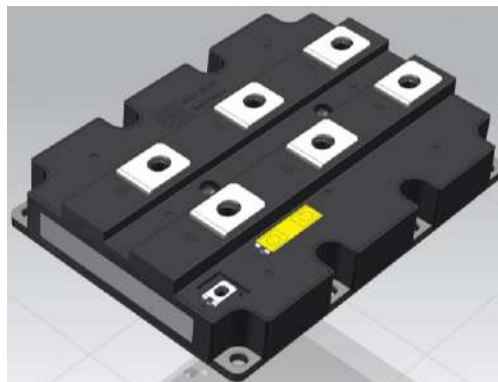


HCG1500S330H2K1

3300V 1500A IGBT 模块, H封装, 内置续流二极管
3300V 1500A IGBT Module, H Package, with FWD

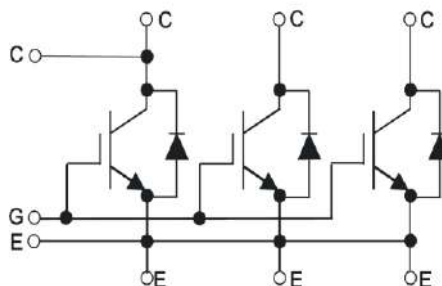
特点 Features

- 低饱和压降
Low $V_{CE(sat)}$
- 高鲁棒性
High Robustness
- 高可靠性
High Reliability
- 标准H封装
Standard H Package
- 工作结温 $T_{vj(op)} = 150^{\circ}\text{C}$
Junction Operating Temperature: 150°C



应用 Applications

- 智能电网
Smart Grid
- 静止无功发生器 SVG
Static Var Generator, SVG
- 牵引系统
Traction Drives
- 电机驱动
Motor Drives



最大额定值 Maximum Rated Values*1

参数 Parameter	符号 Symbol	条件 Conditions	数值 Value	单位 Unit
集电极-发射极电压 Collector-Emitter Voltage	V_{CES}	$V_{GE}=0V, T_{vj}=25^{\circ}\text{C}$	3300	V
集电极电流 DC Collector Current	I_C	$T_C=100^{\circ}\text{C}, T_{vj}=150^{\circ}\text{C}$	1500	A
集电极峰值电流 Peak Collector Current	I_{CM}	$t_p=1\text{ms}$	3000	A
栅极-发射极电压 Gate-Emitter Voltage	V_{GES}		± 20	V
总耗散功耗 Total Power Dissipation	P_{tot}	$T_C=25^{\circ}\text{C}, T_{vj}=150^{\circ}\text{C}$	16	kW
额定正向工作电流 DC Forward Current	I_F		1500	A
正向峰值电流 Peak Forward Current	I_{FRM}	$t_p=1\text{ms}$	3000	A
浪涌电流 Surge Current	I_{FSM}	$V_R=0V, T_{vj}=150^{\circ}\text{C}, t_p=10\text{ms}, \text{half-sinewave}$	13500	A
IGBT短路耐量 IGBT Short Circuit SOA	t_{psc}	$V_{CC}=2500V, V_{CEM\ CHIP} \leq 3300V, V_{GE} \leq 15V, T_{vj} \leq 150^{\circ}\text{C}$	10	μs
最高结温 Maximum Junction Temperature	$T_{vj(max)}$		150	$^{\circ}\text{C}$
工作结温 Junction Operating Temperature	$T_{vj(op)}$		-40~150	$^{\circ}\text{C}$
环境温度 Case temperature	T_C		-40~150	$^{\circ}\text{C}$
存储温度范围 Storage Temperature	T_{stg}		-40~125	$^{\circ}\text{C}$

*1 根据IEC 60747, 最大额定值表明会使器件造成损伤的条件边界

IGBT特征值 IGBT Characteristic Values*2

参数 Parameter	符号 Symbol	条件 Conditions		数值 Value			单位 Unit
				Min.	Typ.	Max.	
集电极-发射极反向击穿电压 Collector-Emitter Breakdown Voltage	V _{(BR)CES}	V _{GE} =0V, I _C =10mA, T _{vj} =25°C		3300			V
集电极-发射极饱和电压*3 Collector-Emitter Saturation Voltage	V _{CE(sat)}	I _C =1500A, V _{GE} =15V	T _{vj} =25°C		2.45	2.95	V
			T _{vj} =125°C		3.10	3.60	V
			T _{vj} =150°C		3.30	3.80	V
集电极-发射极截止电流 Collector-Emitter Cut-off Current	I _{CES}	V _{CE} =3300V, V _{GE} =0V	T _{vj} =25°C			1	mA
			T _{vj} =125°C		15	40	mA
			T _{vj} =150°C		25		mA
栅极-发射极漏电流 Gate-Emitter Leakage Current	I _{GES}	V _{CE} =0V, V _{GE} =±20V, T _{vj} =125°C		-500		500	nA
栅极-发射极开启电压 Gate-Emitter Threshold Voltage	V _{GE(th)}	I _C =240mA, V _{CE} =V _{GE} , T _{vj} =25°C		5.8	6.8	7.8	V
栅极电荷 Gate Charge	Q _G	I _C =1500A, V _{CE} =1800V, V _{GE} =-15V~+15V			6.5		μC
输入电容 Input Capacitance	C _{ies}	V _{CE} =25V, V _{GE} =0V, f=200KHz, T _{vj} =25°C			153		nF
输出电容 Output Capacitance	C _{oes}				12		nF
反向传输电容 Reverse Transfer Capacitance	C _{res}				3		nF
内置栅极电阻 Internal Gate Resistance	R _{Gint}				0.8		Ω
开通延迟时间 Turn-on Delay Time	t _{d(on)}	I _C =1500A, V _{CE} =1800V, V _{GE} =±15V, R _{Gon} =1.0Ω, R _{Goff} =1.5Ω, C _{ge} =330nF, L _S =150nH, Inductive Load	T _{vj} =25°C		600		ns
			T _{vj} =125°C		660		ns
			T _{vj} =150°C		680		ns
上升时间 Rise Time	t _r		T _{vj} =25°C		260		ns
			T _{vj} =125°C		290		ns
			T _{vj} =150°C		300		ns
关断延迟时间 Turn-off Delay Time	t _{d(off)}		T _{vj} =25°C		1700		ns
			T _{vj} =125°C		1850		ns
			T _{vj} =150°C		1900		ns
下降时间 Fall Time	t _f		T _{vj} =25°C		1000		ns
			T _{vj} =125°C		1200		ns
			T _{vj} =150°C		1500		ns

*2 IGBT特征值遵从IEC 60747-9

*3 $V_{CE(sat)}$ 值为芯片值

IGBT特征值 IGBT Characteristic Values*2

参数 Parameter	符号 Symbol	条件 Conditions		数值 Value			单位 Unit
				Min.	Typ.	Max.	
开通损耗 Turn-on Switching Energy	E _{on}	I _C =1500A, V _{CE} =1800V, V _{GE} =±15V, R _{Gon} =1.0Ω, R _{Goff} =1.5Ω, C _{ge} =330nF, L _S =150nH, Inductive Load	T _{vj} =25°C		1600		mJ
			T _{vj} =125°C		2000		mJ
			T _{vj} =150°C		2200		mJ
关断损耗 Turn-off Switching Energy	E _{off}		T _{vj} =25°C		2100		mJ
			T _{vj} =125°C		2500		mJ
			T _{vj} =150°C		2700		mJ
短路电流 Short Circuit Current	I _{SC}	V _{GE} ≤15V, t _{psc} ≤10μs, V _{CC} =2500V, T _{vj} =150°C V _{CEM CHIP} ≤3300V			6500		A

*2 IGBT特征值遵从IEC 60747-9

二极管特征值 Diode Characteristic Values*3

参数 Parameter	符号 Symbol	条件 Conditions		数值 Value			单位 Unit
				Min.	Typ.	Max.	
正向电压*4 Forward Voltage	V _F	I _F =1500A	T _{vj} =25°C		2.10		V
			T _{vj} =125°C		2.30		V
			T _{vj} =150°C		2.30		V
反向恢复电流 Reverse Recovery Current	I _{rr}	I _F =1500A, V _R =1800V, di _F /dt=-2500A/μs, V _{GE} =15V, R _{Gon} =1.0Ω, L _S =150nH, Inductive load	T _{vj} =25°C		900		A
			T _{vj} =125°C		980		A
			T _{vj} =150°C		980		A
反向恢复电荷 Reverse Recovery Charge	Q _{rr}		T _{vj} =25°C		980		uC
			T _{vj} =125°C		1370		uC
			T _{vj} =150°C		1500		uC
反向恢复时间 Reverse Recovery Time	t _{rr}		T _{vj} =25°C		2.95		us
			T _{vj} =125°C		4.40		us
			T _{vj} =150°C		4.95		us
反向恢复损耗 Reverse Recovery Energy Loss	E _{rec}		T _{vj} =25°C		1060		mJ
			T _{vj} =125°C		1600		mJ
			T _{vj} =150°C		1700		mJ

*3 二极管特征值遵从IEC 60747-2

*4 V_F 值为芯片值

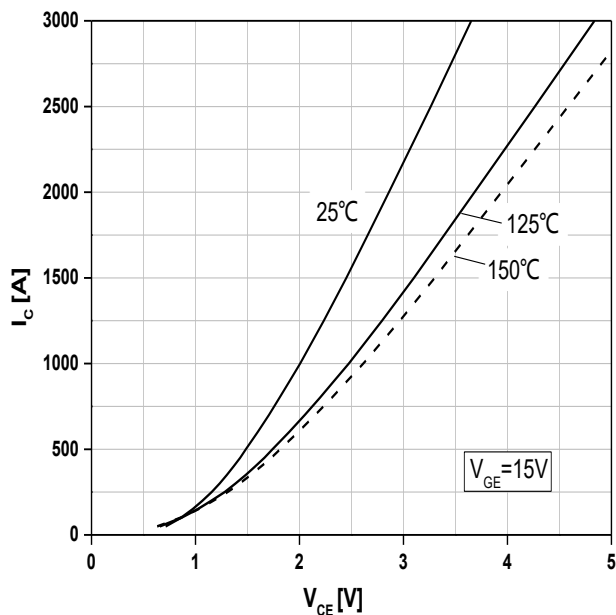
封装特性 Package Properties*5

参数 Parameter	符号 Symbol	条件 Condition	数值 Value			单位 Unit
			Min.	Typ.	Max.	
IGBT 结-壳热阻 IGBT Thermal Resistance: Junction to Case	$R_{th(J-C)}$	每个IGBT/per IGBT		0.0078		K/W
二极管 结-壳热阻 Diode Thermal Resistance: Junction to Case	$R_{th(J-C)}$	每个二极管/per Diode		0.016		K/W
IGBT接触热阻 IGBT Thermal Resistance: Case to Heatsink	$R_{th(C-H)}$	每个IGBT/per IGBT 硅脂导热系数 $\lambda_{grease}=1W/(m\cdot K)$		0.009		K/W
二极管接触热阻 Diode Thermal Resistance: Case to Heatsink	$R_{th(C-H)}$	每个二极管/per Diode 硅脂导热系数 $\lambda_{grease}=1W/(m\cdot K)$		0.018		K/W
绝缘耐压 Isolation Voltage	V_{isol}	RMS, f=50Hz, t=60s		6000		V
局部放电停止电压 Partial discharge extinction voltage	V_{isol}	RMS, f=50Hz, $Q_{pD}\leq 10pC$		2600		V
绝缘间隙 Clearance Distance	d_{cl}	端子到散热器 Terminal to Heatsink		23		mm
		端子到端子 Terminal to Terminal		19		mm
爬电距离 Creepage Distance	d_{cr}	端子到散热器 Terminal to Heatsink		33		mm
		端子到端子 Terminal to Terminal		32		mm
相对漏电起痕指数 Comparative Tracking Index	CTI			>600		
模块寄生电感 Module Stray Inductance	$L_{s, CE}$	每个桥臂/per Switch		8.0		nH
模块引线内阻 Module lead Resistance, Terminal to Chip	R_{CC+EE}	每个桥臂/per Switch, $T_C=25^{\circ}C$		0.12		mΩ
安装扭矩 Mounting Torques	M	基板至散热器, Baseplate to Heatsink, M6	4.0		6.0	Nm
		功率端子安装, Power Terminal, M8	8.0		10.0	Nm
		信号端子安装, Power Terminal, M4	2.0		3.0	Nm
模块重量 Module Weight	G			1400		g

*5 封装特性遵从IEC 60747-15、IEC 60270

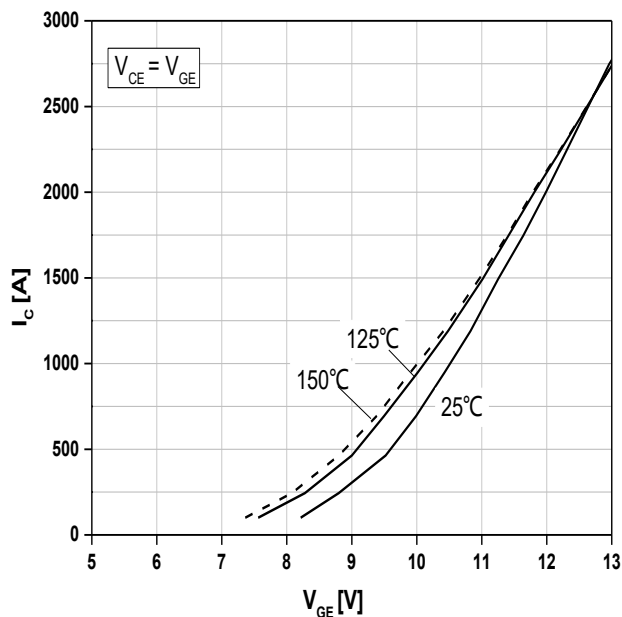
输出特性典型曲线

Typical output characteristics,chip level



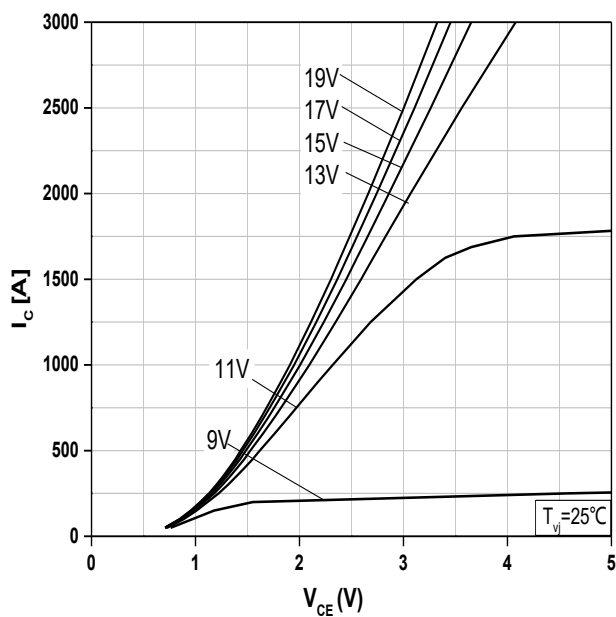
传输特性典型曲线

Typical transfer characteristics,chip level



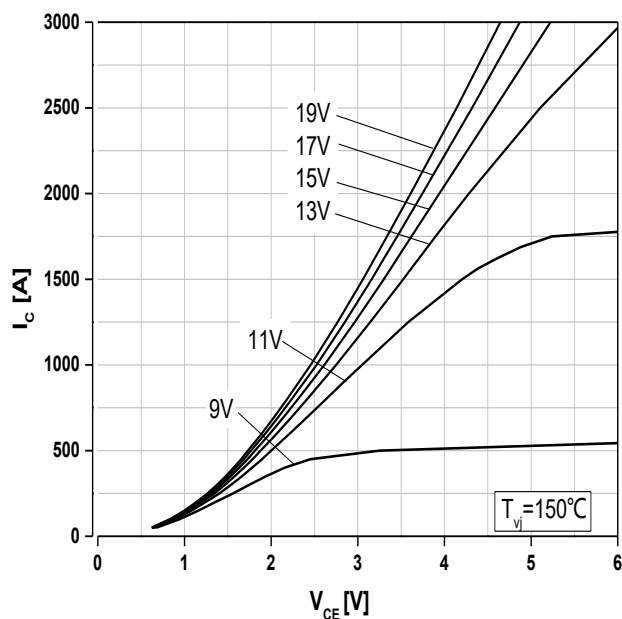
输出特性典型曲线

Typical output characteristics,chip level



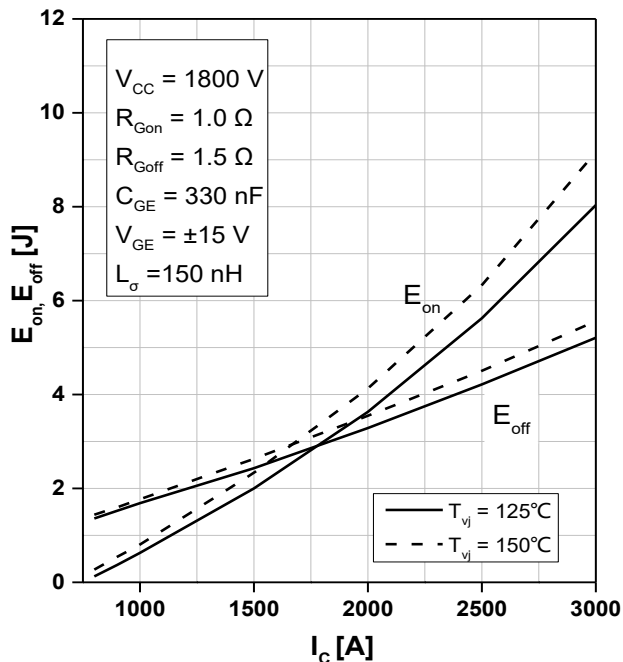
输出特性典型曲线

Typical output characteristics,chip level



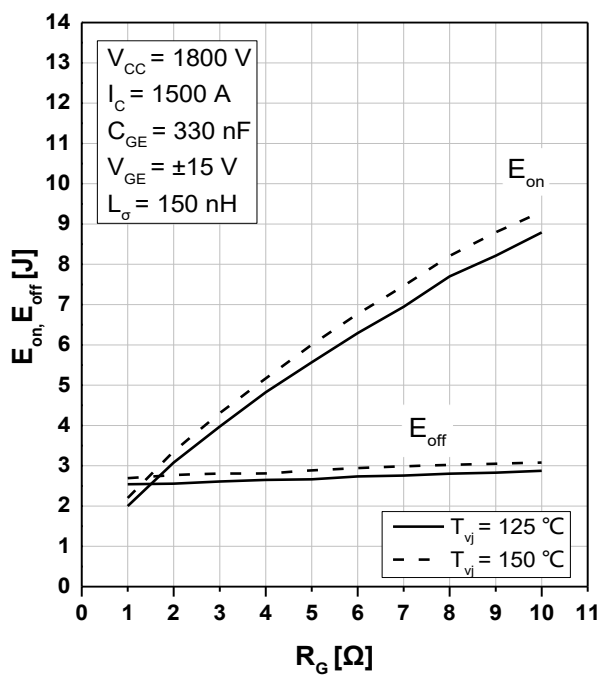
开关损耗与集电极电流关系曲线

Typical switching energies per pulse vs. collector current



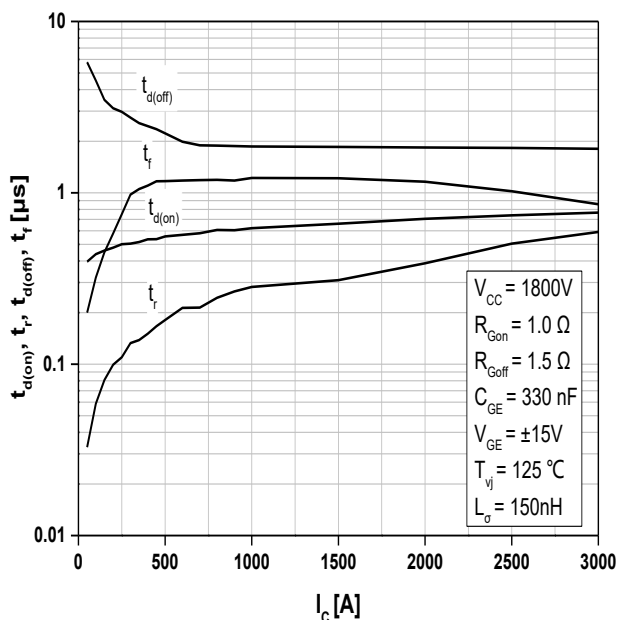
开关损耗与栅极电阻关系曲线

Typical switching energies per pulse vs. gate resistor



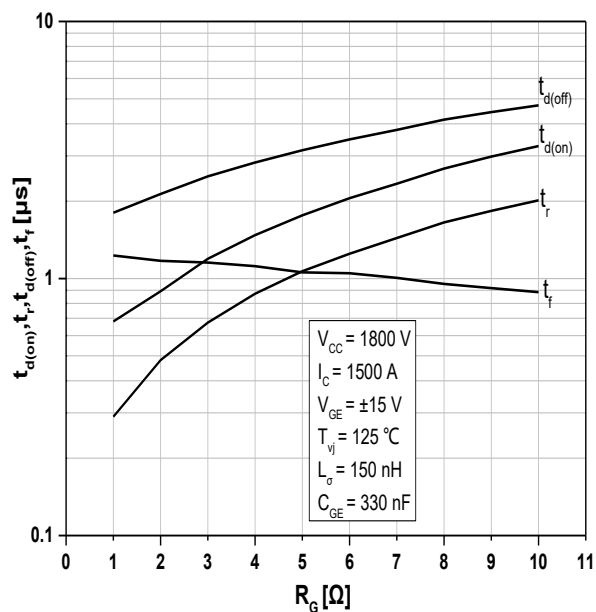
开关时间与集电极电流关系曲线

Typical switching times vs. collector current



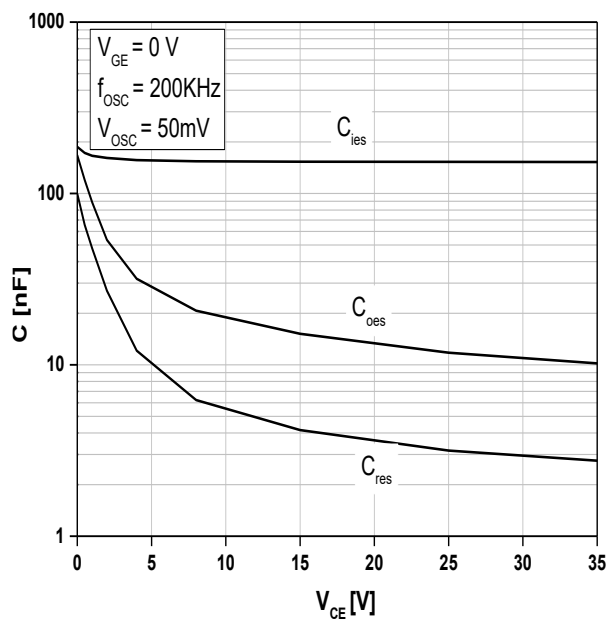
开关时间与栅极电阻关系曲线

Typical switching times vs. gate resistor



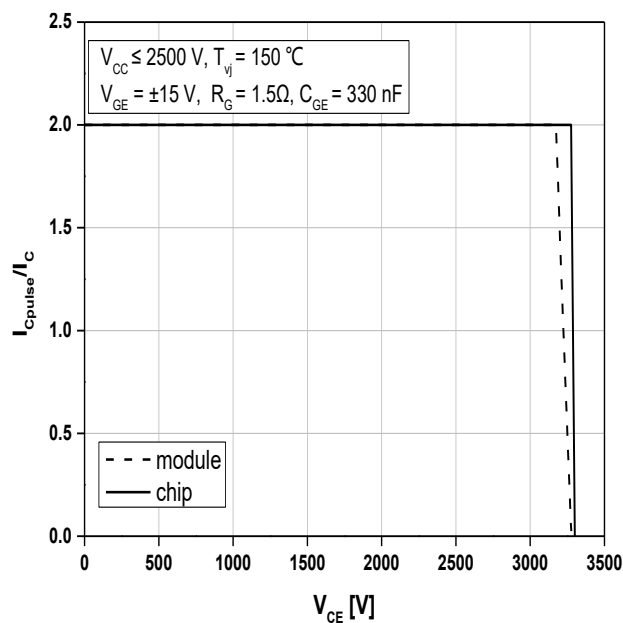
极间电容特性曲线

Typical capacitances vs. collector-emitter voltage



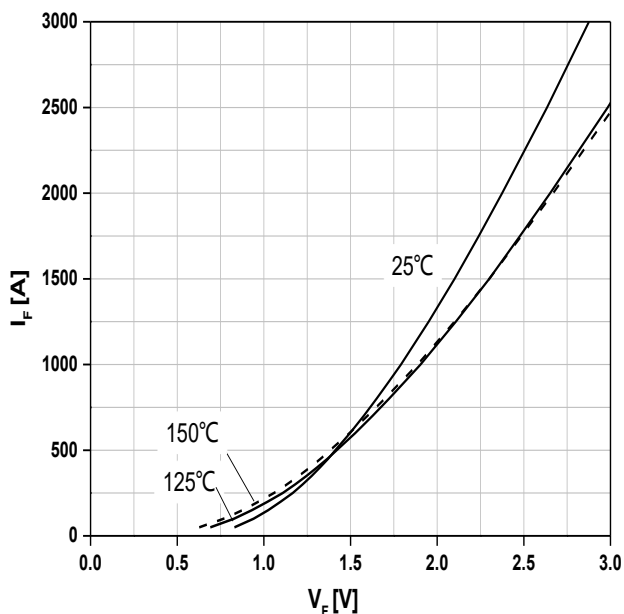
反偏安全工作区

Turn-off safe operating area (RBSOA)



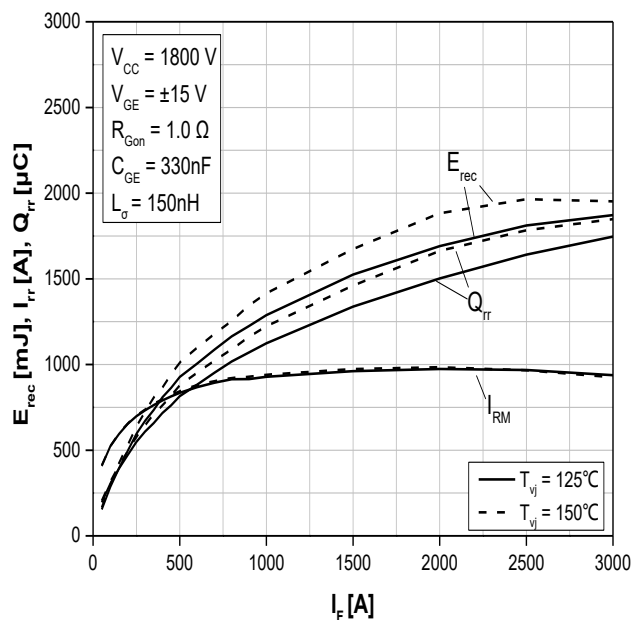
二极管正向偏压特性曲线

Typical diode forward characteristic, chip level



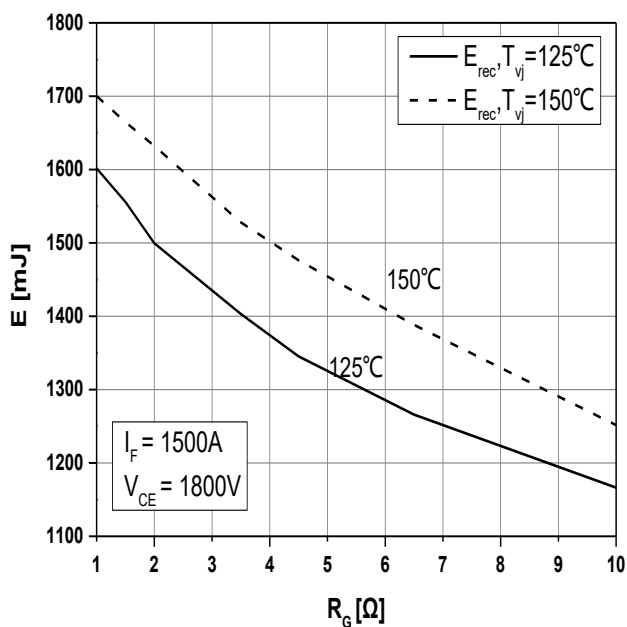
反向恢复特性与集电极电流关系曲线

Typical reverse recovery characteristics vs. forward current



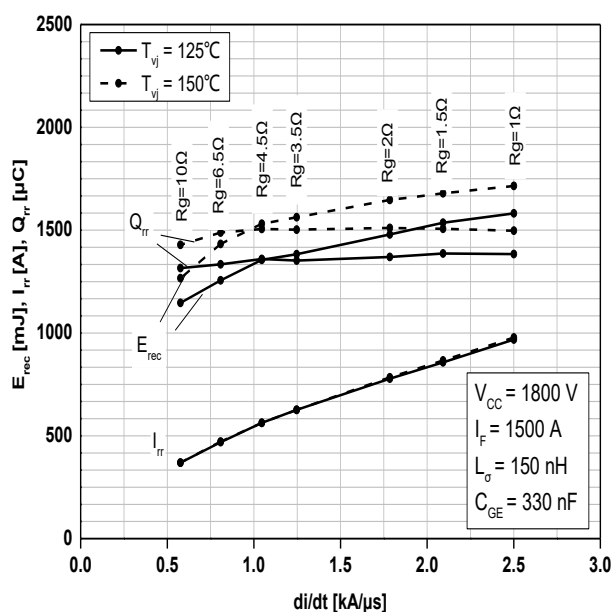
反向恢复特性与栅极电阻关系曲线

Typical reverse recovery characteristics vs. R_G

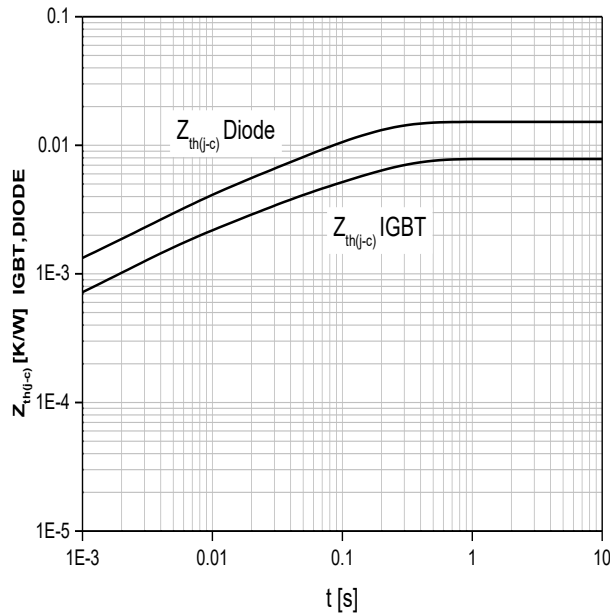


反向恢复特性与di/dt关系曲线

Typical reverse recovery characteristics vs. di/dt



瞬态热阻抗曲线
Thermal impedance vs. time

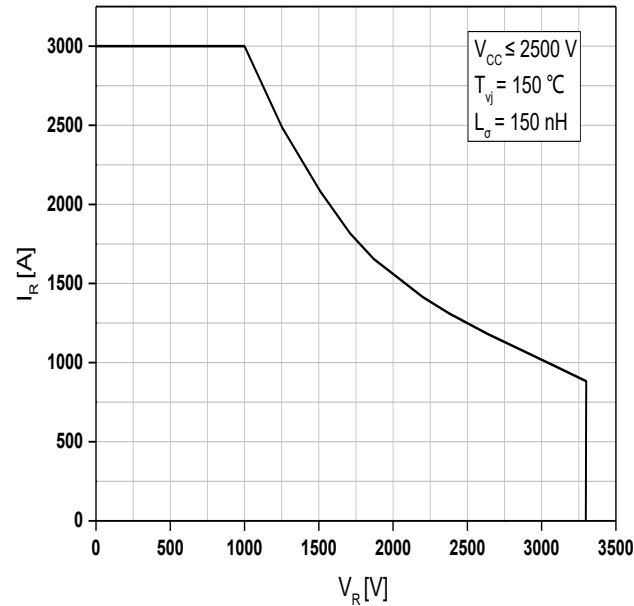


Analytical function for transient thermal impedance:

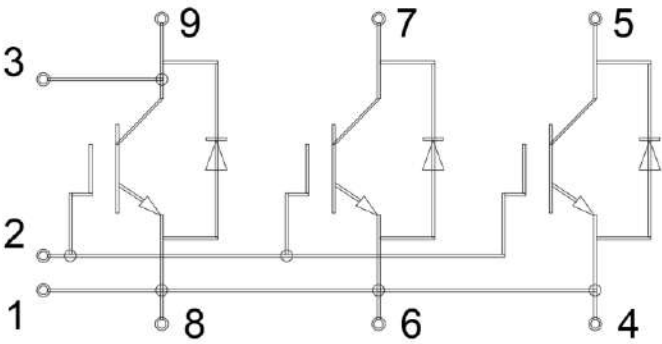
$$Z_{th(j-c)}(t) = \sum_{i=1}^n R_i (1 - e^{-t/\tau_i})$$

IGBT	i	1	2	3	4
	Ri (K/kW)	4.840	1.879	0.885	0.232
DIODE	τ_i (ms)	167.060	18.908	2.033	0.045
	Ri (K/kW)	10.616	3.083	1.146	0.356
	τ_i (ms)	121.520	12.149	1.244	0.031

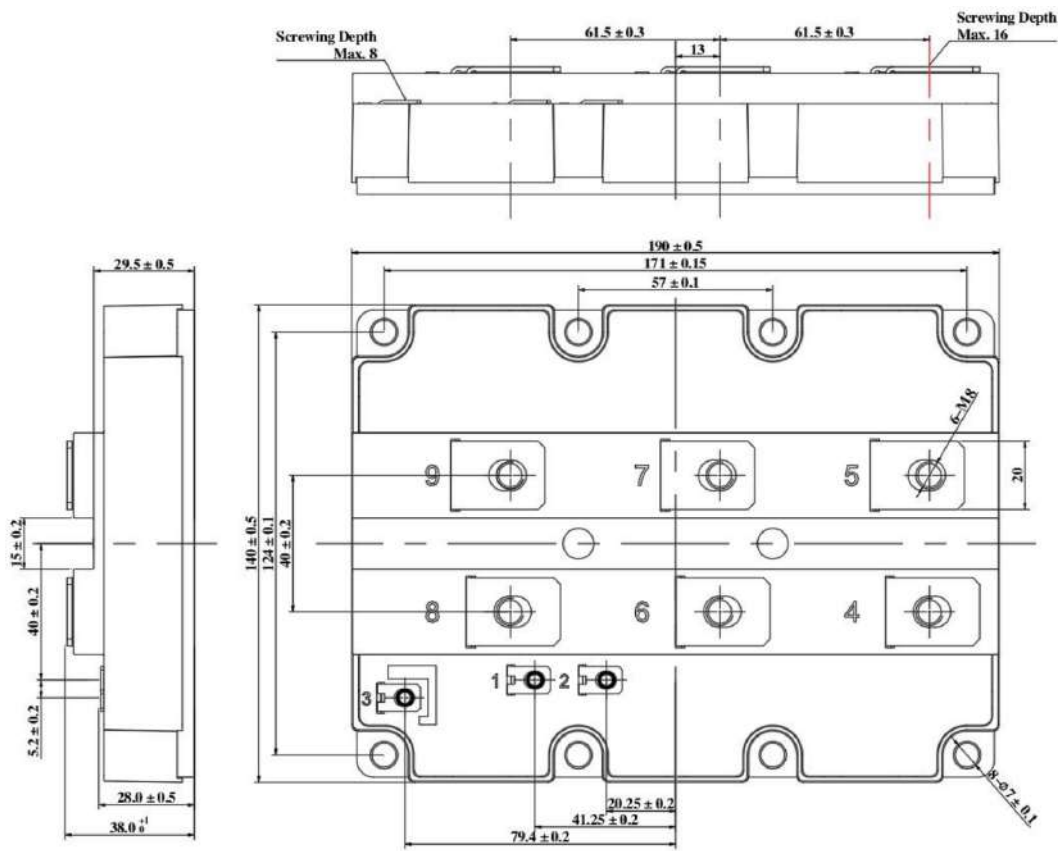
安全工作区 二极管 (SOA)
Safe operating area diode



接线图



封装尺寸



修订记录Revision History

版本Version	日期Date	描述Description
A0	2022-08-02	正式版
A1	2024-03-14	徽标变更

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When the product is in use, it is strictly forbidden to touch the product. After power off, it is confirmed that there is no residual charge and the product has been completely cooled, and it can only be touched under electrostatic protection measures;

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