

1700V IGBT Modul mit low loss IGBT der 2.ten Generation und softer Emitter Controlled Diode  
1700V IGBT Module with low loss IGBT of 2nd generation and soft Emitter Controlled Diode

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	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_{CES}$	1700 1700	V
连续集电极直流电流 Continuous DC collector current	$T_C = 80^{\circ}\text{C}, T_{vj\text{max}} = 150^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}, T_{vj\text{max}} = 150^{\circ}\text{C}$	$I_{C\text{nom}}$ $I_C$	600 975	A A
集电极重复峰值电流 Repetitive peak collector current	$t_P = 1\text{ms}$	$I_{CRM}$	1200	A
总功率损耗 Total power dissipation	$T_C = 25^{\circ}\text{C}, T_{vj\text{max}} = 150^{\circ}\text{C}$	$P_{tot}$	4,80	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	$I_C = 600\text{A}, V_{GE} = 15\text{V}$ $I_C = 600\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_{CE\text{sat}}$	2,60 3,10	3,10 3,60	V V	
栅极阈值电压 Gate threshold voltage	$I_C = 40,0\text{mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$		$V_{G\text{Eth}}$	4,5	5,5	6,5	V
栅极电荷 Gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}$		$Q_G$		7,20	$\mu\text{C}$	
内部栅极电阻 Internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$		$R_{G\text{int}}$		1,6	$\Omega$	
输入电容 Input capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		$C_{ies}$		40,0	nF	
反向传输电容 Reverse transfer capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		$C_{res}$		2,00	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	$I_C = 600\text{A}, V_{CE} = 900\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Gon} = 2,4\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_{d\text{on}}$	0,30 0,30		$\mu\text{s}$ $\mu\text{s}$	
上升时间(电感负载) Rise time, inductive load	$I_C = 600\text{A}, V_{CE} = 900\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Gon} = 2,4\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_r$	0,17 0,17		$\mu\text{s}$ $\mu\text{s}$	
关断延迟时间(电感负载) Turn-off delay time, inductive load	$I_C = 600\text{A}, V_{CE} = 900\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Goff} = 2,4\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_{d\text{off}}$	1,10 1,10		$\mu\text{s}$ $\mu\text{s}$	
下降时间(电感负载) Fall time, inductive load	$I_C = 600\text{A}, V_{CE} = 900\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Goff} = 2,4\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_f$	0,11 0,12		$\mu\text{s}$ $\mu\text{s}$	
开通损耗能量(每脉冲) Turn-on energy loss per pulse	$I_C = 600\text{A}, V_{CE} = 900\text{V}, L_S = 60\text{nH}$ $V_{GE} = \pm 15\text{V}$ $R_{Gon} = 2,4\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{on}$		270	mJ mJ	
关断损耗能量(每脉冲) Turn-off energy loss per pulse	$I_C = 600\text{A}, V_{CE} = 900\text{V}, L_S = 60\text{nH}$ $V_{GE} = \pm 15\text{V}$ $R_{Goff} = 2,4\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{off}$		220	mJ mJ	
短路数据 SC data	$V_{GE} \leq 15\text{V}, V_{CC} = 1000\text{V}$ $V_{CE\text{max}} = V_{CES} - L_{SCE} \cdot di/dt$ $t_P \leq 10\mu\text{s}, T_{vj} = 125^{\circ}\text{C}$		$I_{SC}$		2400	A	
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		$R_{thJC}$		26,0	K/kW	
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个 IGBT / per IGBT $\lambda_{\text{Paste}} = 1\text{W}/(\text{m}\cdot\text{K}) / \lambda_{\text{grease}} = 1\text{W}/(\text{m}\cdot\text{K})$		$R_{thCH}$		24,0	K/kW	
在开关状态下温度 Temperature under switching conditions			$T_{vj\text{op}}$	-40	125	$^{\circ}\text{C}$	

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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	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_{RRM}$	1700 1700	V
连续正向直流电流 Continuous DC forward current		$I_F$	600	A
正向重复峰值电流 Repetitive peak forward current	$t_P = 1 \text{ ms}$	$I_{FRM}$	1200	A
I <sup>2</sup> t-值 I <sup>2</sup> t - value	$V_R = 0 \text{ V}, t_P = 10 \text{ ms}, T_{vj} = 125^{\circ}\text{C}$	$I^2t$	100	kA <sup>2</sup> s
最小开通时间 Minimum turn-on time		$t_{on \text{ min}}$	10,0	μs

特征值 / Characteristic Values

			min.	typ.	max.	
正向电压 Forward voltage	$I_F = 600 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 600 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_F$	2,10 2,10	2,50 2,50	V V
反向恢复峰值电流 Peak reverse recovery current	$I_F = 600 \text{ A}, -di_F/dt = 3500 \text{ A}/\mu\text{s} (T_{vj}=125^{\circ}\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$I_{RM}$	430 520		A A
恢复电荷 Recovered charge	$I_F = 600 \text{ A}, -di_F/dt = 3500 \text{ A}/\mu\text{s} (T_{vj}=125^{\circ}\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$Q_r$	110 200		μC μC
反向恢复损耗 (每脉冲) Reverse recovery energy	$I_F = 600 \text{ A}, -di_F/dt = 3500 \text{ A}/\mu\text{s} (T_{vj}=125^{\circ}\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{rec}$	60,0 110		mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		$R_{thJC}$		50,0	K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / per diode $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	47,0		K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj \text{ op}}$	-40	125	°C

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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
内部绝缘 Internal isolation	基本绝缘 (class 1, IEC 61140) basic insulation (class 1, IEC 61140)		AIN		
爬电距离 Creepage distance	端子- 散热片 / terminal to heatsink 端子- 端子 / terminal to terminal		17,0		mm
电气间隙 Clearance	端子- 散热片 / terminal to heatsink 端子- 端子 / terminal to terminal		10,0		mm
相对电痕指数 Comperative tracking index		CTI	> 275		
			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>		8,00	K/kW
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>		0,37	mΩ
储存温度 Storage temperature		T <sub>stg</sub>	-40		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		1050	g

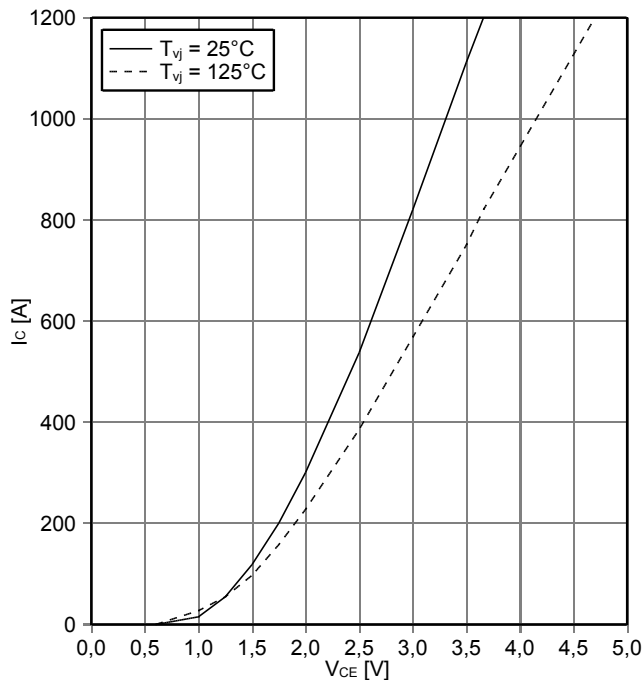
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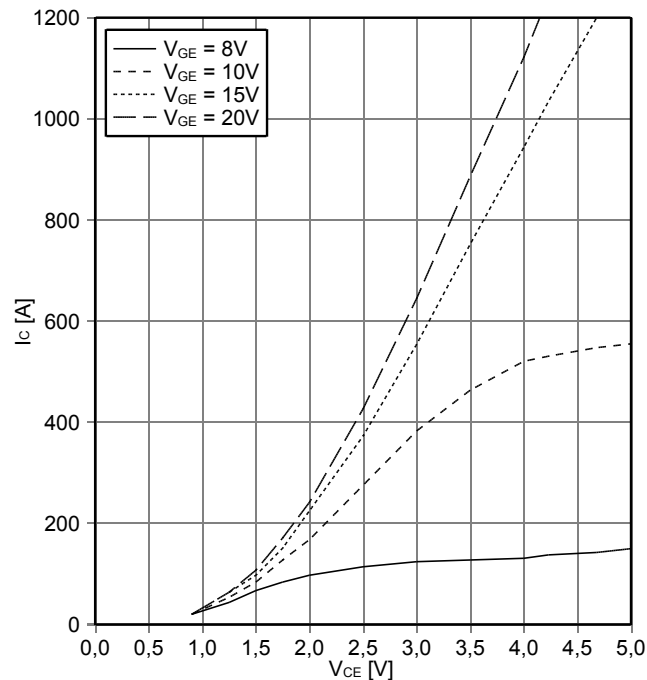
输出特性 IGBT, 逆变器 (典型)  
output characteristic IGBT, Inverter (typical)

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



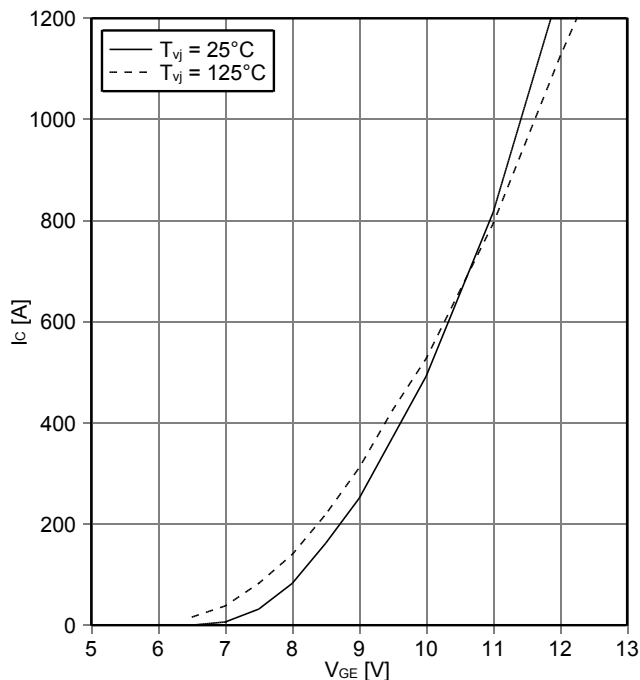
输出特性 IGBT, 逆变器 (典型)  
output characteristic IGBT, Inverter (typical)

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



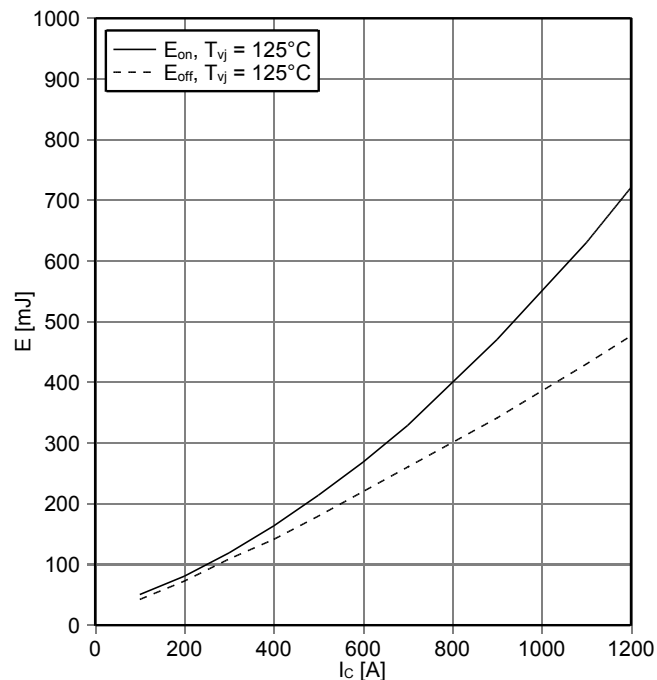
传输特性 IGBT, 逆变器 (典型)  
transfer characteristic IGBT, Inverter (typical)

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



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

$E_{on} = f(I_C), E_{off} = f(I_C)$   
 $V_{GE} = \pm 15\text{ V}, R_{Gon} = 2.4\ \Omega, R_{Goff} = 2.4\ \Omega, V_{CE} = 900\text{ V}$



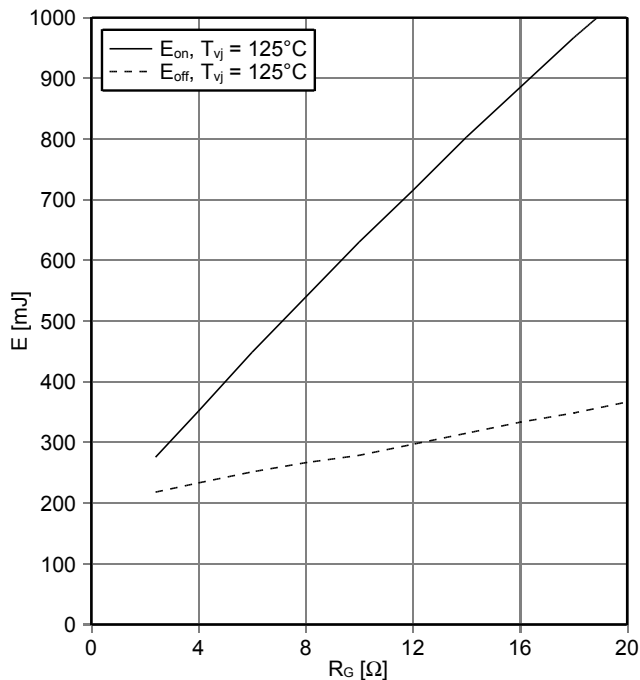
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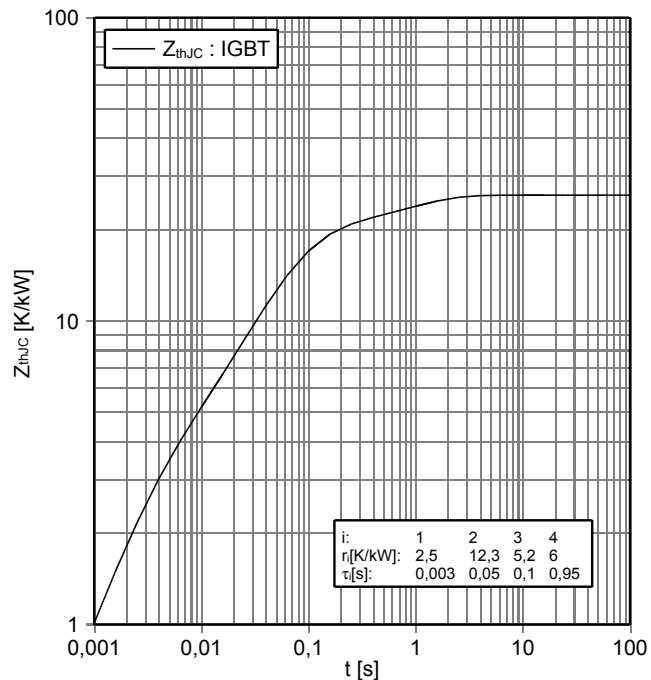
开关损耗 IGBT, 逆变器 (典型)  
switching losses IGBT, Inverter (typical)

$E_{on} = f(R_G), E_{off} = f(R_G)$   
 $V_{GE} = \pm 15\text{ V}, I_C = 600\text{ A}, V_{CE} = 900\text{ V}$



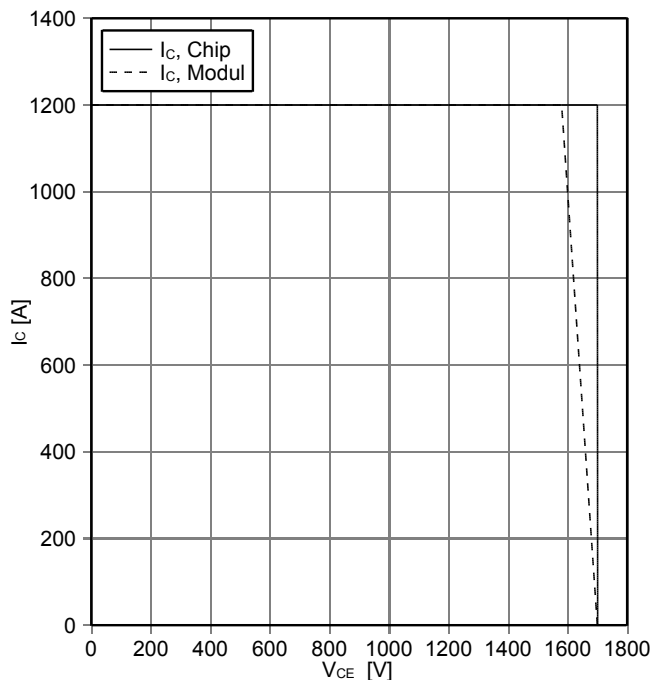
瞬态热阻抗 IGBT, 逆变器  
transient thermal impedance IGBT, Inverter

$Z_{thJC} = f(t)$



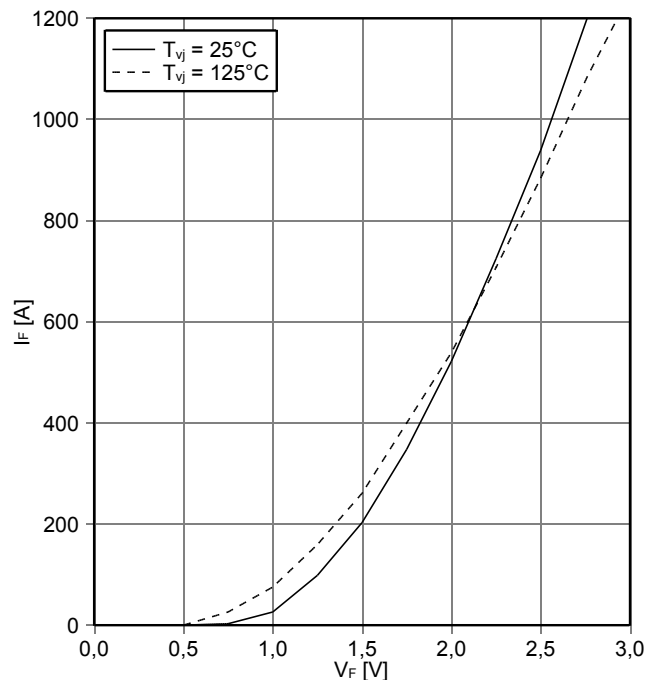
反偏安全工作区 IGBT, 逆变器 (RBSOA)  
reverse bias safe operating area IGBT, Inverter (RBSOA)

$I_C = f(V_{CE})$   
 $V_{GE} = \pm 15\text{ V}, R_{Goff} = 2.4\ \Omega, T_{vj} = 125^\circ\text{C}$



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

$I_F = f(V_F)$



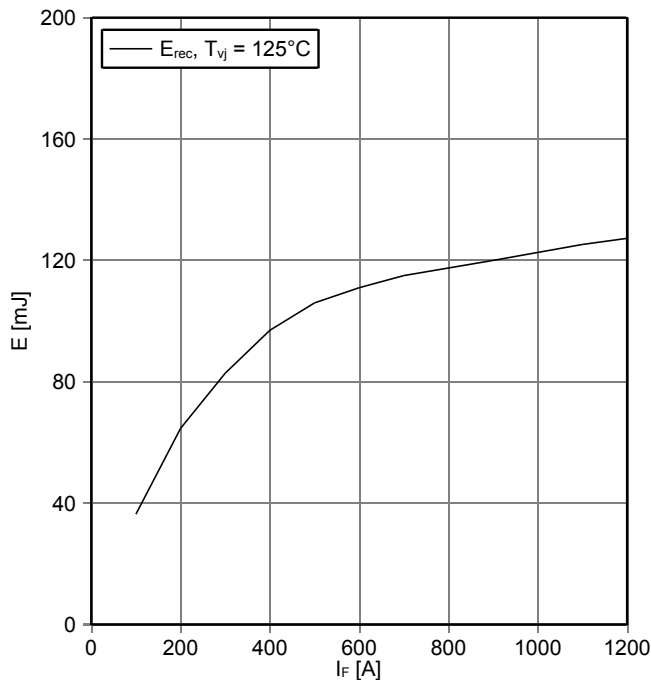
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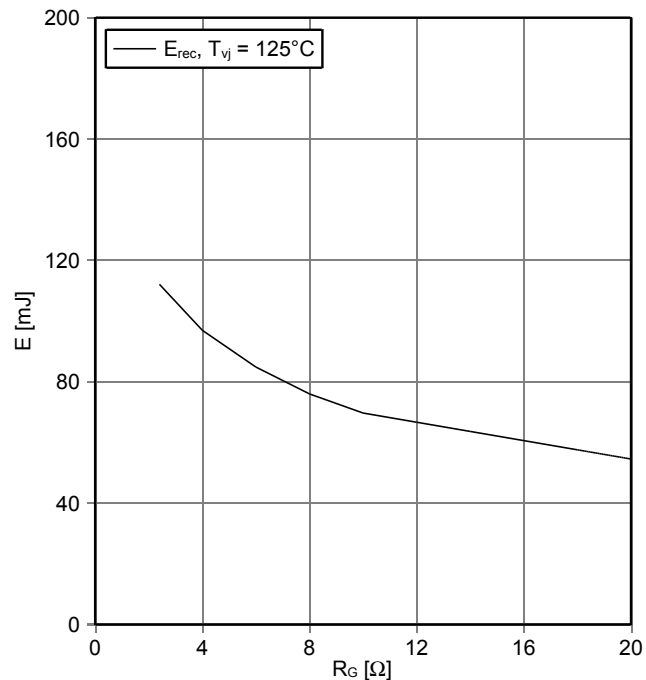
开关损耗 二极管, 逆变器 (典型)  
switching losses Diode, Inverter (typical)

$E_{rec} = f(I_F)$   
 $R_{Gon} = 2.4 \Omega, V_{CE} = 900 V$



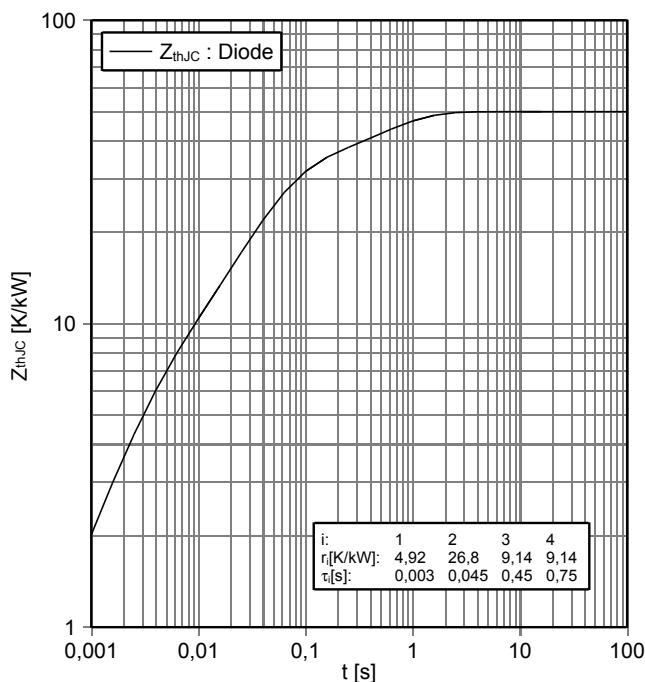
开关损耗 二极管, 逆变器 (典型)  
switching losses Diode, Inverter (typical)

$E_{rec} = f(R_G)$   
 $I_F = 600 A, V_{CE} = 900 V$



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

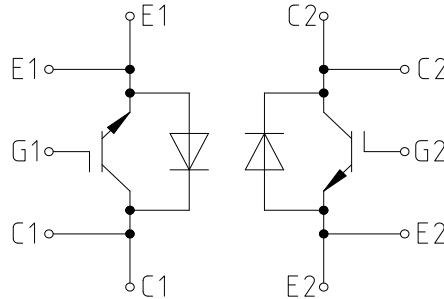
$Z_{thJC} = f(t)$



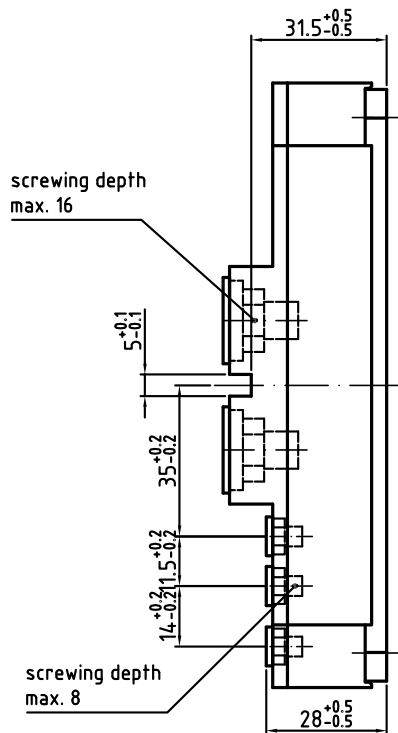
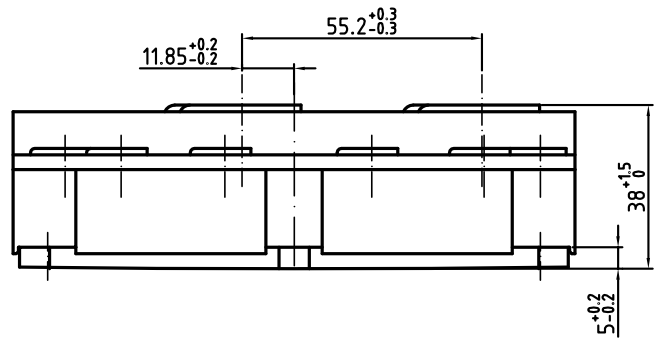
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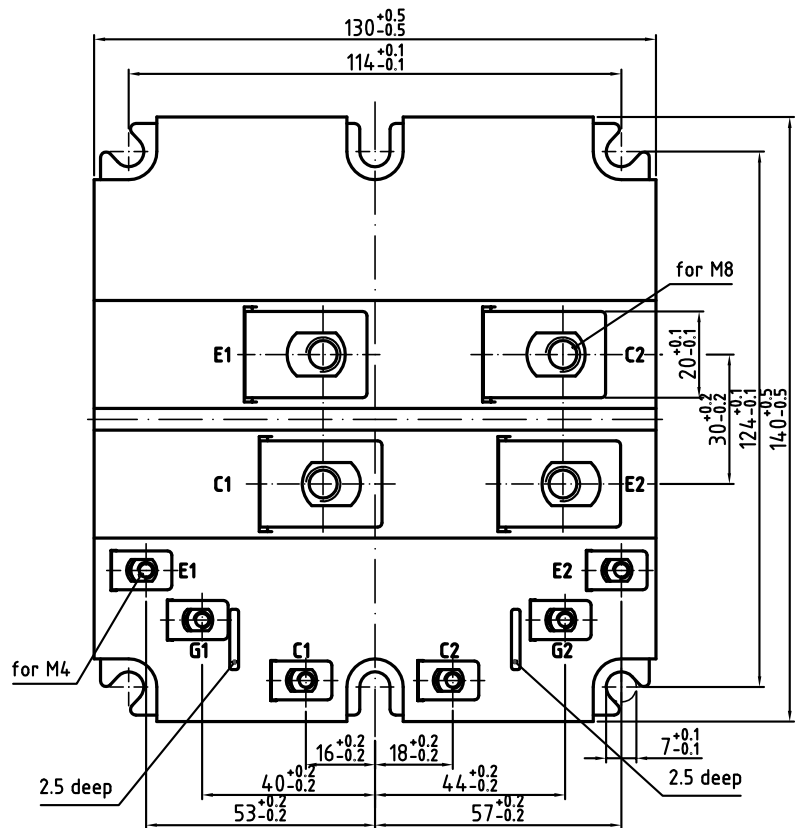
接线图 / circuit\_diagram\_headline



封装尺寸 / package outlines



IH2



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初步数据  
Preliminary Data

使用条件和条款

使用条件和条款

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