f = 1000\text{ kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		C_{res}	2,00		nF
集电极-发射极截止电流 Collector-emitter cut-off current	$V_{CE} = 3300\text{ V}, V_{GE} = 0\text{ V}, T_{vj} = 25^{\circ}\text{C}$		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	$I_C = 450\text{ A}, V_{CE} = 1800\text{ V}$ $V_{GE} = -15 / 15\text{ V}$ $R_{Gon} = 0,7\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_{don}	0,53 0,57 0,58		μs μs μs
上升时间(电感负载) Rise time, inductive load	$I_C = 450\text{ A}, V_{CE} = 1800\text{ V}$ $V_{GE} = -15 / 15\text{ V}$ $R_{Gon} = 0,7\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_r	0,10 0,13 0,13		μs μs μs
关断延迟时间(电感负载) Turn-off delay time, inductive load	$I_C = 450\text{ A}, V_{CE} = 1800\text{ V}$ $V_{GE} = -15 / 15\text{ V}$ $R_{Goff} = 3,3\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_{doff}	1,71 1,86 1,92		μs μs μs
下降时间(电感负载) Fall time, inductive load	$I_C = 450\text{ A}, V_{CE} = 1800\text{ V}$ $V_{GE} = -15 / 15\text{ V}$ $R_{Goff} = 3,3\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_f	0,13 0,24 0,27		μs μs μs
开通损耗能量(每脉冲) Turn-on energy loss per pulse	$I_C = 450\text{ A}, V_{CE} = 1800\text{ V}, L_{\sigma} = 85\text{ nH}$ $di/dt = 3650\text{ A}/\mu\text{s} (T_{vj} = 150^{\circ}\text{C})$ $V_{GE} = -15 / 15\text{ V}, R_{Gon} = 0,7\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{on}	500 765 845		mJ mJ mJ
关断损耗能量(每脉冲) Turn-off energy loss per pulse	$I_C = 450\text{ A}, V_{CE} = 1800\text{ V}, L_{\sigma} = 85\text{ nH}$ $du/dt = 2850\text{ V}/\mu\text{s} (T_{vj} = 150^{\circ}\text{C})$ $V_{GE} = -15 / 15\text{ V}, R_{Goff} = 3,3\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{off}	415 600 660		mJ mJ mJ
短路数据 SC data	$V_{GE} \leq 15\text{ V}, V_{CC} = 1800\text{ V}$ $V_{CE\max} = V_{CES} - L_{SCE} \cdot di/dt$ $t_P \leq 10\ \mu\text{s}, T_{vj} = 150^{\circ}\text{C}$		I_{SC}	1700		A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}		28,4	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}		24,9	K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj\text{ op}}$	-40	150	$^{\circ}\text{C}$

初步数据
 Preliminary Data

 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	$T_{vj} = -40^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	V_{RRM}	3300 3300	V
连续正向直流电流 Continuous DC forward current		I_F	450	A
正向重复峰值电流 Repetitive peak forward current	$t_P = 1\text{ ms}$	I_{FRM}	900	A
I^2t -值 I^2t - value	$V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 125^{\circ}\text{C}$ $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$	I^2t	82,9 68,0	kA^2s kA^2s
最大损耗功率 Maximum power dissipation	$T_{vj} = 150^{\circ}\text{C}$	P_{RQM}	1000	kW
最小开通时间 Minimum turn-on time		$t_{on\ min}$	10,0	μs

特征值 / Characteristic Values

		min.	typ.	max.		
正向电压 Forward voltage	$I_F = 450\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 450\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 450\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	V_F	3,10 2,75 2,65	3,85 3,25	V V V
反向恢复峰值电流 Peak reverse recovery current	$I_F = 450\text{ A}, -di_F/dt = 3650\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 1800\text{ V}$ $V_{GE} = -15\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	I_{RM}	680 680 680		A A A
恢复电荷 Recovered charge	$I_F = 450\text{ A}, -di_F/dt = 3650\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 1800\text{ V}$ $V_{GE} = -15\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	Q_r	230 445 525		μC μC μC
反向恢复损耗 (每脉冲) Reverse recovery energy	$I_F = 450\text{ A}, -di_F/dt = 3650\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 1800\text{ V}$ $V_{GE} = -15\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{rec}	220 490 595		mJ mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}		45,5	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}	25,0		K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj\ op}$	-40	150	$^{\circ}\text{C}$

初步数据
 Preliminary Data

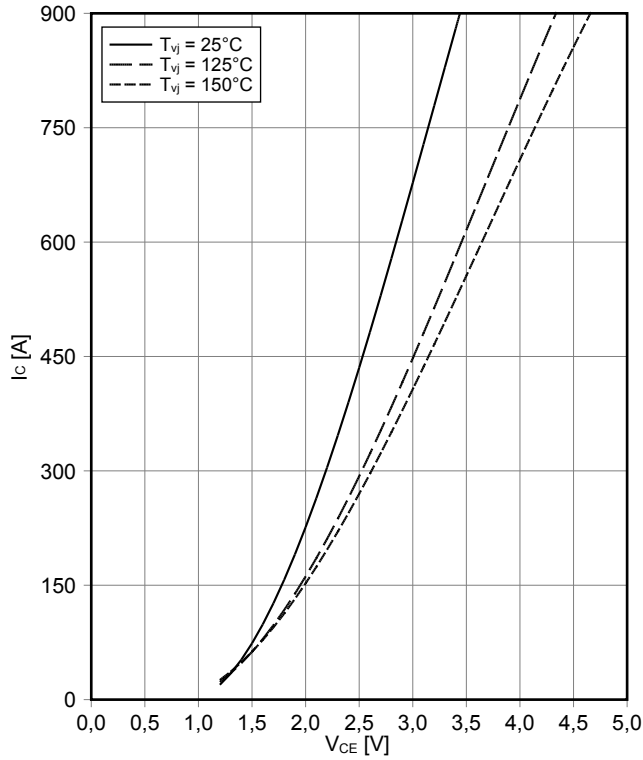
模块 / Module

绝缘测试电压 Isolation test voltage	RMS, f = 50 Hz, t = 10 s	V _{ISOL}	10,4		kV
局部放电停止电压 Partial discharge extinction voltage	RMS, f = 50 Hz, Q _{PD} typ. 10 pC	V _{ISOL}	5,1		kV
模块基板材料 Material of module baseplate			AISiC		
爬电距离 Creepage distance	端子至散热器 / terminal to heatsink 端子至端子 / terminal to terminal		53,0		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		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 _{sCE}		25	nH
模块引线电阻, 端子-芯片 Module lead resistance, terminals - chip	T _c = 25°C, 每个开关 / per switch	R _{CC'+EE'} R _{AA'+CC'}		0,41 0,31	mΩ
储存温度 Storage temperature		T _{stg}	-40		150 °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 M8 根据相应的应用手册进行安装 Screw M8 - Mounting according to valid application note 螺丝 M3 根据相应的应用手册进行安装 Screw M3 - Mounting according to valid application note	M	8,0 0,9	- -	10 1,1 Nm
重量 Weight		G		700	g

初步数据 Preliminary Data

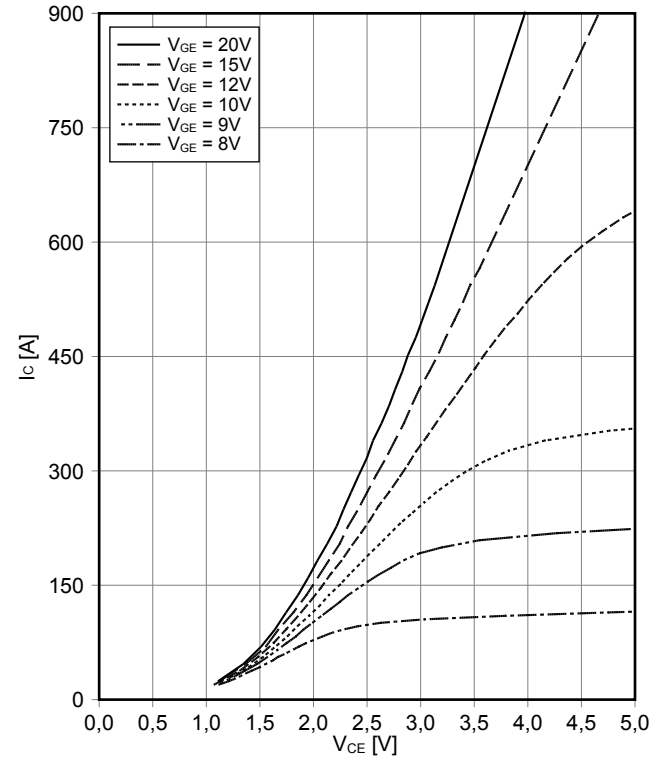
输出特性 IGBT, 逆变器 (典型)
output characteristic IGBT, Inverter (typical)

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



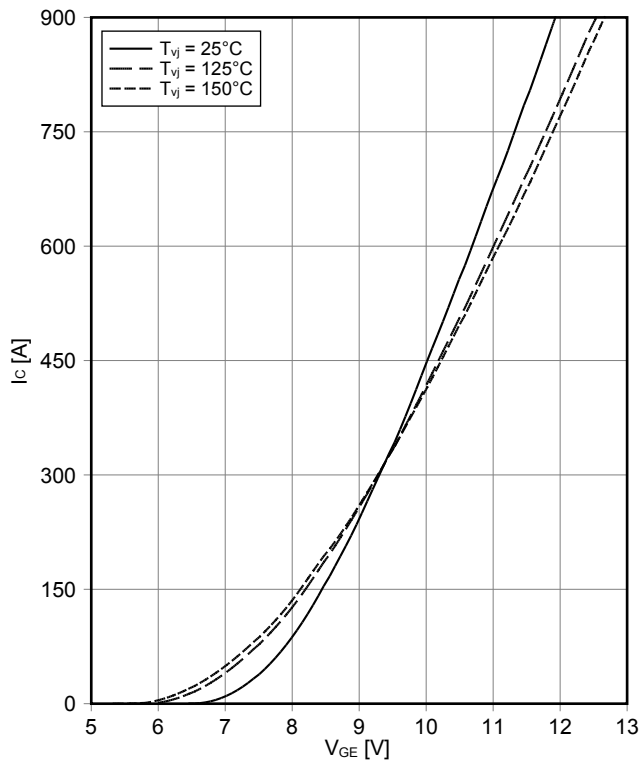
输出特性 IGBT, 逆变器 (典型)
output characteristic IGBT, Inverter (typical)

$I_C = f(V_{CE})$
 $T_{vj} = 150^\circ\text{C}$



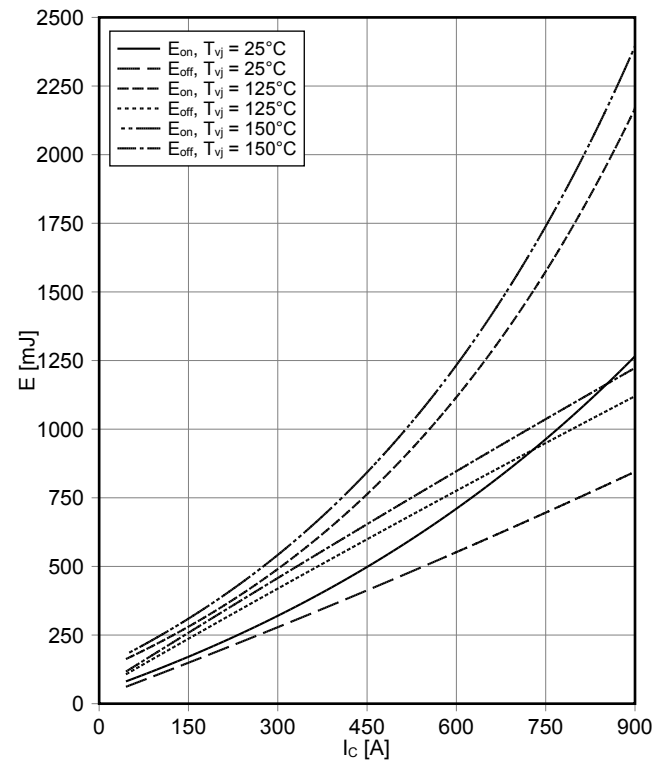
传输特性 IGBT, 逆变器 (典型)
transfer characteristic IGBT, Inverter (typical)

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



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

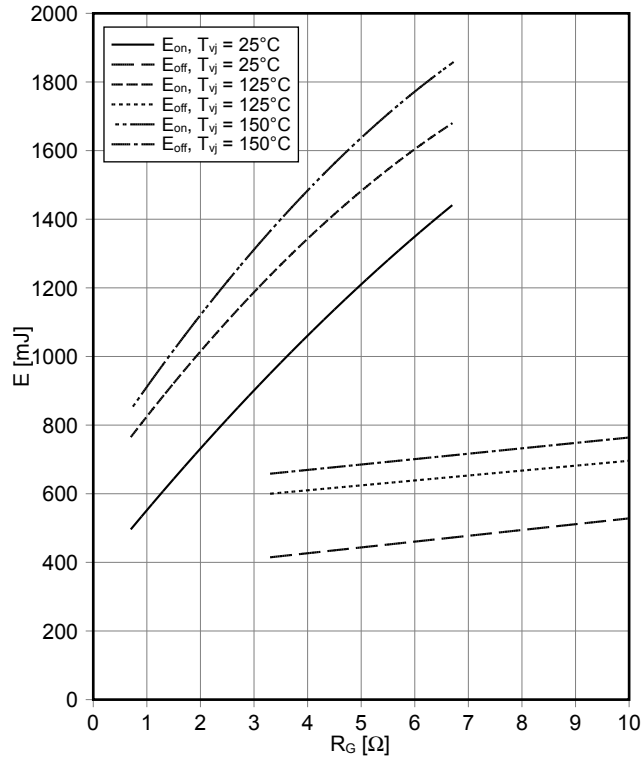
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
 $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.7\ \Omega$, $R_{Goff} = 3.3\ \Omega$, $V_{CE} = 1800\text{ V}$



初步数据 Preliminary Data

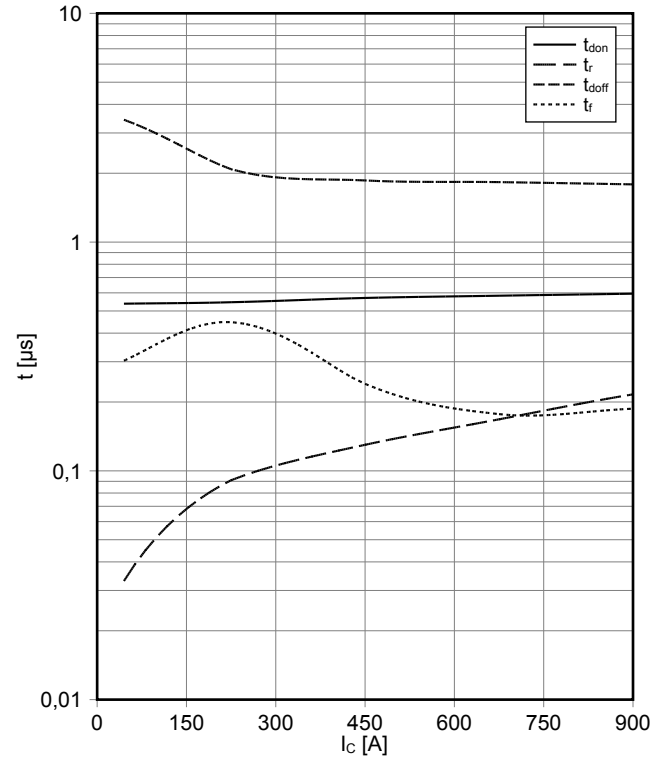
开关损耗 IGBT, 逆变器 (典型) switching losses IGBT, Inverter (typical)

$E_{on} = f(R_G), E_{off} = f(R_G)$
 $V_{GE} = \pm 15\text{ V}, I_C = 450\text{ A}, V_{CE} = 1800\text{ V}$



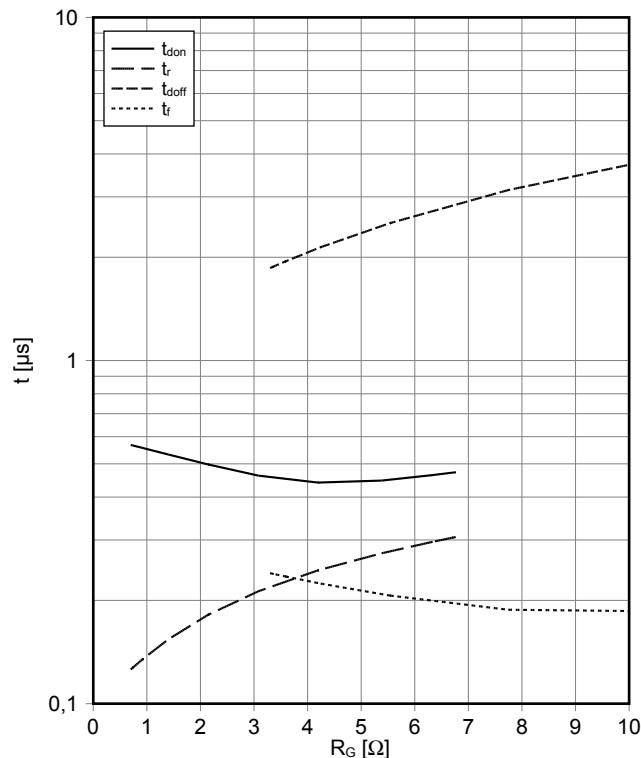
??? IGBT, 逆变器 (典型) switching times IGBT, Inverter (typical)

$t_{don} = f(I_C), t_r = f(I_C), t_{doff} = f(I_C), t_f = f(I_C)$
 $V_{GE} = \pm 15\text{ V}, R_{Gon} = 0.7\ \Omega, R_{Goff} = 3.3\ \Omega, V_{CE} = 1800\text{ V}, T_{vj} = 125^\circ\text{C}$



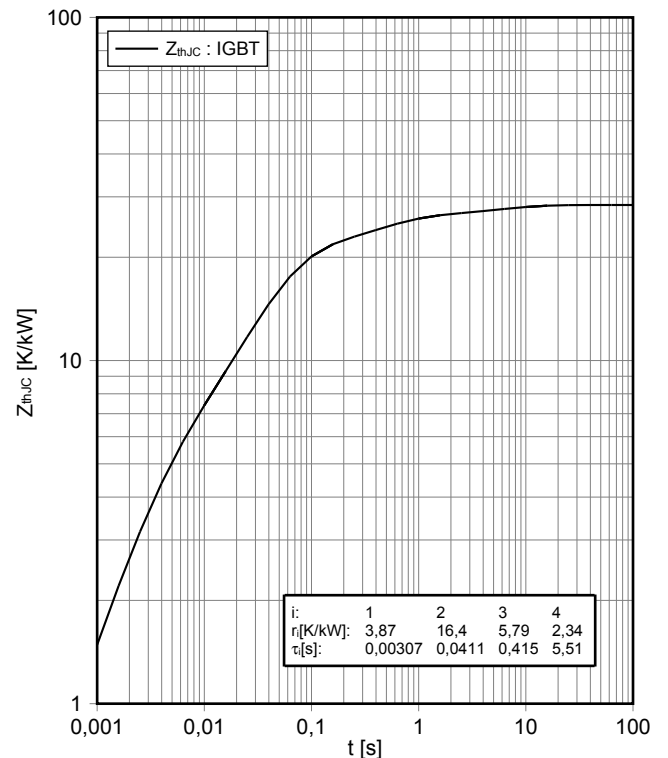
??? IGBT, 逆变器 (典型) switching times IGBT, Inverter (typical)

$t_{don} = f(R_G), t_r = f(R_G), t_{doff} = f(R_G), t_f = f(R_G)$
 $V_{GE} = \pm 15\text{ V}, I_C = 450\text{ A}, V_{CE} = 1800\text{ V}, T_{vj} = 125^\circ\text{C}$



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

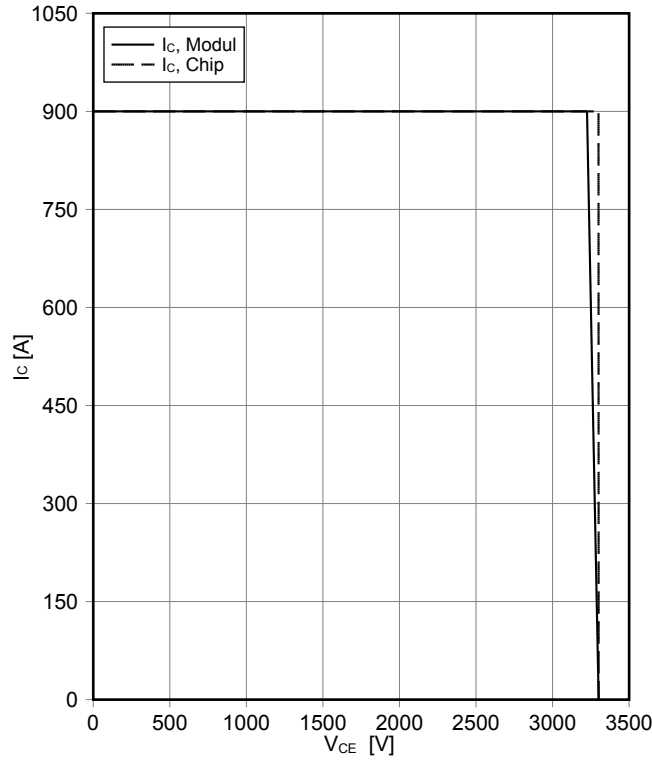
$Z_{thJC} = f(t)$



初步数据 Preliminary Data

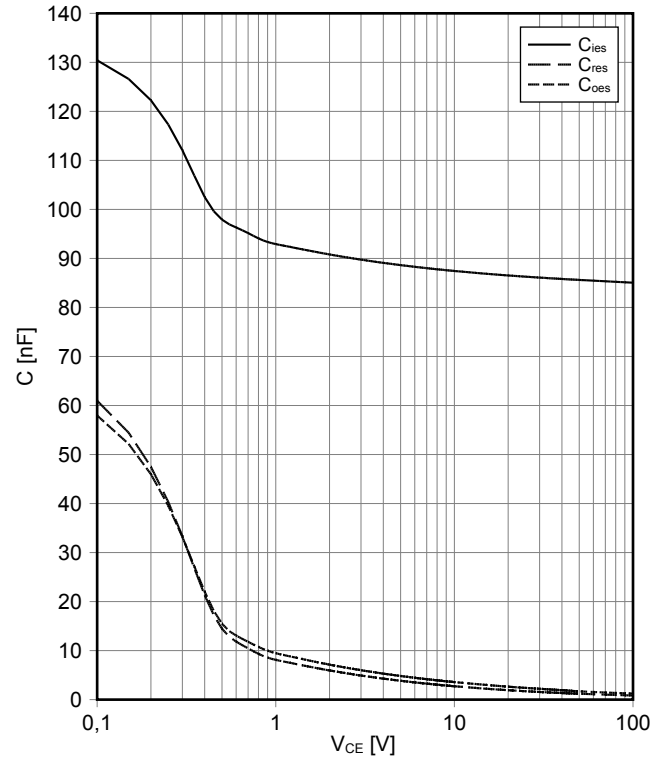
反偏安全工作区 IGBT, 逆变器 (RBSOA)
reverse bias safe operating area IGBT, Inverter (RBSOA)

$I_C = f(V_{CE})$
 $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 3.3\ \Omega$, $T_{vj} = 150^\circ\text{C}$



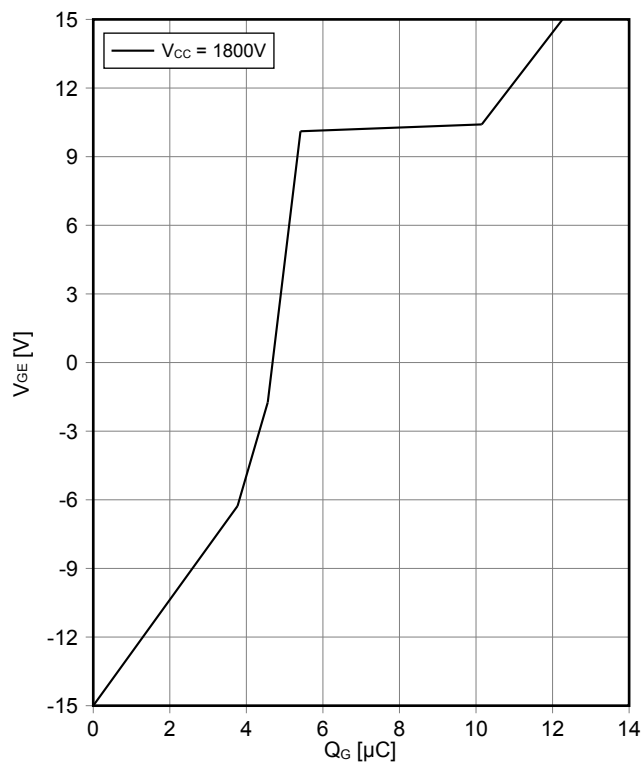
电容特性 IGBT, 逆变器 (典型)
capacity characteristic IGBT, Inverter (typical)

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



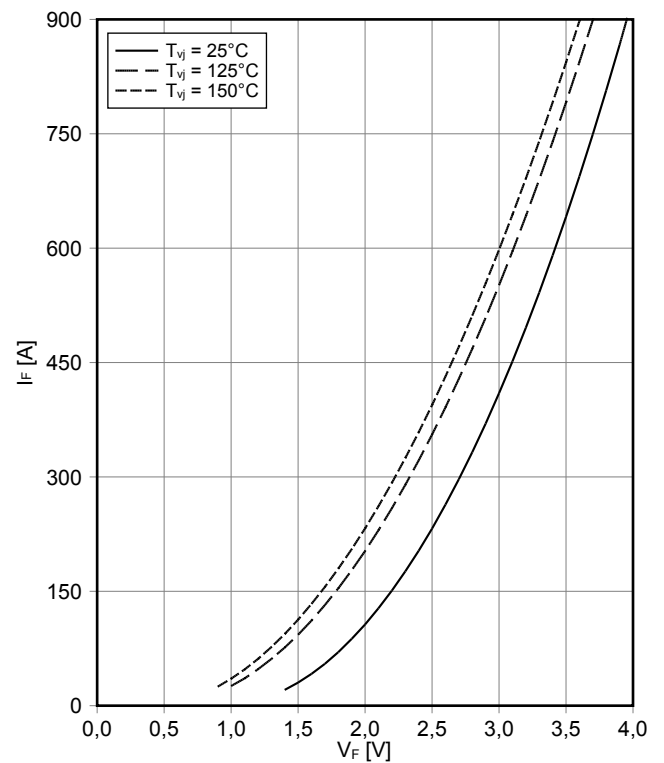
栅极电荷特性 IGBT, 逆变器 (典型)
gate charge characteristic IGBT, Inverter (typical)

$V_{GE} = f(Q_G)$
 $I_C = 450\text{ A}$, $T_{vj} = 25^\circ\text{C}$



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

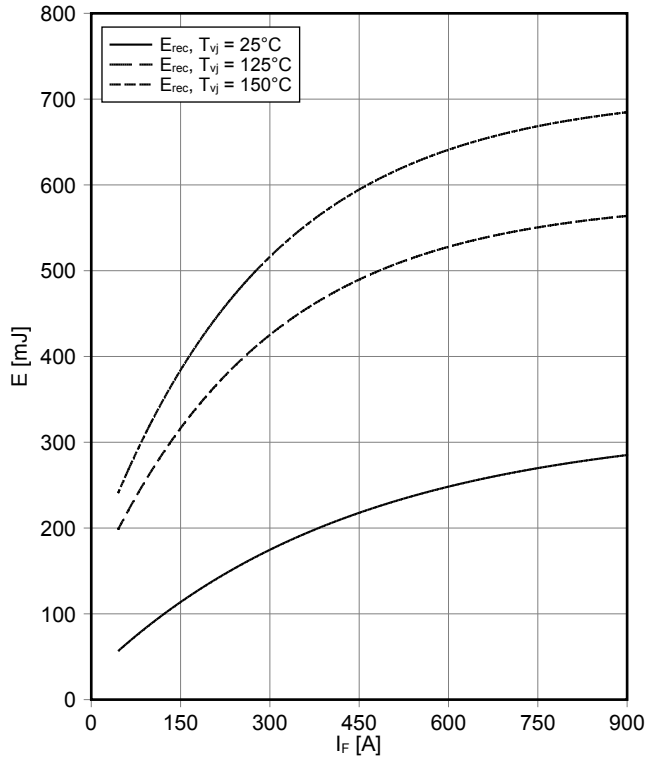
$I_F = f(V_F)$



初步数据 Preliminary Data

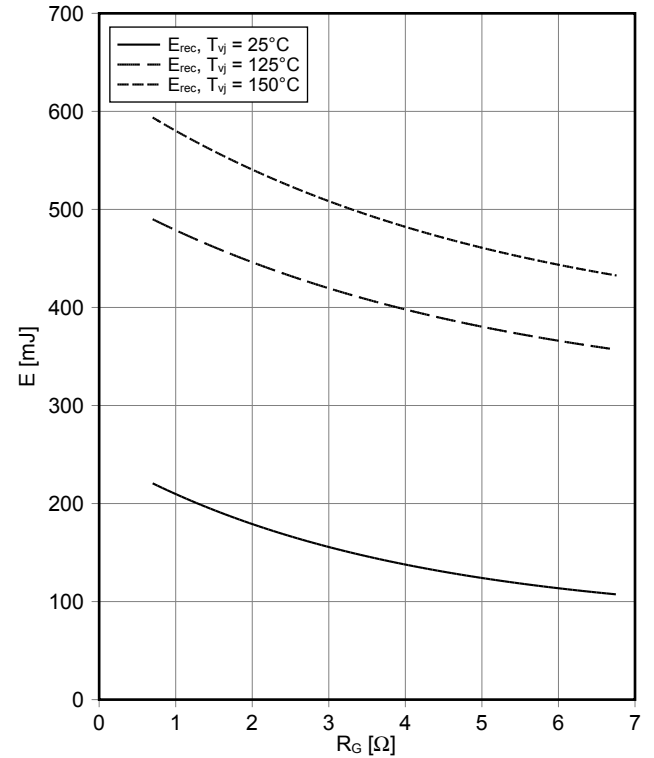
开关损耗 二极管,逆变器 (典型) switching losses Diode, Inverter (typical)

$E_{rec} = f(I_F)$
 $R_{Gon} = 0.7 \Omega, V_{CE} = 1800 V$



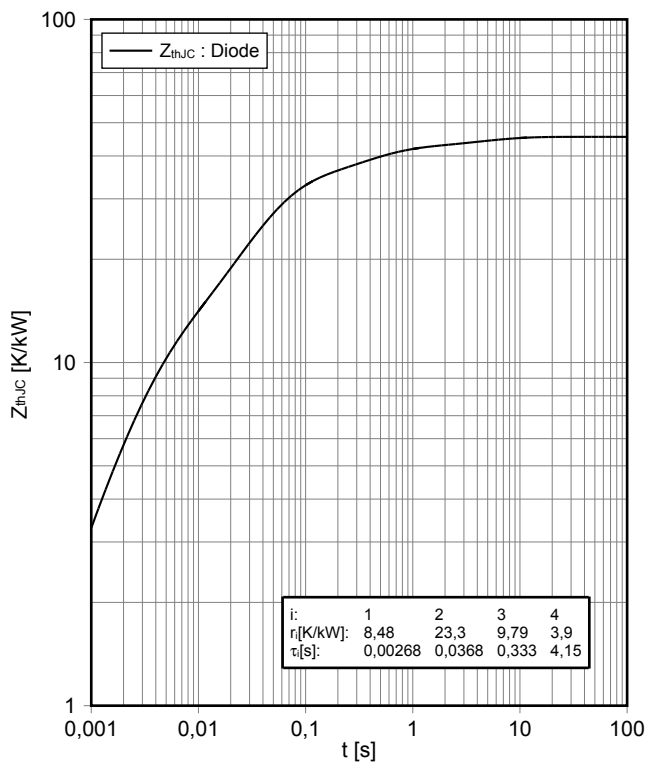
开关损耗 二极管,逆变器 (典型) switching losses Diode, Inverter (typical)

$E_{rec} = f(R_G)$
 $I_F = 450 A, V_{CE} = 1800 V$



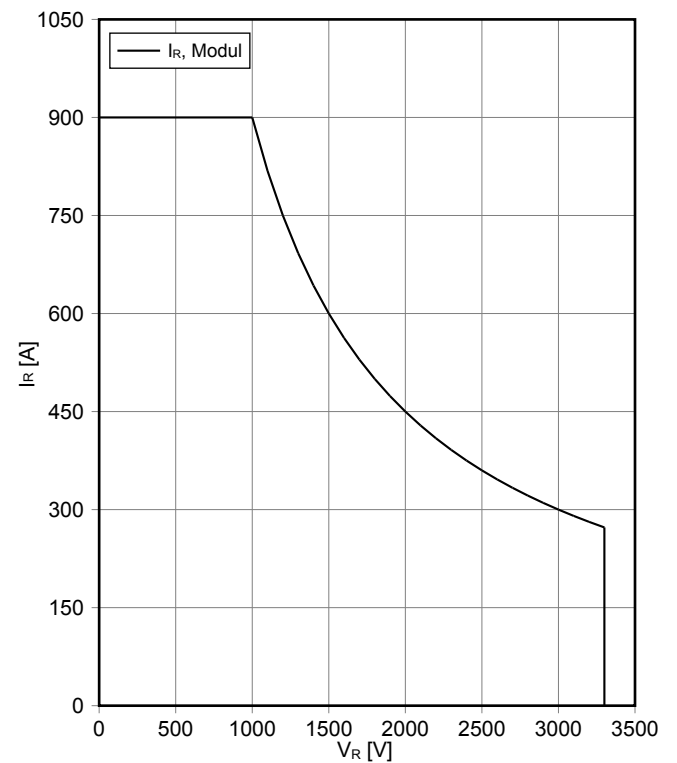
瞬态热阻抗 二极管,逆变器 transient thermal impedance Diode, Inverter

$Z_{thJC} = f(t)$



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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